January 24, 2003

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: CONTAINER LIFE AND SOURCE TERM KEY TECHNICAL ISSUE AGREEMENT 1.05, 1.06., 1.07, and 2.07, WITH REQUEST FOR ADDITIONAL INFORMATION FOR 1.06 AND 1.07.

Dear Mr. Ziegler:

During a Technical Exchange and Management Meeting held on September 12-13, 2000, the U.S. Nuclear Regulatory Commission (NRC) and the U.S. Department of Energy (DOE) reached agreement on a number of issues within the Container Life and Source Term (CLST) Key Technical Issue (KTI). Subsequently, during a Technical Exchange and Management Meeting held on April 15-16, 2002, DOE indicated that the information requested in CLST 1.05, 1.06, 1.07, and 2.07, rather than being provided in Analysis and Model Reports, would be submitted early in the form of a letter report. By letter dated July 5, 2002, DOE submitted information in an attached Letter Report to address CLST 1.05, 1.06, 1.07, and 2.07. By letter dated November 1, 2002, DOE submitted a Supplement to Report with additional information related to CLST 1.06 and 1.07. The NRC staff has reviewed this information, with respect to the agreement, and the results of the staff's review are enclosed.

The NRC has completed review of the Letter Report, the Supplement to the Report, and other available information, and in summary, find that the information provided for the closure of CLST 1.05 and 2.07 is sufficient. Therefore, the NRC staff considers DOE's proposed method of documentation acceptable, and considers CLST Agreements 1.05 and 2.07 "complete".

However, neither the Letter Report nor the Supplement to the Report appropriately addresses the effect of silica to support the assertion about the beneficial effect or insignificance of silica deposition on the corrosion rates measured in the long-term corrosion testing facility, nor do they completely address documentation needed to appropriately address the alternative methods of corrosion measurement used to verify the validity of the 5-year testing. Therefore, NRC staff, has indicated in the attached, list CLST Agreements 1.06 and 1.07 as needing more information.

If there are any questions regarding this letter, please contact Tamara Bloomer at 301-415-6626 or by e-mail at teb@nrc.gov.

Sincerely,

/RA/

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

Attachment: As stated
cc: See attached distribution list

Letter to J. Ziegler from J. Schlueter dated January 24, 2003

cc:

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V. Miller, Fort Independence Indian Tribe

A. Bacock, Big Pine Paiute Tribe of the Owens Valley

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M. Bengochia, Bishop Paiute Indian Tribe

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J. Leeds, Las Vegas Indian Center

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Citizen Alert

D. Feehan, GAO

If there are any questions regarding this letter, please contact Tamara Bloomer at 301-415-6626 or by e-mail at teb@nrc.gov.

Sincerely,
/RA/

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

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cc: See attached distribution list

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NRC Review of DOE Documents Pertaining to
Key Technical Issue Agreements Related to Container Life and Source Term

The U.S. Nuclear Regulatory Commission (NRC) goal of issue resolution during this interim prelicensing period is to ensure 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 prelicensing does not preclude anyone from raising any issue for NRC consideration during the licensing proceedings. Just as important, resolution by the NRC staff during prelicensing does not prejudge what the NRC staff evaluation of that issue will be after its licensing review. Issues are considered to be resolved by the 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 four NRC/DOE agreements. Container Life and Source Term (CLST) Agreements 1.05, 1.06, 1.07, and 2.07 were made during the Container Life and Source Term Technical Exchange and Management Meeting held on September, 12–13, 2000 (see NRC letter dated October 4, 2000, which summarized the meeting). By letter dated December 21, 2001 NRC provided a review of the information provided by DOE regarding CLST 2.07 among other agreements. By letter dated July 5, 2002, DOE submitted information in an attached Letter Report to address CLST 1.05, 1.06, 1.07, and 2.07. By letter dated November 1, 2002, DOE submitted a Supplement to Report with additional information related to CLST 1.06 and 1.07. The documents submitted and associated Key Technical Issue (KTI) agreements are discussed below.

Container Life and Source Term Agreement 1.05

Wording of CLST Agreement 1.05: Provide additional details on sensitivities, resolution of measurements, limitations, and [the effects of the] deposition of silica for the high sensitivity probes. DOE will document the results of the [high] sensitivity probes including limitation and resolution of measurements as affected by silica deposition in the Alloy 22 Analysis Model Report and Titanium Corrosion Analysis Model Report (ANL–EBS–MD–000003 and ANL–EBS–MD–000004) prior to License Application.

NRC Review: As noted in the DOE Letter Report, the underlying concern in this agreement is related to the uncertainties associated with corrosion rate measurements of Alloy 22 and Titanium Grade 7 obtained by weight loss.

