



**Scientific Analysis/Calculation
Error Resolution Document**

QA: QA
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Complete only applicable items.

INITIATION

1. Originator: John M. Scaglione	2. Date: 4-18-2008	3. ERD No. 2 ANL-DS0-NU-000001 ERD 2
4. Document Identifier: ANL-DS0-NU-000001 REV 00	5. Document Title: Screening Analysis of Criticality Features, Events, and Processes for License Application	

4/23/08

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

Introduction:
This document is being written to resolve CR-11887: Two minor errors in Criticality FEP Screening AMR

Background Information Summary:
Two issues are identified in CR 11887. The first being from confusion caused by the way Table 6.4-6 is titled, and 2) for how different frequency earthquakes, which result in different numbers of potentially impacted waste packages are combined to provide a single probability value for potential criticality from any seismic faulting event.

AMR Changes:
Please see attached. Affected areas are as follows: Table 6.4-6 title, Equations listed on pages 6-35 and 6-36, and 2nd paragraph on page 6-36. Since changes are being made to the title for Table 6.4-6 then Table 6.4-5 which is for TAD packages is being changed also to maintain consistency. Values summarized in Table 7.1-1.

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

CONCURRENCE

	Printed Name	Signature	Date
7. Checker	Cliff Hansen	<i>Cliff Hansen</i>	4/23/08
8. QCS/QA Reviewer	Brian Mitcheltree	<i>Brian Mitcheltree</i>	4/23/08

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AMR Changes:

- 1) The title of Table 6.4-6 should be changed to the following: *Probability of Seismic Vibratory Ground Motion Events with Potential to Cause Damage to Codisposal Waste Packages*
- 2) The title of Table 6.4-5 should be changed to the following to maintain consistency in terminology with the change that was made to Table 6.4-6: *Probability of Seismic Vibratory Ground Motion Events with Potential to Cause Damage to TAD Waste Packages*
- 3) The equivalent section on pages 6-35 and 6-36 should be replaced with the following:

PWR TAD canister loading curve violation:

$$1.2 \times 10^{-4} \times (1 - P_B(0; 1.65 \times 10^{-7}, (19.4 \times 4568/7483))) + 4.3 \times 10^{-4} \times (1 - P_B(0; 1.65 \times 10^{-7}, (27.6 \times 4568/7483))) + 1.7 \times 10^{-4} \times (1 - P_B(0; 1.65 \times 10^{-7}, (32.1 \times 4568/7483))) = 1.9 \times 10^{-9}$$

PWR TAD canister absorber misload

$$1.2 \times 10^{-4} \times (1 - P_B(0; 1.25 \times 10^{-7}, (19.4 \times 4568/7483))) + 4.3 \times 10^{-4} \times (1 - P_B(0; 1.25 \times 10^{-7}, (27.6 \times 4568/7483))) + 1.7 \times 10^{-4} \times (1 - P_B(0; 1.25 \times 10^{-7}, (32.1 \times 4568/7483))) = 1.4 \times 10^{-9}$$

44-BWR TAD canister absorber misload

$$1.2 \times 10^{-4} \times (1 - P_B(0; 1.25 \times 10^{-7}, (19.4 \times 2915/7483))) + 4.3 \times 10^{-4} \times (1 - P_B(0; 1.25 \times 10^{-7}, (27.6 \times 2915/7483))) + 1.7 \times 10^{-4} \times (1 - P_B(0; 1.25 \times 10^{-7}, (32.1 \times 2915/7483))) = 9.0 \times 10^{-10}$$

DOE-owned SNF canister absorber misload (DOE1, DOE2, and DOE7)

$$1.0 \times 10^{-4} \times (1 - P_B(0; 1.25 \times 10^{-7}, (2.6+3.5) \times 1223/3074)) + 6.9 \times 10^{-4} \times (1 - P_B(0; 1.25 \times 10^{-7}, (3.7 + 4.9) \times 1223/3074)) + 2.8 \times 10^{-4} \times (1 - P_B(0; 1.25 \times 10^{-7}, (4.3 + 5.7) \times 1223/3074)) + 3.0 \times 10^{-5} \times (1 - P_B(0; 1.25 \times 10^{-7}, (21.6 + 28.5) \times 1223/3074)) = 4.6 \times 10^{-10}$$

Evaluating the event sequences for DOE-owned SNF with the additional absorber loading constraint from Section 4.1.15 that the DOE1 (MOX) and DOE7 waste form (aluminum-based DOE-owned SNF) include neutron absorber shot as well as plate type absorbers results in an estimated DOE-owned SNF canister absorber misload probability given by:

DOE-owned SNF canister absorber misload (89 DOE2 canisters, Table 4.1-2)

$$1.0 \times 10^{-4} \times (1 - P_B(0; 1.25 \times 10^{-7}, (2.6+3.5) \times 89/3074)) + 6.9 \times 10^{-4} \times (1 - P_B(0; 1.25 \times 10^{-7}, (3.7 + 4.9) \times 89/3074)) + 2.8 \times 10^{-4} \times (1 - P_B(0; 1.25 \times 10^{-7}, (4.3 + 5.7) \times 89/3074)) + 3.0 \times 10^{-5} \times (1 - P_B(0; 1.25 \times 10^{-7}, (21.6 + 28.5) \times 89/3074)) = 3.8 \times 10^{-12}$$

- 4) The second paragraph on page 6-36 should be changed as follows: Thus, a conservative estimate for the probability of achieving a configuration with criticality potential in the repository resulting from a seismic faulting initiating event for commercial SNF and DOE-owned SNF, including the DOE1, DOE2, and DOE7 contributions is 4.7×10^{-9} for 10,000 years. The estimate, including only the DOE2 contribution, is 4.2×10^{-9} for 10,000 years.

5) Table 7.1-1 should be changed as follows (changed values are highlighted in yellow):

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
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	1.0×10^{-9}	Insignificant	Insignificant
44-BWR TAD canister	Insignificant	2.8×10^{-10}	Insignificant	Insignificant
DOE-owned SNF canister ^a	Insignificant	2.8×10^{-10}	Insignificant	Insignificant
DOE-owned SNF canister ^b	Insignificant	2.0×10^{-11}	Insignificant	Insignificant
SubTotal	NA	1.6×10^{-9}	NA	NA
Probability Estimate for FEPs Associated with Seismic Event Sequence Initiator - Single Block Rockfall (Section 6.4.2.3)				
PWR TAD canister	Insignificant	Insignificant	Insignificant	Insignificant
44-BWR TAD canister	Insignificant	Insignificant	Insignificant	Insignificant
DOE-owned SNF canister ^a	Insignificant	Insignificant	Insignificant	Insignificant
DOE-owned SNF canister ^b	Insignificant	Insignificant	Insignificant	Insignificant
SubTotal	NA	NA	NA	NA

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

Waste Package Variant	In-Package Intact	In-Package Degraded	Near-Field	Far-Field
	Probability Estimate for FEPs Associated with Seismic Event Sequence Initiator - Faulting (Section 6.4.3)			
PWR TAD canister	Insignificant	3.3×10^{-9}	Insignificant	Insignificant
44-BWR TAD canister	Insignificant	9.0×10^{-10}	Insignificant	Insignificant
DOE-owned SNF canister ^a	Insignificant	4.6×10^{-10}	Insignificant	Insignificant
DOE-owned SNF canister ^b	Insignificant	3.8×10^{-12}	Insignificant	Insignificant
SubTotal	NA	4.7×10^{-9}	NA	NA
Probability Estimate for FEPs Associated with Rockfall Event Sequence Initiator (Section 6.5)				
All Waste Package Variants	Insignificant	Insignificant	Insignificant	Insignificant
Probability Estimate for FEPs Associated with Igneous Event Sequence Initiator (Section 6.6.2)				
PWR TAD canister	Insignificant	Insignificant	Insignificant	Insignificant
44-BWR TAD canister	Insignificant	Insignificant	Insignificant	Insignificant
DOE-owned SNF canister	Insignificant	insignificant	Insignificant	Insignificant
Total ^a	Insignificant	3.7×10^{-5}	Insignificant	Insignificant
Total ^b	Insignificant	3.3×10^{-6}	Insignificant	Insignificant
Total ^c	Insignificant	6.4×10^{-7}	Insignificant	Insignificant

^a DOE-owned SNF waste forms DOE1, DOE2, and DOE7 without distributed neutron absorber in shot form.

^b DOE-owned SNF waste form DOE2 without distributed neutron absorber in shot form.

^c Distributed neutron absorber in all DOE-owned SNF with criticality potential.

Source: Output DTN: MO0705CRITPROB.000, file: "Prob Calc."

NA = not applicable.

Impact Evaluation Results:

The following impacts were observed:

1) LA-SAR — Table title in Section 2.2 is identical to Table 6.4-6 which is being changed with this ERD and quotes Table 6.4-6 of ANL-DS0-NU-000001 REV 00 as the source. LS-PRO-003 will be initiated.

2) ANL-WIS-MD-000027 Rev. 00 — Equations on page 6-828 are identical to the ones on page 6-35 which are being modified in this ERD. In addition, although ANL-DS0-NU-000001 REV 00 is not the source for Table 2.1.14.19.0A-2, it was identified that the title is identical to Table 6.4-6 which is being changed with this ERD and Table 2.1.14.19.0A-1 title is identical to Table 6.4-5 which is being changed with this ERD. The action to initiate an ERD for this report is planned in CR-11887 as action 11887-002.

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