February 4, 2004

Joseph D. Ziegler, Acting Director
Office of License Application and Strategy
U.S. Department of Energy
Office of Civilian Radioactive Waste Management
Office of Repository Development
1551 Hillshire Drive
North Las Vegas, NV 89134-6321

SUBJECT: TOTAL SYSTEM PERFORMANCE ASSESSMENT AND INTEGRATION (TSPAI) AGREEMENTS 3.33, 3.34, 3.35, 3.36 AND IGNEOUS ACTIVITY (IA) 2.15; STATUS: TSPAI 3.33, 3.34, 3.35, 3.36 AND IA 2.15 COMPLETE

Dear Mr. Ziegler:

In a letter dated September 24, 2003, the U.S. Department of Energy (DOE) submitted information to address Key Technical Issue Agreements (KTI) Igneous Activity (IA) 2.11, 2.14 and 2.15, and Total System Performance and Integration (TSPAI) 3.33, 3.34, 3.35, and 3.36. The agreements between DOE and the U.S. Nuclear Regulatory Commission (NRC) were reached during the IA Technical Exchange and Management Meeting held from June 21-22, 2001, and the TSPAI Technical Exchange and Management Meeting held from August 6-10, 2001. The DOE submittal addressed these agreements within Technical Basis Document [Number] 12, "Biosphere Transport," Revision 1 (hereafter, Biosphere TBD). DOE's transmittal letter stated that it considered all the agreements to be fully addressed. The NRC review of the Biosphere TBD, as it pertains to TSPAI Agreements 3.33, 3.34, 3.35 and 3.36, and IA 2.15, is discussed in the enclosure to this letter. Disposition and discussion of IA 2.11 and 2.14 will be sent under a separate cover.

NRC reviewed the DOE KTI Agreement responses within the report to determine whether any aspect of the agreements were excluded from the response. No omissions were found. In addition, NRC performed an independent assessment to determine whether the information provided would support submission of a potential license application for a geologic repository. Notwithstanding new information that could raise new questions or comments concerning the above agreements, the information provided satisfies the intent of the agreements. On the basis of this review, NRC agrees with DOE that the information assembled in response to the agreements is acceptable to support the submission of a license application for the proposed repository at Yucca Mountain, Nevada.

Based upon the enclosed review, the NRC staff agrees with DOE, that the information provided is adequate to support the submission of a potential license application. Therefore, the NRC staff considers agreements IA 2.15, TSPAI 3.33, TSPAI 3.34, TSPAI 3.35, and TSPAI 3.36 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

Enclosure: NRC Review

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Based upon the enclosed review, the NRC staff agrees with DOE, that the information provided is adequate to support the submission of a potential license application. Therefore, the NRC staff considers agreements IA 2.15, TSPAI 3.33, TSPAI 3.34, TSPAI 3.35, and TSPAI 3.36 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.

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Letter or Memorandum to J. Ziegler from J. Schlueter, dated: February 4, 2004
cc:

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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

G. Hudlow

REVIEW BY THE OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS OF THE DEPARTMENT OF ENERGY'S KEY TECHNICAL ISSUE AGREEMENT RESPONSE TO AGREEMENT TSPAI 3.33, 3.34, 3.35, 3.36 AND IA 2.15 FOR A PROPOSED GEOLOGIC REPOSITORY AT YUCCA MOUNTAIN, NEVADA

PROJECT NO. WM-011

1.0 INTRODUCTION

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 during pre-licensing does not prevent anyone from raising any issue for NRC consideration during the licensing proceedings. Also, and just as important, resolution by NRC during pre-licensing does not prejudge what the NRC evaluation of that issue will be after its licensing review. Issues are resolved by NRC during pre-licensing when NRC 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.

By letter dated September 24, 2003, DOE submitted a report titled, Technical Basis Document 12, "Biosphere Transport," Revision 1 to satisfy the informational needs of Key Technical Issue (KTI) Agreements related to Total System Performance Assessment and Integration (TSPAI) and Igneous Activitiy (IA).

