THE U.S. NUCLEAR REGULATORY COMMISSION OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS REVIEW OF THE U.S. DEPARTMENT OF ENERGY'S KEY TECHNICAL ISSUE AGREEMENT RESPONSES RELATED TO THE POTENTIAL GEOLOGIC REPOSITORY AT YUCCA MOUNTAIN, NEVADA: COLLOID-RELATED AGREEMENTS EVOLUTION OF THE NEAR-FIELD ENVIRONMENT 3.05 AND 4.05; RADIONUCLIDE TRANSPORT 1.03 AND 3.07; AND GENERAL 1.01, COMMENTS 43 AND 46

1.0 INTRODUCTION

The U.S. Nuclear Regulatory Commission (NRC) issue resolution goal during this interim pre-licensing period is to assure that the U.S. Department of Energy (DOE) has assembled enough information on a given issue for NRC to accept a License Application for review. Resolution by the NRC staff during pre-licensing does not prevent anyone from raising any issue for NRC consideration during the licensing proceedings. It is equally important to note that resolution of an issue by NRC during the pre-licensing period does not prejudge the NRC staff evaluation of the issue during the licensing review. Issues are resolved by the NRC staff during pre-licensing when the staff have 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.

By letter dated October 3, 2003, DOE submitted a report titled “Technical Basis Document No. 8: Colloids” (Bechtel SAIC Company, LLC, 2003a) to satisfy the informational needs for numerous Key Technical Issue (KTI) agreement items pertaining to colloid-associated release and transport at the potential repository at Yucca Mountain. Among the agreements addressed in the appendixes to that document were the following, categorized under three different KTIs:

— Evolution of the Near-Field Environment (ENFE) Agreements 3.05 and 4.05;
— Radionuclide Transport (RT) Agreements 1.03 and 3.07; and
— General (GEN) Agreement 1.01, Comments 43 and 46.

The other agreements and comments addressed in the appendixes to Bechtel SAIC Company, LLC (2003a) are not discussed in this report. The NRC staff did not review Agreement GEN.1.01, Comment 43, since it was to be addressed only if DOE adopted a “low temperature” operating mode, which is not currently planned, and therefore, will not be discussed any further in this report. The agreements are described in Section 2 of this report. For three of these agreements (RT.1.03, ENFE.3.05, and 4.05) DOE had previously submitted documents that they indicated responded to the information needs, but NRC had judged that the agreement was not completed and replied with an additional information needed (AIN) request (Reamer, 2002; Schlueter, 2002). For all agreements and comments listed above, DOE stated in the technical basis document (Bechtel SAIC Company, LLC, 2003a) that it had satisfied the NRC information needs regarding the agreements and that all agreements should be considered complete. The DOE bases for agreement closure are described in Section 3 of this report, while Section 4 provides the NRC evaluation of the extent to which DOE's submittal satisfies the informational requirements of the agreements.

2.0 WORDING OF THE AGREEMENTS

In Appendixes E and G of Bechtel SAIC Company, LLC (2003a), DOE identified the following KTI agreements as being satisfied by the information provided in the report. The wording of the agreements, grouped according to similarity in the aspect of colloid release and transport being addressed, is listed in the following two subsections.

2.1 Agreements Pertaining to Sensitivity Studies to Test Importance of Colloid Transport Parameters and Models [Response to RT.3.07 and GEN.1.01 (Comments 46)]

RT.3.07

The agreement reads (Reamer, 2000):

"Provide sensitivity studies to test the importance of colloid transport parameters and models to performance for UZ and SZ. Consider techniques to test colloid transport in the Alcove 8/ Niche 3 test (for example, microspheres). DOE will perform sensitivity studies as the basis for consideration of the importance of colloid transport parameters and models to performance for the unsaturated and saturated zones and will document the results in updates to appropriate AMRs, and in the TSPA–LA document, all to be available in FY 2003. DOE will evaluate techniques to test colloidal transport in Alcove 8/Niche 3 and provide a response to the NRC in February 2001."

GEN.1.01, Comment 46

The comment reads (Reamer, 2001a):

"The analysis of sensitivity to increased uncertainty in the reversible colloid parameter K_c (Section 12.5.2.4) yielded "somewhat longer transport times" in the SZ. This analysis does not illustrate the effect of possibly underestimating K_c, because it is not clear that the mean value of K_c is significantly different from the base case. This concern is related to agreements RT 3.07 and TSPAI 3.30."

