

December 19, 2002

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

SUBJECT: ADDITIONAL AND CORRECTED INFORMATION NEEDS PERTAINING TO
UNSATURATED AND SATURATED FLOW UNDER ISOTHERMAL
CONDITIONS (USFIC) AGREEMENT 5.05 AND RADIONUCLIDE TRANSPORT
(RT) AGREEMENT 2.09

Dear Mr. Ziegler:

In your letter dated July 02, 2002, the U.S. Department of Energy (DOE) enclosed a report, "Geologic and Hydrostratigraphic Cross Sections NYE-1, NYE-2, and NYE-3, Southern Nye County, Nevada." The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed this information, with respect to USFIC Agreement 5.05 and RT Agreement 2.09, and the results of the staff's review are enclosed.

Agreements USFIC 5.05 and RT 2.09 stem from staff concerns that characterization of groundwater flow and radionuclide transport pathways in the saturated alluvium was poorly documented and that stratigraphic data from recent Nye County wells had not been incorporated into or used to validate the hydrostratigraphic framework model. Saturated alluvium along groundwater flow paths from Yucca Mountain may play an important role as part of a system of natural barriers to potential radionuclide transport from Yucca Mountain. A concern leading to agreement USFIC 5.05 was the need to validate DOE depiction of the geometry of the interface between the volcanic tuff and alluvial aquifer systems, which affects the length of flow paths along which the radionuclides could travel through alluvium before reaching the regulatory compliance point. A concern for both agreements USFIC 5.05 and RT 2.09 is the need to characterize flow paths within the alluvial aquifer system. For example, the potential for preferential flow paths in longitudinal lenses of sands and gravels, and fractured cemented sediments and volcanic rocks should be recognized and considered (or at least accounted for) in any large-scale performance model. Cross sections that demonstrate an adequate understanding of the variability and possibility of these potential pathways would lend confidence to the flow and transport model and may reduce overall uncertainties within the model.

From NRC staff review, it is noted that the report "Geologic and Hydrostratigraphic Cross Sections NYE-1, NYE-2, and NYE-3, Southern Nye County, Nevada" explicitly states that there are inconsistencies in the hydrogeologic framework model where stratigraphic surfaces are extrapolated beyond the extent of the data sources, and that required manual editing of the model has not yet occurred. Furthermore, the multi-disciplinary agreements are not reflected in the geologically-focused report. These statements suggest that DOE has submitted a work in progress. The attachment to this letter contains requests for corrected information and

additional information needs which should be addressed in order to satisfy USFIC 5.05 and RT 2.09 agreements.

NRC staff understands that DOE intends to release a revised Hydrogeologic Framework Model in six months as an Analysis and Modeling Report (AMR). The schedule for release and the format of the AMR should allow DOE to rework the geologic and hydrostratigraphic cross sections and supporting documentation so that they are technically defensible and address staff concerns of groundwater flow and radionuclide transport. It is our expectation that the AMR will address the items in the attachment to this letter.

Finally, in your cover letter sent with the report entitled "Geologic and Hydrostratigraphic Cross Sections Nye-1, Nye-2, and Nye-3, Southern Nye County, Nevada," you state that " Agreement Item General (GEN).1.01(42) is associated with characterization of the transport properties of alluvium. This agreement has been mapped to RT 2.09 because of the similarity in subject. The proposed DOE resolution in this letter does not explicitly address GEN.1.01 (42). Disposition of GEN.1.01(42) will be included in the Fiscal Year (FY) 2003 and FY2004 KTI Plan." However, the NRC considers that GEN.1.01(42) is complete as described in the letter on RT Agreements 2.03 and 2.04 from J. Schlueter to J. Ziegler on August 30, 2002."

Agreements USFIC 5.05 and RT 2.09 are considered incomplete pending receipt of the requested corrected and additional information. If there are any questions regarding this letter, please contact Bill Dam at 301-415-6710 or by e-mail at wld@nrc.gov.

Sincerely,

/RA/

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

Attachment: NRC Review of DOE Letter Pertaining to USFIC.5.05 and RT.2.09.

cc: See attached distribution list

Letter or Memorandum to J. Ziegler from J. Schlueter dated December 19, 2002

cc:

R. Loux, State of Nevada	R. Massey, Lander County, NV
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M. Chu, DOE/Washington, DC	M. Baughman, Lincoln County, NV
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R. Bahe, Benton Paiute Indian Tribe
C. Anderson, Las Vegas Paiute Tribe
J. Birchim, Yomba Shoshone Tribe
L. Jackson, Timbisha Shoshone Tribe
C. Meyers, Moapa Paiute Indian Tribe
V. Miller, Fort Independence Indian Tribe
A. Bacock, Big Pine Paiute Tribe of
the Owens Valley
R. Quintero, Inter-Tribal Council of Nevada
(Chairman, Walker River Paiute Tribe)
M. Bengochia, Bishop Paiute Indian Tribe
J. Egan, Egan & Associates, PLLC
J. Leeds, Las Vegas Indian Center
K. Tilges, Shundahai Network
J. Triechel, Nuclear Waste Task Force
T. Kingham, GAO