The agreement response provides technical information regarding DOE's methods for modeling environmental transport and exposure pathways in the biosphere. The information was requested by NRC during previous technical exchanges in June and August of 2001. NRC requests, in general, emphasized models and parameters most likely to influence biosphere modeling results based on information available at the time of the technical exchange meeting. Topical areas of focus included: the technical bases for soil sorption coefficients and leaching factors; radionuclide specific biosphere modeling parameters (e.g., animal and plant transfer factors), crop interception fraction parameter values, uncertainty propagation in soil leaching coefficients, and inclusion of external exposure calculations for the igneous activity release scenario. The DOE report included referenced technical documents that included detailed technical information, sensitivity results, and references for supporting data. In addition, the report also referenced the technical bases for model and parameter selection relating to the concerns identified by NRC in agreements TSPAI 3.33, TSPAI 3.34, TSPAI 3.35, TSPAI 3.36, IA 2.11, IA 2.14, and IA 2.15. Specifically, the DOE report states that the NRC's information needs regarding the agreements are satisfied and their status should be considered closed. Section 4.0 provides the NRC evaluation of the extent to which the DOE submittal satisfies the requirements of agreements TSPAI 3.33, TSPAI 3.34, TSPAI 3.35, TSPAI 3.36 and IA 2.15. NRC evaluation of the extent to which the DOE submittal satisfies the requirements of agreements IA 2.11 and IA 2.14 will be provided in a separate document.

2.0 WORDING OF THE AGREEMENTS

NRC found that the DOE in Appendices C through G of its Biosphere TBD identified various KTI agreements as being satisfied by the information provided within the Biosphere TBD. The

NRC review of the DOE response to the agreements within the technical basis document is based upon DOE providing the requested information identified in NRC letters, dated August 23, 2001, (Adams Accession No. ML012410199) for the TSPAI agreements, and dated June 29, 2001, (Adams Accession No. ML011840166) for the IA agreements. The wording of the agreements include the following:

TSPAI 3.33: Provide justification that the K_d values used for radionuclides in the soil in Amargosa Valley based on the results of a literature review are realistic or conservative for actual conditions at the receptor location. DOE will provide justification that the K_d values used for radionuclides in the soil in Amargosa Valley are realistic or conservative for actual conditions at the receptor location. The justification will be provided in Evaluate Soil/Radionuclide Removal by Erosion and Leaching [Analysis Model Report (AMR)] (ANL-NBS-MD-000009) or other document expected to be available to NRC in [Fiscal Year (FY)] 2003.

TSPAI 3.34: For the radionuclides that dominate the [total system performance assessment (TSPA)] dose, provide the technical basis for selection of radionuclide or element specific biosphere parameters that are important in the [biosphere dose conversion factor (BDCF)] calculations (e.g., soil to plant transfer factors). For the radionuclides that dominate the TSPA dose, DOE will provide the technical basis for selection of radionuclides or element specific biosphere parameters (except for K_ds which are addressed in TSPAI 3.33) that are important in the BDCF calculations (e.g., soil to plant transfer factors). The technical basis will be documented in the Transfer Coefficient Analysis AMR (ANL-MGR-MD-000008) or other document and is expected to be available to NRC in FY 2003.

TSPAI 3.35: Provide additional justification to support that the assumed crop interception fraction is appropriate for all radionuclides considered and does not result in underestimations of dose. Discussions should address the impacts of electrostatic charge and particle size on the interception fraction for all radionuclides considered in the TSPA. DOE will provide additional justification to support that the assumed crop interception fraction is appropriate for all radionuclides that dominate the TSPA dose and does not result in underestimations of dose. The justification will include the impacts of electrostatic charge and particle size on the interception fraction. This justification will be documented in Identification of Ingestion Exposure Parameters (ANL-MGR-MD-000006) or other document expected to be available to NRC in FY 2003.

TSPAI 3.36: Document the methodology that will be used to incorporate the uncertainty in soil leaching factors into the TSPA analysis, if that uncertainty is found to be important to the results of the performance assessment. DOE will document the methodology used to incorporate the uncertainty in soil leaching factors into the TSPA analysis. This will be documented in Nominal Performance Biosphere Dose Conversion Factor Analysis AMR (ANL-MGR-MD-000009), Disruptive Event Biosphere Dose Conversion Factor Analysis (ANL-MGR-MD-000003) or other document expected to be available to NRC in FY 2003.