DOE's initial response reads:

"This issue will be handled as part of agreements RT 3.07 and TSPAI 3.30."

2.2 Agreements Pertaining to Screening Criteria for Attachment of Radionuclides to Colloids (Response to RT.1.03, ENFE.3.05, and ENFE.4.05)

RT.1.03

The agreement reads (Reamer, 2000):

"Provide the screening criteria for the radionuclides selected for PA. Provide the technical basis for selection of the radionuclides that are transported via colloids in the TSPA. The screening criteria for radionuclides selected for TSPA are contained in the AMR Inventory Abstraction. DOE is documenting identification of radionuclides transported via colloids for TSPA in the AMR

Waste Form Colloid-Associated Concentration Limits: Abstraction and Summary, in the TSPA-SR Technical Report, and in the TSPA-SR Model Document. These documents will be available to the NRC in January 2001."

The NRC reviewed the documents cited in the agreement and, in an NRC staff letter (Reamer, 2002), replied that additional information was needed as follows (RT.1.03 AIN–1):

"Provide clarification and justification of radionuclides for which reversible and irreversible colloidal transport is modeled."

<u>ENFE.3.05</u>

The agreement reads (Reamer, 2001b):

"Provide the technical basis for selection of radionuclides that are released via reversible and irreversible attachment to colloids for different waste forms in the TSPA. The technical bases for the selection of radionuclides released via reversible and irreversible attachments to colloids for different waste forms is provided in section 3.5.6.1 of the *Total System Performance Assessment (TSPA) Model for Site Recommendation* (MDL–WIS–PA–000002) Rev 00. This document will be provided to the NRC in January 2001."

The NRC reviewed the document cited in the agreement and others and, in an NRC staff letter (Schlueter, 2002), replied that additional information was needed as follows (ENFE.3.05 AIN–1):

"1) Provide clarification and justification of radionuclides for which reversible and irreversible colloidal release is modeled."

"2) Provide a stronger technical basis that release by irreversible attachment can be neglected for spent nuclear fuel."

<u>ENFE.4.05</u>

The agreement reads (Reamer, 2001b):

"Provide the screening criteria for the radionuclides selected for PA. Provide the technical basis for selection of radionuclides that are transported via colloids in the TSPA. The screening criteria for radionuclides selected for TSPA are contained in the AMR *Inventory Abstraction* (ANL–WIS–MD–000006) Rev 00, ICN 01. DOE is documenting identification of radionuclides transported via colloids for TSPA in the AMR *Colloid-Associated Concentration Limits: Abstraction and Summary* (ANL–WIS–MD–000012) Rev 0, in the Total System Performance Assessment for the Site Recommendation (TDR–WIS–PA–000001) Rev 00 ICN 01, and in the *Total System Performance Assessment (TSPA) Model for Site Recommendation* (MDL–WIS–PA–000002) Rev 00. These documents will be available to the NRC in January 2001."

The NRC reviewed the documents cited in the agreement and, in an NRC staff letter (Schlueter, 2002), replied that additional information was needed as follows (ENFE.4.05 AIN–1):

"Provide clarification and justification of radionuclides for which reversible and irreversible colloidal release is modeled."

3.0 TECHNICAL INFORMATION PROVIDED IN DOE'S AGREEMENT RESPONSES

The DOE responses to each KTI agreement and GEN.1.01 comments are presented in appendixes to the colloids technical basis document (Bechtel SAIC Company, LLC, 2003a). In each case, DOE states that "the report contains the information that DOE considers necessary for NRC review for closure of these agreements." The NRC staff found, however, that in most cases, the supporting data and analyses necessary for review were in other DOE reports. This section describes DOE's technical information presented in the technical basis documents and in supporting analysis and model reports that were publicly available at the time of this review.

3.1 Agreements Pertaining to Sensitivity Studies to Test Importance of Colloid Transport Parameters and Models [Response to RT.3.07 and GEN.1.01 (Comments 43 and 46)]

RT.3.07

Appendix E of DOE's technical basis document (Bechtel SAIC Company, LLC, 2003a) provides information related to Agreement RT.3.07. This agreement concerns the need to understand the sensitivity of unsaturated zone and saturated zone transport model results to uncertain models and parameters. In the appendix, DOE cited sensitivity studies that evaluated the importance of several factors influencing colloid-facilitated transport, and stated that uncertainties in these factors were addressed by either establishing appropriately broad parameter distributions or by implementing the more conservative among possible conceptual models.