In the Technical Exchange, DOE proposed the use of high sensitivity probes in some of the long-term corrosion testing facility vessels to conduct on-line measurements, providing an alternative method to estimate uncertainties in corrosion rates and improve resolution of measurements. The objective was to address the limitations of the method used and to confirm the weight loss data. As noted in the Letter Report, DOE has decided not to conduct measurements with high sensitivity probes, claiming that uncertainties in corrosion rates can be significantly reduced by using the 5-year long-term corrosion testing facility data. Instead, DOE will perform detailed characterization of the specimens of the 5-year long-term corrosion testing facility to address the problems related to incomplete descaling and deposition of corrosion products that affect the validity of previous data. DOE does not propose any other method to measure corrosion rates in the long-term corrosion testing facility, as an alternative to the use of sensitivity probes. Because the use of the sensitivity probes is also included in Agreement CLST 1.04, it is agreed that concerns related to sensitivities, resolution of measurements, limitations, and deposition of silica will be addressed in the resolution of CLST 1.04.

Additional Information Needed: None.

Status of the Agreement: Because DOE has changed the test method to addressing the concerns related to these corrosion rate measurements and the concerns related to the sensitivities of these measurements are addressed in Agreement CLST 1.04, NRC considers this agreement complete.

Container Life and Source Term Agreement 1.06

Wording of the CLST Agreement 1.06: Provide the documentation on testing showing corrosion rates in the absence of silica deposition. DOE will document the results of testing in the absence of silica deposits in the revision of Alloy 22 Analysis Model Report (ANL–EBS–MD–000003) prior to License Application.

NRC Review: In the Letter Report and Supplement to Report, DOE stated that it will not add long-term tests in silica-free environments to the series of tests currently conducted in the long-term corrosion testing facility. This decision is based on the argument that intrinsic corrosion rates are desirable but that for risk-based performance assessment calculations, it is more important to establish corrosion rates in the relevant environments and understand the range of uncertainties in such tests. DOE also indicated that silica from mineral precipitates or dust is likely to be present in the repository on the waste package and drip shield surfaces.

DOE approach relies on “relevant or realistic” environments. It is not clear, however, how DOE will determine and bound the range of relevant environments. In previous DOE reports, concentrations of species and relative concentrations of species have been used to describe various environments. Only a narrow range of possible environments based on ratios of inhibiting ions to aggressive ions have been studied in the long-term corrosion testing facility [identified as simulated diluted water (SDW), simulated concentrated water (SCW), simulated acidified water (SAW), and simulated saturated water (SSW)]. It should be clarified that these environments are not necessarily equivalent to those determined through modeling of evaporative processes. The data collected in the long-term corrosion testing facility may not be applicable to the assessment of long-term corrosion rates if substantially different environments are derived by a combination of modeling and experiments. Another possibility is that environments of a particular chemical composition, although not tested, could not be ruled out at a later date. DOE approach does not establish the range of possible environmental conditions that must be included in the test matrix.

The reason for this agreement is the fact that some of the specimens tested in the long-term corrosion testing facility exhibited weight gain rather than weight loss even after descaling. The environments deemed relevant by DOE tend to form silica (or silicate) scales. Even though silica from mineral precipitates or dust is likely to be present under repository conditions, the formation and coverage of these scales would not necessarily be similar to that observed in the long-term corrosion testing facility specimens due to differences in geometry, area, contact modes, and mass transport conditions. In addition, the apparent protective property of such scales is used in the Letter Report as an argument to justify the presence of silica in the tests environments even though the long-term corrosion testing facility data do not have sufficient resolution to support assertions that the scales are actually protective. While the Supplement Report did not address the issue of the silica scales being protective, it did state that silica deposits are not significant.

DOE conducted limited short-term potentiostatic tests in environments without silica and reported no discernible difference in the estimated corrosion rates of Alloy 22 (based on passive current density measurements) in comparison to the data from the long-term corrosion testing facility. It should be noted, however, that the plot shown in Figure 2 of the DOE letter report exhibits a significant discontinuity in the evolution of the current density at about 100 hr,

which is difficult to understand. The current decay follows an almost linear behavior in this log-log plot and just before the sudden change in slope the current density is about 5×10^{-8} A/cm^2, corresponding to a corrosion rate of about 0.5 µm/yr, which is one order of magnitude higher than that reported in the same test after 250 hours of testing. The Supplement Report replaced the previous Figure 2 with Figure 1 using the same data and a modified plot. It is not clear why data points from the previous plot are absent. Substitution of a short-term test where the passive current density is measured in a silica free environment does not address the issue of long-term passive film stability in such an environment nor does it address the uncertainty of the data from the long-term corrosion testing facility.

Additional Information Needed: Additional information is needed addressing the effect of silica to support the assertion about the beneficial effect or insignificance of silica deposition on the corrosion rates measured in the long-term corrosion testing facility. Presentation of the complete results from the 5 year test data in addition to the results of short term electrochemical tests over a range of solution compositions and pHs taken under appropriate testing conditions are required. DOE should also provide sufficient rationale for the relationship between the silica deposition in LTCTF and in the repository.

Status of the agreement: Additional information is still needed to complete this agreement, which remains open.

Container Life and Source Term Agreement 1.07

Wording of the CLST Agreement 1.07: Provide the documentation for the alternative methods to measure the corrosion rate of the waste package material (e.g., ASTM G–102 testing) or provide justification for the current approach. DOE will document the alternative methods of corrosion measurement in the revision of Alloy 22 Analysis Model Report (ANL–EBS–MD–000003), prior to License Application.