IA 2.15: Clarify that external exposure from [high level waste (HLW)]-contaminated ash, in addition to inhalation and ingestion, was considered in the TSPA. Include in this clarification the consideration of external exposure during indoor occupancy times, or provide basis for dwelling shielding from outdoor gamma emitters. DOE will clarify that external exposure from HLW-contaminated ash, in addition to inhalation and ingestion, was considered in the TSPA. DOE will include in this clarification the consideration of external exposure during indoor occupancy times, or provide basis for dwelling shielding from outdoor gamma emitters in a subsequent revision to the AMR Input Parameters Values for External and Inhalation Radiation

Exposure Analysis (ANL-MGR-MD-000001) or equivalent document. This will be available to the NRC in FY [2002]..

3.0 TECHNICAL INFORMATION PROVIDED IN THE DOE AGREEMENT RESPONSE

Appendix C of the DOE Technical Basis Document (Bechtel SAIC Company, LLC, 2003a) provides information related to agreement IA 2.15. This agreement is related to NRC concerns that documentation of the prior DOE TSPA model for estimating exposure for the igneous activity release scenario was unclear regarding the inclusion of external exposure calculations. An additional concern was to document the model or rationale regarding potential exposures from both indoor and outdoor activities. DOE indicates in their response that the external exposure pathway does not contribute significantly to dose except for a few high energy gamma emitting radionuclides (Cs-137, Sn-126).

The DOE response states that the new biosphere model includes a revised microenvironmental modeling approach for external exposures. In the new model, external exposures are calculated as the product of a radionuclide-specific effective dose coefficient, the saturation concentration of the radionuclide in the soil, the average time spent by the exposed individual in indoor and outdoor environments, and an environment-specific shielding factor.

DOE responds to TSPAI 3.33 in Appendix D of the technical basis document on Biosphere Transport (Bechtel SAIC Company, LLC, 2003a). The focus of the agreement is the justification for partition coefficients (K_d's) used to estimate radionuclide leaching from soils in Amargosa Valley for total system performance assessment biosphere transport calculations. DOE correctly notes that partition coefficients have a direct influence on predicted leaching rates and they are subject to considerable uncertainty. Leaching rates for soils control the amount of radionuclides available for plant uptake and subsequent human consumption and therefore are directly related to dose estimates.

When TSPAI 3.33 was created, DOE was using the GENII-S code (Leigh et al., 1993) for biosphere pathway modeling and fixed K_d values from a commonly used literature summary (Sheppard and Thibault, 1990). This approach appeared reasonable to NRC but DOE documentation contained limited justification for the applicability of the K_d values to the YM site (i.e., Amargosa Valley soils). Given the large uncertainties in reported K_d values (Sheppard and Thibault, 1990), NRC was concerned about the possibility of unknown site-specific conditions that might lead to conditions of higher exposure than estimated with the current DOE modeling approach. The resulting agreement, TSPAI 3.33, asked for additional justification regarding the site relevance or that the K_d values used were conservative.

The DOE response in Appendix D of the Technical Basis Report (Bechtel SAIC Company, LLC, 2003a) provides additional site-specific information on the soil properties identified in the Amargosa Valley region (Bechtel SAIC Company, LLC, 2003b) and relates the measured soil properties to two of the four soil categories (sand and loam) used in the literature summary of K_d values (Sheppard and Thibault, 1990). To ensure selected K_d values do not underestimate soil concentration estimates, DOE selects the largest mean value K_d from the two applicable soil categories for use in the TSPA. This results in a more conservative value of K_d that is relevant to known soil conditions.

DOE uses the K_d information in a new biosphere model implemented using the Goldsim Graphical Simulation Environment (Goldsim Technology Group, 2002). The previous leaching model used in GENII-S (Leigh et al., 1993) from Baes and Sharp (1983) has been adopted in

the new DOE biosphere model; however, the new biosphere model allows K_d's (and other parameters) to be sampled thereby propagating uncertainty information obtained from the K_d source information (Sheppard and Thibault, 1990). The new soil concentration model calculates annual soil concentrations from irrigation deposition accounting for removal by leaching, decay, and erosion. For each realization, a leaching removal constant is calculated using the sampled K_d data and the soil model is run for as many irrigation years as necessary to reach equilibrium (i.e., deposition equals removal). The equilibrium soil concentration is then used to calculate biosphere dose conversion factors for use in TSPA. This approach adds conservatism (i.e., overestimation of dose) to the soil concentration calculation for radionuclides with low leach rates. The inability of the prior soil model in GENII-S (Leigh et al., 1993) to propagate the uncertainty in K_d values was also noted as a limitation that led to agreement TSPAI 3.36.