As part of the basis for the agreement response, DOE discussed sensitivity analysis results for the unsaturated zone (Bechtel SAIC Company, LLC, 2003b, Section 6.18). Those analyses focused on the importance of colloid size because fracture transport was dominant over matrix effects. The majority of the colloid mass remains in fractures, which do not retard colloid transport because of size exclusion; thus, matrix transport characteristics had little influence. The effect of permanent filtration in the matrix at unit interfaces was not apparent because in the models colloidal radionuclides were released only into fractures.

For the saturated zone, Bechtel SAIC Company, LLC (2003a) refers to qualitative discussions of model sensitivities (Bechtel SAIC Company, LLC, 2003c,d); no formal sensitivity analysis results for colloid release and transport parameters and models are available. Instead, Bechtel SAIC Company, LLC (2003a, Appendix E) and the cited reports discuss how the uncertainty ranges in colloid-related parameters (e.g., retardation factor for colloids with irreversible attachment in the alluvium) result in ranges of modeled saturated zone breakthrough times.

The most important parameters with respect to colloid transport were identified as the specific discharge rate and the retardation factors in volcanic and alluvial aquifers for colloids with irreversible radionuclide attachment.

With regard to testing colloid transport during the Alcove 8/Niche 3 unsaturated zone tests, DOE provided a letter to NRC (Brocoum, 2001) that discussed some of the considerations involved in conducting such tests (e.g., the need to avoid high-ionic strength waters). The DOE subsequently decided not to perform these tests.

GEN.1.01 (Comment 46)

The bases presented by DOE for closing GEN.1.01, Comment 46, are provided in Bechtel SAIC Company, LLC (2003a, Appendix D and E). For a given radionuclide, the reversible colloid distribution coefficient, K_c, is the product of colloid concentration and the sorption coefficient K_d for the radionuclide onto colloids. For performance assessment, DOE calculates K_c using probability distributions for colloid concentration and K_d. The Appendix D discussions, however, do not include the detailed technical bases for probability distributions for these parameters; rather, development of the distributions is the subject of Bechtel SAIC Company, LLC (2003e, Sections 6.3.2.5 and 6.3.3.1). The distribution for colloid concentrations, also used for seepage water entering the drifts, was based on measurements of groundwaters in the Yucca Mountain and Idaho National Engineering and Environmental Laboratory areas. The value ranges from 0.001 to 200 mg/l (logarithmic), with a median of 0.1 mg/l (Bechtel SAIC Company, LLC, 2003e, Figure 12). DOE concludes that such a probability distribution adequately captures data uncertainty. Probability distributions for K_d onto both iron oxyhydroxide and smectite colloids for plutonium, americium, thorium, protactinium, and cesium were developed based on colloid-specific DOE-sponsored laboratory results and literature data (which did not involve colloid experiments). As noted in Bechtel SAIC Company, LLC (2003d, Section 6.5.2.12), the smectite values compiled in Bechtel SAIC Company, LLC (2003e, Table 10) were selected for modeling reversible attachment during groundwater transport.

3.2 Agreements Pertaining to Screening Criteria for Attachment of Radionuclides to Colloids (Response to RT.1.03, ENFE.3.05, and ENFE.4.05)

RT.1.03, ENFE.3.05, and ENFE.4.05

The bases presented for closing these three KTI agreements are presented in Bechtel SAIC Company, LLC (2003a, Appendix G). All three concern, at least in part, the selection of radionuclides for colloid modeling. The contents of ENFE.4.05 and RT.1.03 differ from ENFE.3.05 only in that the latter is concerned with colloidal release, rather than transport. In addition, ENFE.3.05 concerns whether or not spent nuclear fuel waste forms are considered sources of colloids with irreversible attachment. These three agreements together are related and may be discussed together.

The DOE stated in Agreement ENFE.3.05 (Reamer, 2001b) that the technical basis for selection of radionuclides modeled as released in association with colloids was to be found in CRWMS M&O (2000a, Section 3.5.6.1). The NRC staff conclusion that additional information was needed (Schlueter, 2002; Section 2.2 of this report) was based on review of this and related documents available at the time (CRWMS M&O, 2000b,c,d). Agreements RT.1.03 and ENFE.4.05 are essentially identical, and were intended to address only those aspects of radionuclide screening concerned with colloids. DOE stated in the agreements (Reamer, 2001b, 2000) that the technical basis for selection of radionuclides modeled as transported in association with colloids was to be found in CRWMS M&O (2000a,b,d). The NRC staff conclusion that additional information was needed for closure of ENFE.4.05 and RT.1.03 was based on review of these three documents (see Section 2.2 of this report). In addition, Reamer (2002) stated that the portion of the agreement concerned more generally with radionuclide screening was considered closed on the basis of CRWMS M&O (2000e).

