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August 19, 1986

Mr. John J. Linehan
Section Leader, Salt Section
Repository Projects Branch
Division of Waste Management, MS 623-SS
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Linehan:

SUBJECT: TRANSMITTAL OF RESPONSES TO NRC OBSERVATIONS: WASTE PACKAGE TECHNICAL MEETING JANUARY, 1986

The purpose of this letter is to transmit the Salt Repository Project Office's (SRPO) responses to the observations made by your staff at the NRC/DOE-SRPO Waste Package Technical Meeting held in Columbus from January 22 through 24, 1986.

SRPO appreciates the NRC's participation in the Waste Package Meeting. We feel that the meeting was both helpful and informative to SRPO and NRC staff members. The enclosed responses to NRC's observations are intended to provide additional information regarding our waste package program.

If you have any questions concerning our responses, please contact Mr. Andrew Avel, Licensing and Systems Branch, at FTS 976-5916.

Sincerely,

R.W. Underlich

for J.O. Neff
Project Manager
Salt Repository Project Office

SRPO:APA:max:1208SS

Enclosure:
As Stated

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LS# 166-86

Response to NRC Observations and Open Items

1. Issue: The NRC staff appreciates the effort of the DOE in making available at this meeting the key personnel involved in the salt waste package program. Although final resolution to questions prepared by the NRC staff was not achieved nor expected in many cases, essentially all of these questions were addressed during the presentations. NRC also found the identification of SRPO concerns useful in identifying areas where future NRC guidance is needed. The NRC staff wishes to thank all DOE participants for their effort.

   - No response necessary.

2. Issue: The NRC is concerned that the SRP may be unable to show compliance with the 300-1,000 year containment requirement for the reference waste package design by demonstrating that the hermeticity of the waste package container is preserved for the duration of the containment period. In light of this concern, SRP has not documented viable alternatives to the current waste package design either in terms of alternative materials or supporting data.

   - The Waste Package program plan includes both primary and secondary strategies to meet the waste package containment requirements specified in 10 CFR 60.113. The primary containment strategy is based on a waste package material and wall thickness which the SRP believes, in combination with limited available brine, will exceed the specified containment requirement of 300 years. The SRP recognizes that sufficient information is not presently available to establish the behavior with reasonable assurance nor confirm the underlying assumptions pertinent to this expected behavior. Therefore, alternative strategies are also considered by the Waste Package program.

     It should be noted, however, that the SRP has taken the position that the specified containment requirement does not automatically imply hermeticity of the waste package container. Rather, SRP's position is that, as long as radionuclides do not cross the waste package boundary, at a rate not exceeding that specified in 10 CFR 60.113, then the containment requirement is met.

3. Issue: For the current waste package design, NRC considers that localized corrosion must continue to be regarded as a mechanism by which the container may be breached. Data supporting the analysis of long-term, localized corrosion behavior need to be developed, and future test plans need to be described.

   - Localized corrosion is currently regarded as a mechanism by which the container may be breached.

- The SRP Waste Package program plan delineates the data, range of environmental conditions, and information needs required to address the localized corrosion issue.

4. Issue: Release of information is not timely. For example, the Westinghouse waste package conceptual design report (WTSD-TME-001) was prepared in 1982, yet is only now being released as ONWI-517.

   - SRP is working to expedite the issuance of documents. The SRP program requires that certain documents undergo numerous internal and external reviews [and documentation of resolutions to these reviews] which tend to extend the time required for document issuance.

5. Issue: The SRP's description of waste package behavior under expected conditions is informative and should be a useful starting point in assessing data needs. However, plausible variations in assumed conditions to reflect data uncertainties should be given consideration in both the testing program and in the treatment of variability in the performance assessment. An envelope of environmental parameters within which the waste package testing programs may be performed should be provided to NRC. Actual site properties may fall outside of the design range. As a result, waste package design changes and additional supportive testing may be required that could significantly affect DOE's ability to meet the licensing schedules in the Mission Plan.

   - The variations in assumed or expected conditions are an important aspect of the program. As a result, both the testing and analytical work consider a range of environmental parameters. The range of parameters selected is intended to conservatively bound expected conditions at the site.

6. Issue: While SRP investigators expressed interest in WIPP related information, at this time utilization of this source of salt information is not apparent.

   - At this time, the utilization of WIPP data in SRP's program has not been defined.

7. Issue: The peer review program at Argonne National Laboratory appears to be developing in an appropriate direction. However, it appeared to NRC that peer review was referenced as a method to reach conclusions on subjects where data are unavailable. The NRC believes that extrapolation of limited data over long periods of time should not only be based on the peer review process and expert opinion, but also include: (a) an experimental program based on conservative conditions, (b) a thorough understanding of the fundamental processes involved, and (c) a confirmatory test program extending over a moderate period of time (30-50 years). The peer review process should be expanded to consider review of testing goals and pro-

cedures, possibly from a source not directly related to the SRP (e.g., MRB).