Appendix E of the DOE Technical Basis Document (Bechtel SAIC Company, LLC, 2003a) provides information related to agreement TSPAI 3.34. This agreement requests DOE provide a technical basis for the selection of radionuclide or element specific biosphere parameters (e.g., plant uptake factors) for radionuclides important to the TSPA calculations. The agreement resulted from NRC concerns regarding previously available limited documentation of transfer factor selection and data processing methods used by DOE to derive input parameters for the TSPA. Information sources used by DOE were not site-specific and transfer coefficients were known to exhibit wide variation based on soil conditions and crop types (IAEA, 1994, Sheppard and Thibault, 1990). NRC requested DOE to provide greater assurance that the values selected for the TSPA were applicable to conditions in Amargosa Valley and that selection and data processing documentation was transparent. At the time of the agreement, NRC were also aware of prior studies conducted at the Nevada Test Site, not included in DOE documentation, that might contribute useful site-specific information to the body of available research.

The DOE response in Appendix E refers to a supporting report (Bechtel SAIC Company, LLC, 2003c) for detailed technical documentation. The support documentation includes descriptions of the source data, parameter selection criteria, and data processing methods used by DOE to derive transfer coefficients from available technical reports and scientific literature. DOE derives parameter values for specific crop types by computing an average (i.e., composite value) from technical documents, mostly parameter compilations, that represent various applications of available source data. Some of these compilations use the same original source data (or portions of it) but process it in a slightly different way. As a result, the DOE approach not only averages different sources of data but also, in effect, averages the different approaches used by investigators to derive parameter values from the available data. DOE enhanced the site relevance by emphasizing selection of data sources relevant to local soil characteristics when such information was reported in available references.

Current DOE documentation (Bechtel SAIC Company, LLC, 2003c) also contains information about additional sources of site-specific transfer coefficient research that were consulted. These studies were conducted at the Nevada Test Site during the 1970's and focused on plant uptake of the elements americium and plutonium (Romney and Wallace, 1977; Romney et al., 1977; Au et al., 1977;Schulz, 1977). These experiments measured transfer coefficients for a variety of plants, including alfalfa, and assessed the effects of soil treatments on plant uptake such as adding fertilizer or changing the soil pH. While limited to two radionuclides, this research generally supported values obtained by averaging the values in the compilation references.

Appendix F of the DOE Technical Basis Document (Bechtel SAIC Company, LLC, 2003a) provides information related to agreement TSPAI 3.35. This agreement requests additional information to support the appropriateness of the assumed crop interception fraction used for all radionuclides and to ensure that it does not underestimate dose. This agreement arose from NRC concerns regarding a DOE technical basis that pertained to a small subset of radionuclides and a resulting distribution of crop interception fractions that appeared inconsistent with an available literature summary (Anspaugh, 1987). The original information reported by DOE also resulted in NRC questions concerning the potential impacts of electrostatic charge and particle size on crop interception fraction results.

Appendix F provides detailed technical information regarding the basis for selecting the model used to calculate crop interception fractions, the input parameters for the model, and the model results and how those results compare with crop interception fraction field study results reported in the literature (e.g., Anspaugh, 1987). While DOE uses the same equation to calculate crop interception fractions that was used when the agreement was created (noting the model is the best available method), new documentation includes enhancements to model execution and input parameters. The previous model had been run to develop a single crop interception fraction mean (with minimum and maximum values) for use in modeling all crop types. The revised calculations are run to estimate interception fractions for each crop type. Input parameters specific to each crop type such as irrigation intensity and dry biomass have also been updated. The resulting crop interception fraction range for all crops is from 0.08 to 1.0 with the higher biomass crops producing the crop interception fraction distributions that contain the highest values.

4.0 NRC EVALUATION AND COMMENT

The following sections provide a discussion of the relevance of the agreements to repository performance followed by results of the NRC review of the agreement responses organized by the applicable review methods in the Yucca Mountain Review plan (U.S. Nuclear Regulatory Commission, 2003).

4.1 Relevance to Repository Performance

Biosphere transport encompasses development and implementation of total system performance assessment models to convert concentration estimates of radionuclides in soil and groundwater to human dose estimates for comparison with regulatory limits. Biosphere modeling is conducted by the DOE to develop biosphere dose conversion factors that are inputs to the TSPA. These biosphere dose conversion factors directly impact the results of performance assessment calculations. Uncertainty and variability in the biosphere dose conversion factor calculations are limited by regulatory requirements that have stylized biosphere calculations to some degree to avoid speculative judgements. When calculations are performed in a manner consistent with the regulatory requirements, both DOE and NRC calculations show the drinking water exposure pathway contributes about half of the estimated dose when all pathways are included in the calculation. The remaining half of the dose estimate that is contributed by the non-drinking water exposure pathways is the subject of the agreements discussed in this response letter.