The subsequent DOE technical basis response (Bechtel SAIC Company, LLC, 2003a, Appendix G) is in two parts: (i) screening of radionuclides for the reversible and irreversible attachment models in total system performance assessment; and (ii) neglect of irreversibly-attached radionuclide release from waste forms other than high-level waste glass. Additional details are available in Bechtel SAIC Company, LLC (2003e).

The DOE identified radionuclides for the total system performance assessment model abstraction of colloidal transport based on contribution to dose, inventory, and mobility considerations (Bechtel SAIC Company, LLC, 2003e, Sections 6.3.3.1 and 6.3.3.2). For the reversible attachment model, plutonium, americium, thorium, cesium, and protactinium were chosen, while neptunium, uranium, and strontium were not. Because of relatively high solubility and low sorption under geochemical conditions expected at Yucca Mountain, neptunium and uranium were judged to be relatively insensitive to colloid enhancement, while strontium was eliminated due to the short half-life of Sr–90. For the irreversible model, only plutonium and americium were included, based chiefly on their tendency to desorb very slowly from colloids; no explicit basis was provided for excluding other radionuclides.

Waste form colloidal release from spent nuclear fuel is not modeled because laboratory tests and corroborative natural analog studies suggest that colloidal impact will not be significant (Bechtel SAIC Company, LLC, 2003e, Section 6.3.1.2). The primary source for supporting the neglect of commercial spent nuclear fuel colloids is Mertz, et al. (2003). That report showed low colloid concentrations during spent fuel corrosion tests and demonstrated decreasing colloid and particulate concentrations over time following physical disruptions that raised those concentrations. In addition, Mertz, et al. (2003) reported that uranium mineral colloids were unstable in J–13 water. Corrosion tests on irradiated uranium metal N-Reactor fuel (Bechtel SAIC Company, LLC, 2003e, Section 6.3.1.2.2) produced colloids that comprised less than 0.006 wt % of the original uranium sample. Plutonium was enriched in the colloids relative to uranium, but DOE concluded that colloidal mass was negligible relative to sorbed and retained mass. Finally, a number of natural analog studies were cited (Bechtel SAIC Company, LLC, 2003e, Section 6.3.1.2.4) that show limited uranium mobility associated with colloids.

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. The agreements are grouped according to similarity in the aspect of colloidal release and transport being addressed.

4.1 Agreements Pertaining to Sensitivity Studies to Test Importance of Colloid Transport Parameters and Models [Response to RT 3.07 and GEN 1.01 (Comment 46)]

4.1.1 Relevance to Repository Performance

Radionuclides that attach to colloids have the potential to be transported in a manner that may substantially reduce or eliminate the beneficial effects of sorption to geologic materials along the flow path. Agreement RT 3.07 has been rated by the NRC staff as having medium significance to risk (Travers, 2003). The potential importance of colloidal transport was evident in CRWMS M&O (2000b), which indicated colloidal plutonium is the second highest dose contributor after 70,000 years, when a significant number of waste packages is estimated to have failed. Although performance effects have not yet been explicitly examined using the NRC Total-system Performance Assessment (TPA) code (Mohanty, et al., 2004), the code was used to bound colloid effects by allowing unretarded transport of otherwise relatively immobile actinides such as plutonium, americium, and thorium. That conservative analysis yielded an increase in dose at 10,000 years by more than a factor of 10 (Mohanty, et al., 2004, Section 3.5.3.1). The potential significance of colloidal transport was also demonstrated by comparing the potential dose effect of plutonium to unretarded radioactive iodine and technetium[1]. There is considerable uncertainty concerning the fate of colloids during transport under unsaturated and saturated hydrologic conditions, and parameters governing colloid concentrations, sorption coefficients and kinetics for radionuclide attachment to colloids, and filtration of colloids are not well constrained. Sensitivity analyses of colloid-facilitated transport indicate that the extent and kinetics of filtration (both reversible and irreversible) are the most important aspects in understanding and estimating the importance of colloids to radionuclide transport (Painter, et al., 2002; Cvetkovic, et al., 2004).

