Scientific Analysis/Calculation Error Resolution Document

Complete only applicable items.

QA: QA

1. Document Number: ANL-DS0-NU-000001	2. Revision/Addendum: 00	3. ERD: 03
4. Title: Screening Analysis of Criticality Features, Events, and Processes for License Application		5. No. of Pages Attached: 3

6. Description of and Justification for Change (Identify affected pages, applicable CRs and TBVs):

Introduction:

This document is being written as an action to resolve the following CRs:

CR-12543: Salt separation error in localized corrosion initiation analysis

CR-12589: Error in probability of criticality calculations

CR-12857: Incorrect parameter in probability of criticality calculation

Background Information Summary:

CR-12543 identified an error affecting the localized corrosion initiation analysis that manifests itself in DTN: MO0709TSPALOCO.000 [DIRS 182944]. This DTN is used as an input to CAL-DN0-NU-000002 REV 00C which provides an output DTN (MO0712PANLNNWP.000) used as direct input to ANL-DS0-NU-000001. During an assessment of the extent of condition and the potential impacts to downstream products affected by CR-12543, an error was identified in CAL-DN0-NU-000002 REV 00C that resulted in initiation of CR-12589 and CR-12857. CAL-DN0-NU-000002 ERD 02 was developed as part of the action to resolve CRs 12543, 12589, and 12857. The corrections were made in the spreadsheet files and resulted in DTN: MO0712PANLNNWP.000 being superseded by DTN: MO0810PANLNNWP.001. This ERD implements the changes from the new direct input source. In addition, ANL-EBS-MD-000076 REV 00 ERD 03 was issued as an action to resolve CR-13156 which resulted in several changes to DTNs: MO0705EARLYEND.000 and MO0701PASHIELD.000, resulting in some minor numeric changes for the nominal (early failure) event scenario discussed in Section 6.3.2.

AMR Changes:

Please see attached.

Impact Evaluations/Results:

The following documents were evaluated for impact: : LA-SAR, ANL-EBS-MD-000076 Rev. 00 ACN 01, ANL-WIS-MD-000024 Rev. 01 ACN 01, ANL-WIS-MD-000026 Rev. 00, and ANL-WIS-MD-000027 Rev. 00 ACN 01.

See attached for impacts.

These changes in the ERD do not impact the conclusion of ANL-DS0-NU-000001 REV 00 nor the final quoted value for the probability of criticality for the DOE SNF and CSNF waste forms (3.7×10^{-5}) because the probabilities that are affected are too small (several orders of magnitude) to affect the final sum.

	Printed Name	Signature	Date
7. Checker	Charles S. Henkel	Charles S. Henkel	26 Feb 2009
8. QCS/QA Reviewer	Brian T. Mitcheltree		2/26/09
9. Originator	John M. Scaglione	John Scaglione	2/26/09
10. Responsible Manager	Paul R. Dixon	Jerry A McKinney for P.D.	2.26.09

AMR CHANGES

1) p. 3-1, last paragraph: DTN: MO0712PBANLNWP.000 [DIRS 184480] should be DTN: MO0810PANLNNWP.001 [DIRS 185842]

2) p. 4-2, Table 4.1-1 and the source information below it should be updated as follows:

Table 4.1-1. Undetected Errors in Waste Package Fabrication and Operational Processes

Waste Package Operations	Probability perCanister
Absorber material selection error [a]	1.25×10^{-7} per canister
Drying and inerting process failure	3.77×10^{-5} per canister
Outer closure lid weld stress mitigation process failure [a]	3.77×10^{-5} per canister
Emplacement error for drip shield [a]	2.19×10^{-9} per drip shield
Fraction of waste package OCB lid weld flaws oriented normally to surface [b]	8.0×10^{-3}
Probability of undetected fabrication defects in a waste package OCB [c]	1.13×10^{-4} per waste package
Probability of at least one flaw in waste package OCB lid closure weld [d]	1.56×10^{-1}

Sources: [a] DTN: MO0705EARLYEND.000 [DIRS 186104], file: *Table 6-8 and 6-12.doc*.
[b] DTN: MO0701PASHIELD.000 [DIRS 186103], file: *Tables for DTN Readme.doc*, Table 1.
[c] DTN: MO0701PASHIELD.000 [DIRS 186103], file: *SAPHIRE OUTPUT.zip*.
[d] DTN: MO0701PASHIELD.000 [DIRS 186103], file: *EarlyFail-WeldDefects.zip*, Section A.7.