Limited variation in the biosphere calculations results in the current NRC characterization of the risk significance of the biosphere calculations as low. Current NRC modeling suggests any anticipated potential changes in any of these areas would not change expected dose results more than about a factor of two.

Because DOE has recently made major changes to their biosphere model and has not provided NRC with documentation concerning the significance of the model revisions, DOE conclusions regarding the importance of parameters and models using their revised model may differ from current NRC understanding based on the NRC TPA code. As documentation of the new model becomes available NRC intends to conduct a review of areas that have changed to determine if the changes could potentially impact the magnitude of dose estimates.

4.2 System Description and Model Integration

Issues related to inclusion of external exposure calculation for the igneous activity release scenario discussed in the response to IA 2.15 are included in the integrated subissue for biosphere characteristics. The IA 2.15 agreement resulted from a NRC review of DOE documentation that is consistent with Review Method 1 in Section 2.2.1.3.14.2 of the Yucca Mountain Review Plan (U.S. Nuclear Regulatory Commission, 2003). The NRC's review of the response is also conducted in accordance with the aforementioned review method. This review method includes verification that all important features and phenomena have been included in the abstraction.

The DOE response provides detailed documentation of a revised external exposure model. By including the time spent in indoor and outdoor environments and the shielding factors in the equation, the new model addresses the concern regarding the inclusion of both outdoor and indoor exposures in the external dose calculations. Based upon the NRC's review of the DOE response to IA 2.15 in accordance with methods discussed in the appropriate section of the Yucca Mountain Review Plan (Section 2.2.1.3.14.2, Review Method 1) NRC found DOE's response to the agreement to be satisfactory.

4.3 Data and Model Justification

Issues related to soil sorption discussed in the response to TSPAI 3.33 are included in the integrated subissue for redistribution of radionuclides in soil. The TSPAI 3.33 agreement resulted from a NRC review of DOE documentation that is consistent with Review Method 2 in Section 2.2.1.3.13.2 of the Yucca Mountain Review Plan (U.S. Nuclear Regulatory Commission, 2003). The NRC's review of the response is also conducted in accordance with the aforementioned review method. This review method requests confirmation that soil and hydrology data used in the TSPA abstraction are based on a combination of techniques including laboratory experiments, site-specific field measurements, natural analog research, and process modeling studies. The review method also includes examination of data synthesis methods.

The focus of the agreement is on a single parameter (K_d) relevant to the abstraction of radionuclide leaching in soil. The K_d combines all retardation mechanisms into a single parameter. As a result, the K_d is a considerable simplification of very complex geochemical processes. Nonetheless, it provides an efficient means for incorporating sorption processes into models of simple systems such as irrigation of surface soil with contaminated groundwater.

The data source for K_d's used by DOE (Sheppard and Thibault, 1990) is a compendium of K_d values derived from a combination of techniques in available literature including laboratory and field experiments, modeling studies, and mathematical relations with available plant uptake data. Because sorption processes are directly linked to soil properties, this compendium provides K_d values based on four general soil classifications (sand, loam, clay, organic) that are explicitly defined. To support selection of K_d values, the DOE agreement response for TSPAI

3.33 provides additional site-specific information on the classification of Amargosa Valley soils. Because Amargosa Valley soils contain both sand and loam, DOE selects the values that produce higher soil concentrations. The selected K_d values are then used in a model for estimating soil concentrations that is implemented conservatively. Data reported in the DOE response (Bechtel SAIC Company, LLC, 2003c) compared favorably with the source reference and for most values no additional processing was conducted. Based upon NRC's review of the DOE response to TSPAI 3.33 in accordance with methods discussed in the appropriate section of the Yucca Mountain Review Plan, (Section 2.2.1.3.13.2, Review Method 2) NRC found DOE's response to the agreement to be satisfactory.