A. Remus, Inyo County, CA
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
J. Charles, Ely Shoshone Tribe
D. Crawford, Inter-Tribal Council of NV
H. Blackeye, Jr., Duckwater Shoshone Tribe
D. Eddy, Jr. Colorado River Indian Tribes
G. Runkle, DOE, Washington, DC
E. Hiruo, Platts Nuclear Publications
H. Jackson, Public Citizen
M. Smurr, BNFL, Inc.
Citizen Alert
D. Feehan, GAO

additional information needs which should be addressed in order to satisfy USFIC 5.05 and RT 2.09 agreements.

NRC staff understands that DOE intends to release a revised Hydrogeologic Framework Model in six months as an Analysis and Modeling Report (AMR). The schedule for release and the format of the AMR should allow DOE to rework the geologic and hydrostratigraphic cross sections and supporting documentation so that they are technically defensible and address staff concerns of groundwater flow and radionuclide transport. It is our expectation that the AMR will address the items in the attachment to this letter.

Finally, in your cover letter sent with the report entitled "Geologic and Hydrostratigraphic Cross Sections Nye-1, Nye-2, and Nye-3, Southern Nye County, Nevada," you state that " Agreement Item General (GEN) 1.01(42) is associated with characterization of the transport properties of alluvium. This agreement has been mapped to RT 2.09 because of the similarity in subject. The proposed DOE resolution in this letter does not explicitly address GEN 1.01 (42). Disposition of GEN 1.01(42) will be included in the Fiscal Year (FY) 2003 and FY2004 KTI Plan." However, the NRC considers that GEN 1.01(42) is complete as described in the letter on RT Agreements 2.03 and 2.04 from J. Schlueter to J. Ziegler on August 30, 2002."

Agreements USFIC 5.05 and RT 2.09 are considered incomplete pending receipt of the requested corrected and additional information. If there are any questions regarding this letter, please contact John Bradbury at 301-415-6597 or by e-mail at jwb@nrc.gov.

Sincerely,
/RA/

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

Attachment: NRC Review of DOE Letter Pertaining to USFIC.5.05 and RT 2.09.

cc: See attached distribution list

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*See Previous Concurrence

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OFC	HLWB	HLWB	HLWB	HLWB	HLWB	DWM	HLWB
NAME	B. Dam*	P. Justus*	H. Arlt*	J. Bradbury*	L. Campbell*	T. McCartin*	J. Schlueter
DATE	11/19/02	11/21/02	11/21/02	11/22/02	11/22/02	12/2/02	12/19/02

NRC Review of DOE Documents Pertaining to 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 NRC staff during prelicensing does not prevent anyone from raising any issue for NRC consideration during the licensing proceedings. Just as important, resolution by NRC staff during prelicensing does not prejudice what NRC staff evaluation of that issue will be after its licensing review. Issues are resolved by NRC staff during prelicensing 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 two agreements, USFIC 5.05 and RT 2.09, which were reached between NRC and DOE during two technical exchange and management meetings.^{1,2}

Wording of the Agreements

USFIC 5.05 and RT 2.09 both state: "Provide the hydrostratigraphic cross sections that include the Nye County Data. DOE will provide the hydrostratigraphic cross sections in an update to the Hydrogeologic Framework Model for the Saturated Zone Site Scale Flow and Transport AMR expected to be available during FY2002, subject to the availability of Nye County data."

NRC Review

Background

The staff concerns leading to agreements USFIC 5.05 and RT 2.09 were that characterization of groundwater flow and radionuclide transport pathways in the saturated alluvium was poorly documented and that stratigraphic data from recent Nye County wells had not been incorporated into or used to validate the hydrostratigraphic framework model. Saturated alluvium along groundwater flow paths from Yucca Mountain is expected to play an important role as part of a system of natural barriers to potential radionuclide transport from Yucca Mountain. A concern leading to agreement USFIC.5.05 was the need to validate DOE depiction of the geometry of the interface between the volcanic tuff and alluvial aquifer systems, which affects the length of flow paths along which the radionuclides will travel through alluvium before reaching the regulatory compliance point. A concern for both agreements USFIC 5.05 and RT 2.09 is the need to characterize flow paths within the alluvial aquifer system. For example, the potential for preferential flow paths (e.g., longitudinal lenses of sands and gravels) should be recognized and considered (or at least accounted for) in any large-scale performance model. Cross sections that demonstrate an adequate understanding of the variability and possibility of these potential pathways would lend confidence to the flow model and may reduce overall uncertainties within the model.