4.1.2 Result of NRC Review

Agreement RT.3.07 focused on whether DOE colloid transport parameters sufficiently bounded uncertainty. In Bechtel SAIC Company, LLC (2003a) and supporting reports, DOE presented sensitivity analyses only for the unsaturated zone, but also discussed how parameter uncertainty is manifest in saturated zone breakthrough curves. Although formal sensitivity analyses were not provided in all cases, staff concludes that the documents provide information relevant to the agreement and the staff has no further questions at this time. Based on information presented in the technical basis document and supporting reports, DOE has provided the documentation requested in Agreement RT 3.07. Staff may evaluate performance sensitivity to colloid transport parameters in documentation accompanying the potential License Application, and may perform independent sensitivity analyses as appropriate.

Staff may evaluate specific aspects of the retardation factor probability distributions if they are employed in the potential License Application, particularly the basis for the truncation of the distributions for both tuff and alluvium at the low end. DOE states that this is justified because: (i) in their model a population of colloids is transported unretarded; and (ii) “all colloids that become filtered experience some degree of retardation...” (Bechtel SAIC Company, LLC,

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[1]Pickett, D.A., and W.L. Dam. “Approach to Assessing the Potential Effects of Colloidal Radionuclide Transport on Nuclear Waste Repository Performance.” *Nuclear Science and Engineering*. Accepted for publication (2004).

2003c, Section 6.5.3). The fact that the model-dependent un-retarded fraction is quite low (Section 3.1 of this report) emphasizes the importance of the technical basis for the low-value truncation of the retardation factor distribution. Exclusion of the lower values from the distribution does not appear justified in light of the lack of data. In addition, the technical basis for the un-retarded fraction itself is not strong and will be the subject of reviews related to the potential License Application. The model on which these fraction of un-retarded colloids is based, assumes a homogeneous population governed by a single filtration rate. Data compiled by DOE (Bechtel SAIC Company, LLC, 2003c, Figure 1) show a decrease in the apparent filtration rate parameter with time, which would be consistent with a heterogeneous population governed by multiple rates.

Comment 46 of Agreement GEN.1.01 focused on whether uncertainty in the reversible colloid attachment parameter K_c is captured by DOE probability distributions. In Bechtel SAIC Company, LLC (2003a) and supporting reports, DOE provided the detailed technical bases for probability distributions for the two parameters, colloid concentration and K_d for sorption to colloids, that are multiplied to calculate K_c. Therefore, DOE has responded to the intent of Agreement GEN.1.01, Comment 46. Staff may review some of the supporting data not presented in the available reports (e.g., the compilation of measured groundwater colloid concentrations) to understand whether parameter distributions underestimate potential colloid transport effects.

4.2 Agreements Pertaining to Screening Criteria for Attachment of Radionuclides to Colloids (Response to RT.1.03, ENFE.3.05, and ENFE.4.05)

4.2.1 Relevance to Repository Performance

The relative effect of colloid-associated transport on barrier performance is radioelement-dependent. This can be attributed to the variability of radioelements in terms of: (i) tendency to sorb to colloids; (ii) rates of adsorption and desorption to colloids; and (iii) tendency to be permanently attached to colloids relative to being dissolved. For example, if a radioelement has a high-solubility limit and does not sorb strongly to solids, both the fraction of that element permanently attached to waste-form colloids and the fraction reversibly sorbed to colloids is likely to be negligible relative to the dissolved fraction. Conversely, a low-solubility, highly sorptive element such as plutonium is more likely to be significantly affected by colloids. Performance assessment modeling efficiency is enhanced when limiting the number of radionuclides deployed, but a rationale must be provided for those selections to support confidence that effects of colloids on release and transport will not be underestimated. Agreements RT 1.03, ENFE 3.05 and ENFE 4.05 have been rated by the NRC staff as having low significance to risk (Travers, 2003). More general comments on relevance of colloids to performance are in Section 4.1.1.

4.2.2 Result of NRC Review

Agreements RT.1.03, ENFE.3.05, and ENFE.4.05 focused on: (i) the basis for selection of radionuclides to be included in colloidal release and transport abstractions; and (ii) for excluding waste-form colloids derived from spent nuclear fuel. Based on information presented in Bechtel SAIC Company, LLC (2003a) and supporting reports, DOE has provided the documentation identified in Agreements RT.1.03, ENFE.3.05, and ENFE.4.05. The selection of radionuclides is based appropriately on considerations of dose, inventory, and mobility.