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3) p. 4-12, last paragraph: DTN: MO0712PANLNNWP.000 [DIRS 184480] should be DTN: MO0810PANLNNWP.001 [DIRS 185842]; file *mo0712panlnnwp 000.zip* should now be *CSNF_CDSP.zip*

4) p. 4-13, 1st paragraph: DIRS 182994 should be DIRS 186103; "…(files: *CSNF_bin[x].txt* for x= 1, 2, 3, 4, and 5; *CDSP_bin[x].tx*t for x = 1, 2, 3, 4, and 5)" should be replaced with "…*A*_Fraction_*B*_bin[x].txt where *A* = Lith or NonLith, *B* = CDSP or CSNF, and x = 1, 2, 3, 4, and 5)"

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5) p. 6-13, 3rd paragraph should be modified as follows:

"The probabilities of events … is given in DTN: MO0705EARLYEND.000 [DIRS 186104], *Table 6-8 and 6-12 doc*, as 3.77×10^{-5}. The probability that a waste package OCB closure weld has a flaw that can propagate through the OCB was estimated previously as 1.25×10^{-3} per waste package. The mean probability of waste package OCB fabrication defects as 1.13×10^{-4} per waste package and the mean probability value for improper emplacement of a drip shield is given in Table 4.1-1 as 2.19×10^{-9} per drip shield…"

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6) pp. 6-15 and 6-16: all instances of 3.84×10^{-5} should be replaced with 3.77×10^{-5} and all instances of 4.36×10^{-9} should be replaced with 2.19×10^{-9}. These changes do not result in a change to any of the reported results except on p. 6-16, 4th paragraph where 4.6×10^{-5} should be changed to 2.4×10^{-5}. A typo was identified in this location for the value 10,557 which should be changed to 10,767 to match the total number of packages identified in Table 4.1-2.

7) p. 6-31, 1st paragraph: "These files, derived …DTN: MO0712PBANLNWP.000 ([DIRS 184480], file: *mo0712panlnnwp 000.zip*…" should be "These files derived… DTN: MO0810PANLNNWP.001 ([DIRS 185842], file: *CSNF_CDSP.zip*…"

8) p. 6-31, Table 6.4-7 and the paragraph below it should be replaced as follows:

Table 6.4-7 Probability of Criticality due to Seismic Vibratory Events Resulting in Drip Shield Rupture and Waste Package Failure from Localized Corrosion

Criticality Event Sequence	Probability of Waste Package OCB Failure – Lithophysal Zone	Probability of Waste Package OCB Failure – Nonlithophysal Zone	Total Probability
PWR TAD Loading Curve Violation	1.19×10^{-9}	6.02×10^{-9}	7.2×10^{-9}
PWR TAD Canister Absorber Misload	9.04×10^{-10}	4.56×10^{-9}	5.5×10^{-9}
BWR TAD Canister Absorber Misload	5.77×10^{-10}	2.91×10^{-9}	3.5×10^{-9}
DOE-owned SNF Canister Absorber Misload [a]	8.83×10^{-10}	1.51×10^{-9}	2.4×10^{-9}
DOE-Owned SNF Canister Absorber Misload [b]	6.36×10^{-11}	9.96×10^{-11}	1.6×10^{-10}

Output DTN: MO0705CRITPROB.000, file: *DSLC 01-29-08.zip*, folders 3D and 4D.

[a] Includes DOE-owned SNF waste form groups DOE1, DOE2, AND DOE7.
[b] Includes only DOE-owned SNF waste form group DOE2.

PWR = Pressurized Water Reactor, BWR = Boiling Water Reactor, OCB = outer corrosion barrier.