¹Reamer, C.W. "U.S. Nuclear Regulatory Commission/U.S. Department of Energy Technical Exchange and Management Meeting on Unsaturated and Saturated Flow Under Isothermal Conditions (October 31–November 2, 2000)." Letter (November 17, 2000) to S. Brocoum, DOE.

²Reamer, C.W. "U.S. Nuclear Regulatory Commission/U.S. Department of Energy Technical Exchange and Management Meeting on Radionuclide Transport (December 5–7, 2000)." Letter (December 12) to S. Brocoum, DOE.

In response to KTI agreements USFIC 5.05 and RT 2.09, DOE provided by letter³ a report by Spengler and Chornack (2002) that contains geologic and hydrostratigraphic cross sections from three transects in the Fortymile Wash and northern Amargosa Valley areas.

Summary and Review of Information Provided by DOE

The report by Spengler and Chornack (2002) provides the documentation for geologic and hydrostratigraphic cross sections for the three transects, referred to as Nye-1, Nye-2, and Nye-3. These transects represent the southern portion of Fortymile Wash and the northern portion of Amargosa Valley. Nye-1 and Nye-3 are predominately east-west cross sections, while Nye-2 is a predominately north-south section coincident with the modern fluvial channel in Fortymile Wash. These DOE cross sections are intended to represent interpretations of stratigraphy based on information from wells, field mapping of rock and sediment distribution, and geophysical data.

NRC staff understands that DOE intends to release a revised Hydrogeologic Framework Model in six months as an Analysis and Modeling Report. The schedule for release and the format of the AMR will allow DOE to rework the geologic and hydrostratigraphic cross sections and supporting documentation to address staff concerns of groundwater flow through those stratigraphic layers in which radionuclide transport will occur.

Staff Comments

1. A quality check of the geologic and hydrostratigraphic cross sections in the Spengler and Chornack (2002) report revealed the following apparent errors or inconsistencies. Correct information is needed including:
 - a. Table 2 of the report lists the geologic unit designated as Cb as overlying the unit designated as Cn. In the geologic cross sections in Plate 1, however, unit Cn is depicted as overlying Cb.
 - b. Topopah Spring Tuff is listed as stratigraphically above Tiva Canyon Tuff in Table 2. The order is reversed, as compared to that at Yucca Mountain.
 - c. In Figure 9 of the report, well, WT#13 is mistakenly labeled as WT#3.
 - d. Table 3 identifies the Lower Clastic Confining Unit Thrust (LCCUT-1), which in Table 2 is listed as "model unit not found in cross section," but this unit is clearly depicted in the Nye-2 cross section in Figure 9. Further, the depiction of hydrostratigraphic unit LCCUT-1 in Figure 9, does not appear to match the geologic depiction of this cross section in Plate 1.
 - e. There is no HFM Slice Unit Number <11> in Table 3, but 11 VSU (lower) appears in Figures 4 through 12.

³Ziegler, J.D. "Transmittal of Report Addressing Key Technical Issue (KTI) Agreement Items Unsaturated and Saturated Flow Under Isothermal Conditions (USFIC) 5.05 and Radionuclide Transport (RT) 2.09." Letter (July 2, 2002) to J. Schlueter.

- f. Table 2 lists the units comprising the Volcanic and Sedimentary Units (upper) and (lower), labeled 2002 Hydrogeologic Unit Number 21 and 11, respectively, with the same Lithologic Acronyms and Lithologic Names. The staff is unclear as to the significance of this listing.
 - g. Figures 7 and 11 of the report list two different stratigraphic profiles at the location of well 1DX. The graphical resolution of these figures is insufficient to determine whether this is a simple typographic error in the list of hydrostratigraphic units at well 1DX, or whether a fundamental flaw exists in the hydrogeologic framework model itself.
 - h. Figures 7 through 12 depict the Nye County wells as penetrating up to 6,000 m (20,000 ft) of stratigraphy, to a depth of 4,000 m (13,000 ft) elevation below mean sea level. In fact, most of the Nye County wells are only a few hundred meters deep and only one of the Nye County wells has penetrated Paleozoic bedrock at a depth slightly more than 1,000 m (3,300 ft). Depicting the Nye County wells in this way gives the erroneous impression that the geology in the cross sections is well known and was largely established from the well data.
2. Section 3.4 of the report explicitly states that there are inconsistencies in the hydrogeologic framework model where stratigraphic surfaces are extrapolated beyond the extent of the data sources, and that required manual editing of the model has not yet occurred. These statements suggest that DOE has submitted a work in progress.