Issues related to plant transfer factors discussed in the response to TSPAI 3.34 are included in the integrated subissue for biosphere characteristics. The agreement resulted from a NRC review of DOE documentation that is consistent with Review Method 2 in Section 2.2.1.3.14.2 of the Yucca Mountain Review Plan (U.S. Nuclear Regulatory Commission, 2003). NRC's review of the response is also conducted in accordance with the aforementioned review method. This review method requests confirmation that data used in the TSPA abstraction are based on a combination of techniques including laboratory experiments, site-specific field measurements, natural analog research, and process modeling studies.

The source information referenced by DOE incorporates a large amount of data obtained by a combination of available techniques including a variety of laboratory and field studies. DOE supplements the information with more site-specific information from local field and laboratory experiments conducted at the Nevada Test Site. The selection of transfer coefficients is also informed by other site-specific information where possible, including soil type and applicable crop types. In addition to providing the capability to sample K_d's, DOE also implements a -0.8 correlation between sampled K_d's and plant uptake factors so, as expected, larger K_d's lead to lower plant uptake. Documentation is sufficiently detailed to identify the data sources where such information influenced the selection of data. The supporting documentation is also sufficiently detailed to allow NRC to reproduce the transfer coefficient estimates derived by the source data.

DOE derives parameter values by computing an average (i.e., composite value) from technical documents, mostly parameter compilations, that represent various applications of available source data. This approach produces consensus results but also conveys an appearance that there is more original data than there actually is. However, the NRC found that it would be more transparent for DOE to reference only original data sources. NRC understands that the DOE averaging approach was designed to obtain consensus values of transfer coefficients from a variety of applications, and NRC is familiar with a number of the referenced publications used in the DOE analysis, therefore, the approach is considered suitable for the intended use.

DOE has made efforts to enhance the site relevance of selected transfer coefficients and some additional data has been identified. General consistency of site-specific studies with literature values based on a variety of studies adds confidence that selection of values from general literature compendiums will not underestimate plant radionuclide concentration estimates. Limitations in the available site-specific data support the DOE use of more general compilations of transfer coefficient data as the best available information. Based upon NRC's review of the DOE response to TSPAI 3.34 in accordance with methods discussed in the appropriate section of the Yucca Mountain Review Plan, (Section 2.2.1.3.14.2, Review Method 2) NRC found DOE's response to the agreement satisfactory.

Issues related to crop interception discussed in the response to TSPAI 3.35 are included in the same review method as TSPAI 3.34. In the response, DOE updates the previous calculation using an experimentally derived process-model that produces results consistent with the available laboratory and field studies reported in Anspaugh, (1987). Resulting mean values for crop interception fractions appear unlikely to underestimate interception of radionuclides by crops. Considering the limited available information, and physical constraints of the parameter (range from 0 to 1.0), NRC found that the calculated values are unlikely to under predict actual interception conditions in Amargosa Valley and the DOE response provides sufficient information to satisfy agreement TSPAI 3.35.

4.4 Data Uncertainty

Issues related to propagation of uncertainty in soil leaching coefficients discussed in the response to TSPAI 3.36 are included in the integrated subissue for radionuclide redistribution in soil. The agreement TSPAI 3.36 resulted from a NRC review of DOE documentation that is consistent with Review Method 3 in Section 2.2.1.3.13.2 of the Yucca Mountain Review Plan. NRC's review of the response is also conducted in accordance with the aforementioned review method which includes adequate representation of parameter uncertainty in models.

Agreement TSPAI 3.36 originated from a NRC concern that uncertainty was not being propagated for a highly uncertain and potentially important parameter (K_d). The DOE response provides a discussion of the new biosphere model which includes the capabilities to sample from distributions of K_d values. The K_d distribution parameters are provided in a referenced report (Bechtel SAIC Company, LLC, 2003b). Documentation of data interpretation and processing to derive distribution parameters is sufficiently complete to allow verification by NRC. The technical bases for selected K_d values is the topic of agreement TSPAI 3.33 and will not be discussed further here. Based upon NRC's review of the DOE response to TSPAI 3.36 in accordance with methods discussed in the appropriate section of the Yucca Mountain Review Plan (Section 2.2.1.3.13.2, Review Method 3), NRC found DOE's response to the agreement to be satisfactory.

5.0 SUMMARY

NRC reviewed the DOE KTI Agreement responses within the report to determine whether any important aspect of the agreements were excluded from the response. No such omissions were found. In addition, NRC performed an independent assessment to determine whether the information provided would support submission of a potential license application for a geologic repository. Notwithstanding new information that could raise new questions or comments concerning the above agreements, the information provided satisfies the intent of the agreements. On the basis of this review, NRC agrees with the DOE that the information assembled in response to the agreements is adequate to support the submission of a license application for the proposed repository at Yucca Mountain, Nevada.

