HLWYM HEmails

From: Osvaldo Pensado
Sent: Wednesday, September 28, 2005 10:39 AM
To: Osvaldo Pensado; Aladar Csontos; Tae Ahn; Richard Codell
Cc: Yi-Ming Pan; 'dDunn@swri.org'; Lietai Yang; Pavan Shukla; Xihua He; 'Vijay Jain'
Subject: Revised notes + SRD text
Attachments: Corrosion.wpd

This is the proposed SRD text:

SRD TEXT

Input parameters will be incorporated into the TPA code to define a length fraction for failure by corrosion of the drip shield, waste package, and weld areas. These new parameters will add flexibility to barrier neutralization studies. For example, they will allow to "remove" the waste package and drip shield (setting the corresponding fractions for failure as 0), without changing the thermal profiles in the system. Technical basis for selecting a less than a 100% value for the failure fraction could be derived, for example, by examining the minimal thickness needed for the Alloy 22 container to be crushed at the support pallet due the waste package weight. After a revised mechanical interaction model (MECHFAIL) is implemented in the TPA code, staff will evaluate the relevance of failure fraction parameters, and propose base case values or ranges for the failure fractions, if such fractions are relevant to radionuclide release rate and dose estimates.

Find attached the revised notes to respond to the questions compiled by B. Leslie.

Hearing Identifier: HLW_YuccaMountain_Hold_EX
Email Number: 1668

Mail Envelope Properties (003101c5c43a$607254e0$d4c8a281)

Subject: Revised notes + SRD text
Sent Date: 9/28/2005 10:39:05 AM
Received Date: 9/28/2005 10:39:27 AM
From: Osvaldo Pensado

Created By: opensado@cnwra.swri.edu

Recipients:
"Yi-Ming Pan" <ypan@cnwra.swri.edu>
Tracking Status: None
"'dDunn@swri.org'" <dDunn@swri.org>
Tracking Status: None
"Lietai Yang" <ltyang@cnwra.swri.edu>
Tracking Status: None
"Pavan Shukla" <pshukla@cnwra.swri.edu>
Tracking Status: None
"Xihua He" <xhe@cnwra.swri.edu>
Tracking Status: None
"'Vijay Jain'" <vjain@cnwra.swri.edu>
Tracking Status: None
"Osvaldo Pensado" <opensado@cnwra.swri.edu>
Tracking Status: None
"Aladar Csontos" <Aladar.Csontos@nrc.gov>
Tracking Status: None
"Tae Ahn" <Tae.Ahn@nrc.gov>
Tracking Status: None
"Richard Codell" <Richard.Codell@nrc.gov>
Tracking Status: None

Post Office: DAKATH

Files	**Size**	**Date & Time**
MESSAGE	1105	9/28/2005 10:39:27 AM
Corrosion.wpd	19297	

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

SRD TEXT

Input parameters will be incorporated into the TPA code to define a length fraction for failure by corrosion of the drip shield, waste package, and weld areas. These new parameters will add flexibility to barrier neutralization studies. For example, they will allow to “remove” the waste package and drip shield (setting the corresponding fractions for failure as 0), without changing the thermal profiles in the system. Technical basis for selecting a less than a 100% value for the failure fraction could be derived, for example, by examining the minimal thickness needed for the Alloy 22 container to be crushed at the support pallet due the waste package weight. After a revised mechanical interaction model (MECHFAIL) is implemented in the TPA code, staff will evaluate the relevance of failure fraction parameters, and propose base case values or ranges for the failure fractions, if such fractions are relevant to radionuclide release rate and dose estimates.

B. Corrosion of Waste Package and Drip Shield and the Near Field Geochemical Environment

1. Identify those variables in the tpa.inp that should not be changed individually (e.g. the passive current density is linked to the corrosion potential).

A note will be added in tpa.inp about corrosion parameters that are correlated

2. Address whether the failure criterion for Alloy-22 accounts for a non-homogeneous roughness or requires the full thickness to be penetrated before it is considered to be failed.

316 SS will be used as inner container material. This material cannot fail due to corrosion unless the Alloy 22 outer container is penetrated. Disregarding the 316 SS container in the performance assessment model is conservative. The DOE does not assign any credit to 316 SS even when estimating radionuclide release rates from early failure mechanisms such as initial defects. The basis for not giving credit to the 316 SS inner container is its lower corrosion resistance compared to Alloy 22. In consistency with the DOE approach, no credit is assigned to the presence of the 316 SS inner container, once the outer Alloy 22 container is breached.

