UNITED STATES
NUCLEAR REGULATORY COMMISSION
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Dr. Prasad K. Nair, Manager
CNWRA EBS Program Element
CNWRA/ San Antonio Office
Southwest Research Institute
5220 Culebra Road
San Antonio, TX 78228-015

Dear Dr. Nair:

SUBJECT: COMMENTS ON EBS PROGRAM ELEMENT INTERMEDIATE MILESTONE DELIVERABLES

References:
1. EBS Program Element Intermediate Milestone No. 20-3702-013-305, "Preliminary Assessment of Pitting Corrosion Models," Letter report, dated September 2, 1992

2. EBS Program Element Intermediate Milestone No. 20-3702-013-246, "'SUBSTANTIALLY COMPLETE CONTAINMENT' (SCC) ELICITATION REPORT," CNWRA 92-016, August 1992.

3. EBS Program Element Intermediate Milestone No. 20-3702-013-005:
   Part 1 -- "Leaching of Borosilicate Glass Using Draft ASTM Procedure for High-Level Waste," CNWRA 92-018, August 1992.

   Part 2 -- "An Assessment of Borosilicate Glass as a High-Level Waste Form," CMWRA 02-017, September 1992.

4. EBS Program Element Intermediate Milestone No. 20-3702-013-315:
   Part 1 -- "MARIANA -- A Simple Chemical Equilibrium Module, Version 1," CNWRA 92-020, August 1992.
   Part 2 -- "TWITCH -- a Transient Diffusion, Electromigration, and Chemical Reaction in one Dimension," CNWRA 92-019, August 1992.

5. EBS Program Element Intermediate Milestone No. 20-3702-013-212, "Engineered Barrier Systems Performance Assessment Codes Development Plan, Status 2," October 1992

The purpose of this letter is to summarize various comments received in reviews of deliverables received on selected subjects in recent months. These supplement the comments that you have already seen in my November 12, 1992 acceptance letter to you on these referenced items. While none of these comments are meant to relate to the suitability or quality of the deliverables, they do give staff concerns and perspectives that should be considered in future work.

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SUBJECT: **Reference 1 --** "Preliminary Assessment of Pitting Corrosion Models," Letter report. See my acceptance letter transmitted on November 12, 1992.

SUBJECT: **Reference 2 --** "'SUBSTANTIALLY COMPLETE CONTAINMENT' (SCC) ELICITATION REPORT"

During our review of this report, a staff member suggested that, in your future work on releases from containers that are apparently intact or moderately failed, the following should be considered in calculations. When calculations of releases of radionuclides are made, the integrity of the containment vessel, which was the focus of the CNWRA Report No. 90-001, is not the only thing that should be taken into account. In order to completely discount a potential cause of releases, another important consideration is any potential release demonstrated to be negligibly small, and so small that the release would not reasonably have to be accounted for. Releases due to diffusion and high vapor pressure are cited below as areas of concern.

For unfailed containers, those that have not failed any containment criterion of the type contemplated in the technical considerations report, volatile and non-volatile constituents could be released through diffusion:

(1) Bulk diffusion for radionuclides would seem unlikely through a metal/ceramic container wall, unless aided by diffusion-induced grain-boundary migration, a phenomena not yet well studied for repository container materials.

(2) Surface diffusion along any system of cracks and pores that might become continuous from the outside to the inside of the container, with time.

These diffusive releases should be considered as significant or innocuous depending on how much radioactivity could potentially result from the release.

For volatile radionuclides, escape from some types of failures caused by corrosion, pitting, and structural damage, might not be negligible for radionuclides with larger vapor pressures.

The above are fine points that may not have been dealt with explicitly in the CNWRA Report No. 90-001 on technical considerations. Perhaps the place to deal with these points is in the Format and Content Regulatory Guide or in the Compliance Demonstration Methodology, or perhaps even in any follow-on effort to update the information given in the already published report on technical considerations.