Thus, a conservative estimate for the probability of achieving a configuration with criticality potential in the repository resulting from a seismic vibratory induced drip shield rupture and subsequent localized crevice corrosion breaching of the waste package OCB for commercial SNF and DOE-owned SNF, including the DOE1, DOE2, and DOE7 contributions is 1.9×10^{-8} for 10,000 years. The estimate, including only the DOE2 contribution, is 1.6×10^{-8} for 10,000 years. These probability evaluations have been developed for the in-package degraded scenario, FEP 2.1.14.19.0A (Table 1.2-1). The events in the in-package intact configuration scenario, FEP 2.1.14.18.0A, are the same as those for the in-package degraded scenario and do not increase the probability of achieving a configuration with potential for criticality. The probability values for FEP 2.1.14.18.0A are thus insignificant.

9) Table 7.1-1 should be modified as follows (changed portion shown below, but rest remains the same):

Table 7.1-1. Estimated Probability of Criticality Configurations in the Repository over 10,000 Years

Waste Package Variant	In-Package Intact	In-Package Degraded	Near-Field	Far-Field
	Probability Estimate for FEPs Associated with Nominal (Early Failure) Event Sequence Initiators (Section 6.3.2)			
PWR TAD canister	Insignificant	1.5×10^{-7}	Insignificant	Insignificant
44-BWR TAD canister	Insignificant	4.1×10^{-8}	Insignificant	Insignificant
DOE-owned SNF canister [a]	Insignificant	1.7×10^{-8}	Insignificant	Insignificant
DOE-owned SNF canister [b]	Insignificant	1.3×10^{-9}	Insignificant	Insignificant

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SubTotal	NA	2.1×10^{-7}	NA	NA
	Probability Estimate for FEPs Associated with Seismic Event Sequence Initiator - Vibratory Impact at 90% RST (Section 6.4.2.1)			
PWR TAD canister	Insignificant	3.4×10^{-7}	Insignificant	Insignificant
44-BWR TAD canister	Insignificant	9.5×10^{-8}	Insignificant	Insignificant
DOE-owned SNF canister [a]	Insignificant	3.7×10^{-5}	Insignificant	Insignificant
DOE-owned SNF canister [b]	Insignificant	2.7×10^{-6}	Insignificant	Insignificant
SubTotal	NA	3.7×10^{-5}	NA	NA
	Probability Estimate for FEPs Associated with Seismic Event Sequence Initiator - Vibratory Drip Shield Rupture (Section 6.4.2.2)			
PWR TAD canister	Insignificant	1.3×10^{-8}	Insignificant	Insignificant
44-BWR TAD canister	Insignificant	3.5×10^{-9}	Insignificant	Insignificant
DOE-owned SNF canister [a]	Insignificant	2.4×10^{-9}	Insignificant	Insignificant
DOE-owned SNF canister [b]	Insignificant	1.6×10^{-10}	Insignificant	Insignificant
SubTotal	NA	1.9×10^{-8}	NA	NA

10) The following changes should be made in Section 8.3 and all instances of the DIRS numbers throughout the document should be replaced with the new ones:

185808 MO0709TSPALOCO.000. TSPA Localized Corrosion Analysis. Submittal date: 10/20/2008.

185842 MO0810PANLNNWP.001. Probabilistic Analyses of Drip Shield Failure and CSNF and CDSP Package OCB Localized Corrosion. Submittal date: 10/21/2008.

186104 MO0705EARLYEND.000. Waste Package/Drip Shield Early Failure End State Probabilities. Submittal date: 02/05/2009.

186103 MO0701PASHIELD.000. Waste Package/Drip Shield Early Failure Probabilities. Submittal date: 02/05/2009.

11) Appendix I: the values of 3.84×10^{-5} listed on pages I-3 and I-6 should be changed to 3.77×10^{-5}.

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IMPACT EVALUATION RESULTS

The following impacts were observed:

1) ANL-WIS-MD-000027 REV 00 – Table 2.1.14.19.0A-4 will need to be updated, but the conclusions will remain the same.

No other documents have been identified as impacted by any change from this ERD.