Input parameters will be incorporated into the TPA code to define a length fraction for failure by corrosion of the drip shield, waste package, and weld areas. These new parameters will add flexibility to barrier neutralization studies. For example, they will allow to "remove" the waste package and drip shield (setting the corresponding fractions for failure as 0), without changing the thermal profiles in the system. Technical basis for selecting a less than a 100% value for the failure fraction could be derived, for example, by examining the minimal thickness needed for the Alloy 22 container to be crushed at the support pallet due the waste package weight. After a revised mechanical interaction model (MECHFAIL) is implemented in the TPA code, staff will evaluate the relevance of failure fraction parameters, and propose base case values or ranges for the failure fractions, if such fractions are relevant to radionuclide release rate and dose estimates.

Mechanical interactions could cause earlier failure of a partially corroded waste package. The second stage of the milestone "Updated and Revised MECHFAIL Abstractions ..." will address mechanical performance of the waste package undergoing general corrosion.

3. Address whether physical separation of the drip shield will impact the percentage of waste packages affected by adverse fluid compositions.

The separation of drip shield sections is an unlikely scenario that does not affect the waste packages performance. DOE states in the Seismic Consequence Abstraction report that drip shield separation takes place for seismic events with a mean annual frequency of exceedance (MAFE) of 10^{-6} or lower, as long as the drift is intact. The center staff agrees with this viewpoint because if the drift has degraded, the rubble prevents the separation of the drip shield section. However, DOE indicates that for strong ground motions drift degradation occurs early, and the drip shield can be assumed to be surrounded by rubble during all the dynamic analyses. The staff understanding is that seismic events with a MAFE of 10^{-6} or lower will very likely occur when the rubble is already surrounding the drip shield. For both scenarios, the presence of rubble will prevent drip shield separation. For these reasons, the updated version of

the TPA will not consider this failure mode.

4. Address whether all the important uncertainties, including features, events and processes, have been captured in the current conceptualization.

FEPs that may not have been yet incorporated into the TPA code include the following.

High temperature boiling point solutions have been reported. Solutions with as high as 190 °C boiling point have been measured with salt mixtures that may be present in dust have been reported by the DOE. Such high temperature solutions may be detrimental from a general corrosion viewpoint. However, DOE has reported low general corrosion rates and, also, that nitrate is an effective localized corrosion inhibitor. We need to define an experimental program to measure high-temperature corrosion rates to corroborate the DOE conclusions. Additional analyses are needed before incorporating the presence of high-temperature boiling point solutions into the TPA code. In the meanwhile, we will study the DOE data.

Nitrate is not only a localized corrosion inhibitor, but also an oxidant. Thus, nitrate tends to polarize the corrosion potential towards higher values. This dependence may cause localized corrosion to be exhibited in higher frequency than currently estimated. It is unclear the mechanism by which nitrate could enhance the corrosion potential. Nitrate could be consumed by reduction reactions, limiting the nitrate oxidation capability. Additional analyses are needed before incorporating nitrate as an oxidant species into the TPA code. We will study DOE data to abstract a correlation between nitrate and the corrosion potential; however, such a correlation will not yet be incorporated into the TPA code.

Stifling and repassivation have been noted in all of the experiments of localized corrosion in Alloy 22 at CNWRA. The decrease in the localized corrosion propagation rate is referred to as stifling. Arrest of the localized corrosion front is referred to as repassivation. As a first approximation, stifling could be accounted for by revising the TPA parameters defining the localized corrosion rate. Disregarding stifling is conservative. Incorporation of stifling into the TPA code will be evaluated if radionuclide release rates associated to localized corrosion are significant to dose estimates.

5. Address whether strengthening the technical basis or revising parameters to account for range of general corrosion rates considering effect on localized corrosion and DOE's data is required.

We will study the DOE data as indicated in (4).

6. Address whether and how a technical basis for extrapolating data above 95 °C can be generated.

The current equation for the corrosion potential has a mechanistic basis and, therefore, it can be extrapolated to a limited extent. High temperature experiments are difficult because of lack of a reference electrode and it is difficult to prepare bulk solutions of a high boiling point. Nonetheless, we will explore an experimental program to corroborate high temperature extrapolations.

The critical potential for localized corrosion has been measured at temperatures up to

125 °C. In general, the proposed empirical correlation to compute the critical potential tends to underestimation at high temperatures. Therefore, extrapolation of the critical potential is conservative.

At high temperatures, the general corrosion rate may exceed extrapolated values from the activation energy and the Arrhenius relationship. An experimental program is needed to measure general corrosion rates in high temperature solutions.

A long term integral program is proposed to measure realistic corrosion rates of alloy 22 at temperatures above 100 °C contacted by seeping water, and allowing a natural evolution of brines by evaporation.