- The Waste Package extrapolation of limited data over long periods of time should not be based solely on peer/expert opinion. However, the SRP intends to use peer reviews (1) to evaluate the plausibility and probability of events, (2) to independently assess procedures that exist or are being planned within the waste package laboratory testing and in situ program, and (3) to independently review the interpretations of the data gathered to support waste package design and performance assessment. The philosophy of the SRP has been that such reviews be used to augment, and not serve as a surrogate for, an orderly approach to gaining project data based on a sound experimental program.

  Currently, independent groups review testing procedures (MRB) and testing goals (ERG/ANL). Test results are also presented to the general technical community through published reports and technical conferences and publications.

8. Issue: Design approaches to container failure based on limited brine availability are inadequate to demonstrate containment in cases where failure by localized corrosion cannot be excluded.

   - See the response to Issue 2.

9. Issue: The rationale for selecting the material of the waste package container is unclear. This makes it very difficult to establish conformance with performance criteria that can be related to the regulatory requirements.

   - As stated in the meeting, the rationale for selecting the waste package material is to provide an Engineered Barrier System which will comply with 10 CFR 60.113. This selection included consideration of the material's characteristics of: acceptable general corrosion rate, absence of significant localized corrosion, history of application, weldability, castability, attenuation of radiation, strength and cost. Details of the selection are included in BMI/ONWI-517, "Waste Package Reference Conceptual Designs for a Repository in Salt". As the testing program evaluates these traits under site-specific expected environmental conditions, their collective performance is expected to show that this material will meet the requirements contained in 10 CFR 60.

10. Issue: The NRC staff considers discussion of irradiation effects to be an acceptable approach to acquisition and application in assessing waste package environment.

    The NRC is concerned that the high pH brines produced by heating salt, as observed by BNL, have not been considered adequately in the matrix of experiments for the waste package.

    - The SRP plans to conduct further study into the effects of pH on waste degradation processes. It should be noted, however, that the effects of near field conditions will have a strong impact on the overall effect of package degradation. Hence, the effects of variations in pH must be put in the context of the overall performance of the waste package system.

11. Issue: It is unclear how information (including data and analyses) developed by PNL prior to corrections to the PNL QA Program will be used, and if it is to be used as information to support a license application, how that information will be qualified. While NRC staff realizes that qualification of existing information is an issue for which policy/guidance is currently being developed, the staff is concerned that the function of and deficiencies related to the existing information has not been evaluated and documented so that it can be considered in future program work.

    - All upgrades to the PNL QA program involved making the documentation more comprehensive, procedures more definitive, and QA program training more comprehensive. However, some audit findings related to data collection/analyses performed to date have involved noncompliance. In these few cases, the corrective actions have involved validation of those data/analyses determined to be critical to licensing by repeating previous work utilizing approved QA procedures.

12. Issue: SRP indicated that a waste package program plan is under development. A program plan should be prepared which states the objectives of the waste package and how these objectives will be met through the analytical and experimental efforts to be performed, and how the information will be used to demonstrate compliance with the regulatory requirements. For example, the program plan should: (a) state the regulatory requirements which must be met, (b) state the function and design objectives of the waste package which ensure the regulatory requirements will be met, (c) identify the design and the technical considerations and concerns affecting the design's ability to meet those objectives, and (d) explain the information needed and the analytical and experimental programs to be performed to obtain the information and resolve the technical considerations and concerns. Schedules should also be presented.

    Based on the presentations, it is not clear that several testing programs under way and planned have been developed with the above

logic in mind. For example, spent fuel leach testing appears to be under way without clear understanding of how it will be ultimately used to demonstrate compliance with the regulatory requirements.

- The present Waste Package Program has been described in program plans (NWTS-96 and NWTS-34) that stated (1) the function and design objectives, (2) the design/technical considerations that affect performance, (3) the information needed and experimental programs to gain the information, and (4) the schedule. The WPPP discussed at the meeting is an upgrade of previous plans and will continue to serve as a guide to the next steps in designing, developing, and testing a waste package concept. The pending WPPP will contain the elements cited in the observation.

13. Issue: The fugacity of hydrogen should be assessed for the metal/environment systems proposed, and the effects of hydrogen can be assessed. These effects include embrittlement (ductility loss, cracking), and hydrogen damage/attack.

- The SRP presently plans to establish the fate of the nascent corrosion product hydrogen as well as the radiolysis hydrogen. The hydrogen fugacity at the container surface will be considered in evaluating hydrogen diffusion into the container material.

14. Issue: Test plans for corrosion and embrittlement studies should always include assessments of the relative behavior of the weld metal, the heat affected zone, and the base metal.

- SRP agrees.

15. Issue: In view of the very limited structural analysis performed to date, NRC believes more detail is required concerning what structural failure modes will eventually be considered and how the project will analyze them.

- SRP is planning to address this issue as part of the definition of the waste package in the Advanced Conceptual Design report.

16. Issue: Although SRP intends to add use of probability distribution functions to later WAPPA analysis to account for variabilities and uncertainties in parameters, such analysis is yet to be performed. It is unclear how the analysis will be accomplished, how experimental data will be turned into probability distribution functions, and which parameters will be applied in the form of pdf's (as opposed to single values or ranges).