To fulfill the intent of USFIC 5.05 and RT 2.09 agreement, the following additional information is needed:

- 1. One of the critical underlying technical goals of the agreements was to develop information about geologic cross sections that are important to reducing uncertainties in groundwater flow and transport. For example, information derived from properly constructed and technically defensible geologic cross sections could greatly reduce uncertainties with regard to the location of the tuff-alluvium contact and the thickness and identification of tuff and alluvium within the upper several hundred meters of the basin sections. The cross sections presented in the Spengler and Chornack, (2002) report are insufficient to support these technical goals. The cross sections instead depict approximately 6,000 m [20,000 ft] of section in which the details of the near surface stratigraphy are obscured by the gross scale of cross-section construction.
- 2. Figures 4 through 12 present hydrogeologic cross sections extracted from a "2002 Hydrogeologic Framework Model." No reference is provided for this hydrogeologic framework model, which is apparently an updated model based on the stratigraphic interpretations in Plate 1 of the report. The hydrogeologic framework model used in DOE performance assessments to date—the one reviewed by NRC—was published in 2000 (CRWMS M&O, 2000). It is not clear whether this revised hydrogeologic framework model will be used to update the site-scale saturated zone flow model and the performance assessment abstraction for saturated zone flow and transport. If the revised model is not to be used as input to performance assessment analyses, then a comparison of the revised model, which is presumed to be the best DOE interpretation, to the older model used in performance assessments should be provided.

3. Critical information and discussion of the identification of the various tuff units encountered in the Nye County Wells are absent from the report. In parallel with the technical goals stated in RAI #1 above, identification of the tuff units in these wells could provide the DOE with the necessary information to either validate or improve the flow and transport model depiction of groundwater in the shallow alluvial aquifer of Fortymile Wash. Staff anticipated that the report would include such information as it was informally presented at a previous Technical Exchange.⁴
4. The technical basis for identification of the geologic or hydrologic units encountered in the Nye County wells is not provided in the report. The geologic units are simply named in summary tables with references to other data sources. The report lacks sufficient technical discussion of the criteria used to identify the geologic units or the resulting data and interpretations used to generate the stratigraphic units from the Nye County well cuttings. Without such information, there is insufficient technical basis to support interpretations in the cross sections.
5. There is no technical basis or discussion provided in the report about how the geophysical data were used to develop the stratigraphic information in the cross sections. The report simply identifies the data sources and associated reports and papers. Without such information, there is insufficient technical basis to support interpretations in the cross sections.
6. There is no technical basis or technical discussion provided in the report about how the regional geologic data from geologic maps or cross sections were used to develop the stratigraphic information in the cross sections. The report simply identifies the data sources and associated reports and papers. Without such information, there is insufficient technical basis to support interpretations in the cross sections.
7. Many of the lithologic identifications used in the report are unique to these cross sections (e.g., lithologic units Tgeg1–Tgeg6 in Table 2 of Spengler and Chornack, 2002), without apparent consideration of existing geologic information. Many of these similar aged units have been identified, described, and mapped in the surrounding outcrop exposures of bedrock.⁵ It is not clear whether the previously identified lithologic units have been renamed, or whether new lithologic units are being proposed.

Additional Information Needs

DOE should provide hydrostratigraphic cross sections containing Nye County data in the forthcoming revised Hydrogeologic Framework Model AMR or separate report. NRC staff suggests the revised report also address the two comments for corrected information and the

⁴Spengler, R.W. Presentation at U.S. Nuclear Regulatory Commission/U.S. Department of Energy Technical Exchange and Management Meeting on Unsaturated and Saturated Flow Under Isothermal Conditions, October 31–November 2, 2000.

⁵Murray, D. A., Stamatakos, J. A., and Ridgway, K. D., “Regional Stratigraphy of Oligocene and Lower Miocene Strata in the Yucca Mountain Region,” Center for Nuclear Waste Regulatory Analyses, San Antonio, TX, July 2002, IM01402.471.220.

seven comments for additional information needs previously discussed in the staff comments section of this review.

Status of Agreements: Agreements USFIC 5.05 and RT 2.09 are considered incomplete pending receipt of the corrected and additional information needed.

References

CRWMS M&O. "Hydrogeologic Framework Model for the Saturated Zone Site-Scale Flow and Transport Model." ANL-NBS-HS-000033. Rev. 00. Las Vegas, Nevada: CRWMS M&O. 2000.

Spengler, R.W. and M.P. Chornack. "Geologic and Hydrostratigraphic Cross Sections NYE-1, NYE-2, and NYE-3, Southern NYE County, Nevada." Las Vegas, Nevada: DOE, Office of Civilian Radioactive Waste Management, Yucca Mountain Site Characterization Office. 2002.