6.0 STATUS OF THE AGREEMENTS

Based upon the above review, NRC agrees with DOE that the information provided is adequate to support the submission of a potential license application. Therefore, NRC considers agreements IA 2.15, TSPAI 3.33, TSPAI 3.34, TSPAI 3.35, and TSPAI 3.36 to be complete.

7.0 REFERENCES

Au, F.H.F., Leavitt, V.D., Beckert, W.F, and J. C. McFarlane. Incorporation of Transuranics into Vegetable and Field Crops Grown at the Nevada Test Site. *Transuranics in Desert Ecosystems*. White, M.G., Dunaway, P.B., and D.L. Wireman, eds. NVO-181. Las Vegas, Nevada: U.S. Energy Research and Development Administration. 1977, Pages 1-15.

Anspaugh, L. R. Retention by Vegetation of Radionuclides Deposited in Rainfall — A Literature Summary. UCRL-53810. Livermore, California: Lawrence Livermore National Laboratory. 1987.

Baes, C.F., II and R. D. Sharp. A Proposal for Estimation of Soil Leaching and Leaching Constants for Use in Assessment Models. Journal of Environmental Quality, 12(1):17-28. Madison, Wisconsin: American Society of Agronomy. 1983.

Bechtel SAIC Company, LLC. Technical Basis Document No. 12: Biosphere Transport, Revision 1. Las Vegas, Nevada: Bechtel SAIC Company. September, 2003a.

Bechtel SAIC Company, LLC. Soil-Related Input Parameters for the Biosphere Model. ANL-NBS-MD-000009, Rev 01. Las Vegas, Nevada: Bechtel SAIC Company. July, 2003b.

Bechtel SAIC Company, LLC. Environmental Transport Input Parameters for the Biosphere Model. ANL-MGR-MD-000007, Rev 01. Las Vegas, Nevada: Bechtel SAIC Company. June, 2003c.

Goldsim Technology Group. Goldsim, Graphical Simulation Environment, User's Guide, Version 7.40. Redmond, Washington: Golder Associates. 2002

International Atomic Energy Agency. Handbook of Parameter Values for the Prediction of Radionuclide Transfer in Temperate Environments. Technical Reports Series No. 364. Vienna, Austria: International Atomic Energy Agency. 1994.

Leigh, C.D., B.M. Thompson, J.E. Campbell, D.E. Longsine, R.A. Kennedy, B.A. Napier et al. User Guide for GENII-S: A Code for Statistical and Deterministic Simulation of Radiation Doses to Humans from Radionuclides in the Environment. SAND 91-0561. Albuquerque, New Mexico: Sandia National Laboratories. April, 1993.

Romney, E.M., and Wallace, A. Plutonium Contamination of Vegetation in Dusty Field Environments. *Transuranics in Natural Environments*. White, M.G. and Dunaway, P.B., eds. NVO-178. Las Vegas, Nevada: U.S. Energy Research and Development Administration. 1977, Pages 287-302.

Romney, E. M., Wallace, A., Wieland, P.A.T., and J.E. Kinnear. Plant Uptake of $^{239, 240}$Pu and ^{241}Am Through Roots from Soils Containing Aged Fallout Materials. *Environmental Plutonium on the Nevada Test Site and Environs*. White, M.G., Dunaway, P.B., and W.A. Howard, eds. NVO-171. Las Vegas, Nevada: U.S. Energy Research and Development Administration. 1977, Pages 53-64.

Schulz, R.K. Root Uptake of Transuranic Elements. *Transuranics in Natural Environments*. White, M.G. and Dunaway, P.B., eds. NVO-178. Las Vegas, Nevada: U.S. Energy Research and Development Administration. 1977, Pages 321-330.

Sheppard, M.L., and D.H. Thibault. 1990. Default Soil Solid/Liquid Partition Coefficients, K_ds, for Four Major Soil Types: A Compendium. *Health Physics.* Vol. 59, No. 4. pp. 471–478. 1990.

U.S. Nuclear Regulatory Commission. Yucca Mountain Review Plan, Final Report. NUREG-1804, Revision 2. Washington DC: U.S. Nuclear Regulatory Commission. July, 2003.