- The general philosophy of how system level models are used within the SRP is discussed in the Performance Assessment Plan (PAP) (BMI/ONWI-545), now in the process of being updated. The inputs for

the WAPPA model, used for subsystem level assessments of the waste package, are derived from detailed process models and models established to yield boundary conditions to which the waste package is exposed. The parameters from which pdf's developed can be derived from sensitivity analyses that indicate which parameters are the most critical. The pdf's are created (1) based on available experimental data, (2) from extrapolations based on understandings of first principles, and (3) modified by independent peer reviews if less than sufficient data can be derived within the general schedule of the project (e.g., long-term test data will be used to upgrade estimations of pdf's but these data may not be totally available when the initial assessments using WAPPA takes place). When developing pdf's from experimental data, variations between laboratory conditions and expected in situ conditions can be accounted for by using conservative estimates of means which may be two standard deviations to the conservative side of the mean measured experimentally in the laboratory. When possible, these conservative estimates will verified through the in situ tests at the selected site.

17. Issue: NRC understands that SRPO/ONWI would like to have PNL test data presently being collected released as unanalyzed data reports, NRC would like to receive from SRPO a specific commitment for release and a description of how and in what time frame PNL test data and analyses results will be documented and released.

    - Current plans would make data available in a timely manner both in an online and report format.

18. Issue: The NRC regards the subject of brine migration and other sources of water as an area that requires a much greater emphasis.

    - The development of a strong case for the limited brine failure mode approach will rely on an improved understanding of what mechanisms and in what quantities water will be brought in contact with the waste package. This increased emphasis is reflected in the forthcoming WPPP.

19. Issue: The NRC continues to regard the use of Jenks equation for brine migration inappropriate. There are a number of limitations (with which ONWI/SRP appear to agree).

    These include:

    (a) the equation is empirical rather than mechanistic

    (b) the equation was developed for intracrystalline migration, and was not intended to model intercrystalline migration

    (c) the equation is not properly dimensionally balanced

    (d) there are concerns that the Salt Block 2 data used to validate BRINEMIG is limited in applicability.

The NRC does not believe BRINEMIG has been validated and may be inappropriate for use in modeling brine migration as expected under repository conditions.

- The SRP is familiar with the limitations regarding BRINEMIG (the Jenk's equation). These understandings were stated at the meeting as was the fact that BRINEMIG is expected to be augmented based on data related to water sources other than that controlled by simplistic migration concepts. The use of BRINEMIG to date reflects our initial steps at developing models that reflect experimental observations. This model, and its variants, are expected to be significantly enhanced as discussed in the PAP. An ONWI document "Expected Brine Movement at Potential Nuclear Waste Repository Salt Sites" is in preparation and discusses the brine migration phenomenon and addresses the use of BRINEMIG.

20. Issue: It appears that brine migration test plans should include studies of combined effects. For example, experiments should include the effects of radiation, pressure, clay seams, and repository construction (e.g., fracturing) in addition to thermal effects.

- The SRP agrees that brine migration test plans should include studies of combined effects.

21. Issue: The issue of radionuclide source term characterization has begun to be addressed by complex engineering type experiments by McVay. Simpler experiments which isolate single variables need to be undertaken so that the complex experiments may be understood. For example, technetium/iron experiments are needed to determine why technetium is being removed from solution in the whole system type experiments. The reaction products in all experiments need to be characterized to the extent possible. The effects of varying oxygen levels on the radionuclide source term needs to be determined experimentally.

- The SRP agrees that complex experiments, once scoping overviews are obtained, need to be simplified through isolation of important single variables so that integration effects can be assessed. The source term characterizations being conducted at PNL were designed to serve as scoping/order-of-magnitude exercises to assess the general behavior of waste form dissolution. As specific areas are identified, these experiments are being narrowed in scope to assist in isolating fundamental behavior characteristics. Some of the issues cited, e.g., reaction product characterization are being addressed in the PNL solubility studies while others, e.g., oxygen level effects, are already in the future test plans.

22. Issue: It appears that an initial performance allocation for components of the waste package, in accordance with the September 26-27, 1985, agreement between NRC and DOE/HQ, has not been included

in the salt waste package program. Such a performance allocation should be incorporated into the SCP to provide a systematic way of giving the information needed to determine whether testing will adequately support licensing. It would be a tentative technical management decision and subject to revision as tests are run and refined.

- An initial performance allocation was discussed during the meeting when dependence on only the waste package container was stated as being the mechanism for assuring containment during the containment period, i.e., no credit was taken for spent fuel cladding, canister material nor packing materials.

  It was further stated that release would be partially controlled by the container-packing-corrosion product barriers but numerical estimates regarding release performance are still not available. The details of exactly how the concepts of performance allocation are to be used at greater levels of detail are currently being addressed by an advisory group created explicitly for that purpose. The recommendations made by this group will be implemented in the SCP to define what testing will be needed to support licensing.