NRC Review: DOE has stated that data from the 5-year long-term corrosion testing facility will be used to reduce uncertainties in corrosion rate data used in the model abstraction for Alloy 22 and Titanium Grade 7 (an acceptable justification is provided for the use of Titanium Grade 16 instead of Titanium Grade 7 specimens). In addition, DOE will perform detailed examination of the 5-year long-term corrosion testing facility specimens to gain additional confidence in the measured corrosion rates. DOE will use electrochemical techniques (i.e., potentiostatic tests, polarization resistance, and electrochemical impedance spectroscopy) in short term tests to be completed in Fiscal Year 2003, only to corroborate results of the long-term corrosion testing facility.

DOE has stated that the deviation in the corrosion rates calculated from weight loss measurements, as estimated by the expressions accounting for the propagation of errors associated with the various variables involved (i.e., weight loss, specimen dimensions, test time, etc.), is reduced in the 5-year tests with respect to the 2-year tests. Although this argument is acceptable, the main concern is related to systematic errors such as those associated with the deposition of silica or other minerals or corrosion products and the resolution of the measurements, factors that preclude the precise and accurate determination of intrinsic corrosion rates.

The descaling and examination procedure that will be used to examine the 5-year long-term corrosion testing facility specimens references ASTM G–1, which addresses the assessment of corrosion damage. This portion of the ASTM G–1 procedure specifically references the ASTM G–31 procedure for the assessment of corrosion rates as a function of time. In turn, ASTM G–31 contains recommendations for testing time as a function of anticipated corrosion

rate. For the corrosion rates calculated based on the weight loss of specimens from the long-term corrosion test facility, DOE has not justified the use of this method for long term projection. The Supplement Report provided information that ASTM G-1 is used only as a guide for performing corrosion rate measurements using the weight loss method. DOE should clearly indicate the standards or recommended practices that were adopted for the measurement of corrosion rates with the long-term corrosion test facility specimens. If ASTM G–31 or similar standard for evaluating corrosion rate determined by weight loss (i.e., ASTM G–4) is used, the technical justification for conducting tests for times much shorter than the recommended practice should be provided.

Although DOE listed several electrochemical techniques (i.e., potentiostatic tests, linear polarization, and alternating current impedance) to confirm corrosion rates measured in the long-term corrosion test facility, the justification, advantages, and limitations of each of these techniques, which constitute the documentation that was agreed upon in CLST 1.07, have not been provided. In addition, the justification for the current approach is based on the expectation that the weight loss measurements after 5 years will be reliable is not complete. The information included in the Letter Report to justify the approach adopted is one example (the data shown in Figure 1, based on work conducted under contract at McDermott). As expected, the corrosion rates are initially higher after a few weeks and decreases with time, as is characteristic of corrosion resistant alloys in which the formation and growth of the passive film offers protection against fast uniform corrosion. The main concern, however, is related to the limitations and uncertainties in the estimate of the corrosion rate in the long-term, beyond the planned 5-year testing, supporting DOE's assertion that corrosion rates will decrease below a bounding value. The information included in Figure 3 of the Supplement Report does not address this issue. While it is evident that an attempt was made to connect the loss of tensile strength as a function of time with extrapolation of the 5 year test data the basis for this assumption is inappropriate.

Additional information needed: The use of appropriate standards should be adopted and exceptions should be properly justified. If a standard is mentioned but not used in its entirety, DOE should indicate specifically which parts of the code will be used (example, G1 is used for identification of equipment, G1 is used for data interval, etc.). Better justification for not using alternative techniques is needed. If such a justification cannot be provided, then DOE must provide details on the alternative techniques to be used for corrosion rate measurements.

Status of the agreement: Additional information is still needed to complete this agreement, which remains open.

Container Life and Source Term Agreement 2.07

Wording of the CLST Agreement 2.07: Provide documentation for the fabrication process, controls, and implementation of the phases which affect the TSPA model assumptions for the waste package (e.g., filler metal, composition range). DOE stated that updates of the documentation on the fabrication processes and controls (TDR–EBS–ND–000003, Waste Package Operations Fabrication Process Report and TDP–EBS–ND–000005, Waste Package Operations FY-00 Closure Weld Technical Guidelines Document) will be available to the NRC in January 2001.

NRC Review: In the Letter Report, DOE stated that it will produce welded material "with the material compositions covering the range specified in the ASTM–B-575 for Alloy 22" and the remainder of items under CLST 2.07 will be covered under CLST 2.04. Welded material "with the material compositions covering the range specified in the ASTM–B-575 for Alloy 22" will be included in future aging and phase stability studies.

The letter also states that “It is planned to produce welded plates of prototypical thickness with the material compositions covering the range specified in the ASTM–B-575 for Alloy 22. Samples obtained from these plates will be included in future aging and phase stability studies.” Based on this statement, NRC understands that DOE will systematically explore the range of alloying elements and allowable trace element compositions allowed with the ASTM–B–575 specification. Any significant changes to the welding study not captured in CLST 2.04 will be cause to readdress this agreement.

Additional Information Needed: None.

Status of Agreement: This agreement is considered complete; all the requested information will be provided according to CLST 2.04.