The DOE should consider providing an explicit basis for excluding radioelements other than plutonium and americium from the irreversible model. The appropriateness of this choice will be judged based on how effectively the irreversible colloidal species are transported relative to more mobile dissolved elements such as neptunium and uranium in the total system performance assessment supporting the potential License Application. With regard to the reversible model, preliminary independent calculations (Contardi, et al., 2001)[2] suggest that the effect of reversible attachment on less retarded elements such as uranium and neptunium is relatively small.

With regard to the exclusion of spent nuclear fuel colloids, the laboratory report provided by DOE (Mertz, et al., 2003) is responsive to the need for a technical basis as specified in Agreement ENFE.3.05. However, DOE should consider addressing some issues if this exclusion is retained in analyses supporting potential License Application. For example, in Mertz, et al. (2003), detected colloid concentrations in unsaturated spent fuel corrosion tests were described as "low," but quantifying the concentrations was not possible. Therefore, DOE should address if colloidal plutonium concentrations were low enough as to be negligible in the context of the enhanced transport that colloid association provides. In addition, solution collected in the bottom of the test vessel from which colloids were sampled may not be representative of the water in contact with fuel during the experiments in terms of chemical parameters such as pH and ionic strength (Mertz, et al., 2003, page 26). Thus, colloid stability and concentration could have changed as solution left the corroding fuel surface, passed through the holder, and entered the vessel. Furthermore, DOE documents refer to published corrosion tests on unirradiated UO_2 (Wronkiewicz, et al., 1997) that included the "formation of a dense mat of alteration products" that may have "reduced particulate release by trapping particulates in the altered products" (Bechtel SAIC Company, LLC, 2003a, page 3-9; 2003e, pages 43–44). It is not clear from DOE's reports (Bechtel SAIC Company, LLC, 2003a,e) if this process could have artificially masked colloid production during the recent spent nuclear fuel tests of Mertz, et al. (2003); i.e., the discussions do not demonstrate whether this process could inhibit colloid formation in a repository setting. Furthermore, if the "mat" is thought to represent a repository feature that could inhibit release, there is no information on its long-term stability. In addition, recent results from spent fuel corrosion tests at Pacific Northwest National Laboratory indicate formation of a plutonium-enriched surface alteration layer that may serve as a source for colloidal mobilization (Buck, et al., 2004a). These results and observations of colloids in UO_2 tests helped form the basis for an alternative conceptual model for spent fuel colloid generation (Buck, et al., 2004b). The latter report concluded that conditions necessary for colloid mobilization are not expected under typical repository conditions, but the model has not been quantified. The question of the extent of spent nuclear fuel waste form colloids remains uncertain. An argument for exclusion based on the physical and chemical improbability of mobilization of spent fuel colloids (Buck, et al., 2004b) should be consistent with the inclusion of colloids from glass waste forms.

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[2]Pickett, D.A., and W.L. Dam. "Approach to Assessing the Potential Effects of Colloidal Radionuclide Transport on Nuclear Waste Repository Performance." *Nuclear Science and Engineering*. Accepted for publication (2004).

5.0 SUMMARY

The NRC reviewed DOE's KTI agreement responses within the technical basis document to determine whether sufficient information was provided to close the agreement items. On the basis of this review, and notwithstanding new information that could raise new questions or comments concerning the above agreements, NRC considers that the information provided in the technical basis document and supporting reports, together with other available information, satisfies the intent of the Agreements RT.1.03 AIN–1, RT.3.07, ENFE.3.05 AIN–1, ENFE.4.05 AIN–1, and GEN.1.01, Comments 46, and the staff has no further question at this time. However, in developing a high-quality License Application, the NRC staff recommends DOE consider the comments above concerning exclusion of radioelements other than Pu and Am from the irreversible colloidal model and exclusion of spent fuel as a source of colloids.

6.0 STATUS OF THE AGREEMENTS

Based on the above review, NRC agrees with DOE that the information provided satisfies the intent of the agreements. Therefore, NRC considers the Agreements RT.1.03 AIN–1, RT.3.07, ENFE.3.05 AIN–1, ENFE.4.05 AIN–1, and GEN.1.01, Comments 46, closed.

7.0 REFERENCES

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