SUBJECT: **Reference 3, Part 1 --** "Leaching of Borosilicate Glass Using Draft ASTM Procedure for High-Level Waste"

This report gives results of PCT tests conducted at CNWRA using the Draft ASTM Procedures. The following comments and requests were made by the reviewer:

(1) The reasons for the systematic decrease of elemental releases, when compared with the DOE round-robin data, should be explored. These apparent decreases may lead to conflicts in ranking glasses when a number of like glasses are tested in the future. Perhaps, tests of the same DOE samples or the use of auxiliary analytical tools other than ICP may be the first thing to be considered.

(2) It is not clear on what bases the criteria of the glass ranking (Table 5-1) are deduced. The trends for Li and Si are not the same as those for other elements (Figures 5-1 thru 5-6). Please provide the bases for our future DOE WAPS review.

(3) Please provide references for "15,000 packages" of glass HLW and for the "500 mg/L" criterion for the release of alkali elements.

SUBJECT: **Reference 3, Part 2 --** "An Assessment of Borosilicate Glass as a High-Level Waste Form."

This report reviews various characteristics of borosilicate glass as a HLW form. Certainly, it seems to be useful to have all information in one report. It would have been better if the following issues were considered also:

(1) In the previous evaluation of geochemical codes, several mineral phases have been identified to assess the equilibrium concentration. It will be very useful to include these mineral phases and to review quoted kinetic models with respect to these mineral phases. Among the minerals in question are chalcedony, analcime, saponite, and nontronite.

(2) It will be very useful for source term analyses to include (1) the behavior of fission products and actinides and (2) analogue inferences.

(3) More recent data on glass leaching exist for unsaturated environmental conditions and these should be considered in future work.

SUBJECT: **Reference 4, Part 1 --** "MARIANA -- A Simple Chemical Equilibrium Module, Version 1," Efforts for simplifying chemical equilibriums are given in this report. However, the reviewer recommends that the applicability of this work be stated more specifically, for the following reasons:

1. When containers (and waste forms) are reacted with groundwater, the reactions proceed largely through activation processes and this has not been considered in MARIANA, primarily because MARIANA deals with the equilibrium only.

2. It is recommended that the author state more explicitly what advantage this code has over conventional equilibrium approaches in which the mass balance and charge neutrality are used to calculate concentrations in solution. An example would be helpful to demonstrate the advantages of the Gibbs-free-energy approach used in MARIANA.

SUBJECT: **Reference 4, Part 2 --** "Twitch -- a Transient Diffusion, Electromigration, and Chemical Reaction in one Dimension,"

This code is written to determine crevice corrosion kinetics and it is a derivative of previous codes such as those developed by Watson or by Alkire. The author claims that it has corrected an error involved in previous codes. The author further claims to have a simplified numerical analyses procedure, but we suggest that you discuss with us the justification for these claims.

The choice of electroneutrality instead of Poisson's equation is a merit of this work for the simplification of calculational procedures. Actually, the report is not clear as to whether electroneutrality is used in Twitch or only in the Watson code from which it was derived. In any event, if it is used in Twitch, this choice would be more convincing if it were justified explicitly, for instance by giving a numerical example.

The correction of an error was made in the current density at the metal/solution interface through averaging of the current inside the crevice. This correction can raise arguments in the definition of the initiation of crevice corrosion. Normally, it is considered that the passive layer is preserved in the initiation stage of crevice corrosion of passive materials. Therefore, the use of passive current, by Watson, appears to be valid, because the current is nearly independent of potential and the solution current is related in series to the passive current is only one. Also, we suggest that you plan to have a discussion with us on this and related topics, e.g. the embodiment of a pitting mechanism to explain crevice corrosion, the use of a passive current in the initiation stage in narrow crevices, the use of Twitch in propagation stages for passive materials, and the applicability of Twitch to nonpassive materials. If possible, lets set aside some time for Watson and Ahn to meet, which also allows you and me to be present.

SUBJECT: **Reference 5 --** See my aforementioned acceptance letter.

If you have any questions regarding this matter, please contact me at 301-504-1552.

Sincerely,

/S/

Charles G. Interrante, Manager
EBS Program Element
High-Level Geology and Engineering Branch
Division of High Level Waste
Office of Nuclear Materials Safety and Safeguards

cc: M. Knapp, PMDA
S. Mearse, DCPM

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