

## LSNReviews

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**From:** Oleg Povetko  
**Sent:** Friday, October 31, 2008 3:54 PM  
**To:** Whaley, Sheena; Sippel, Timothy; 'Razvan Nes'  
**Cc:** Tripp, Christopher; Fisher, Christian  
**Subject:** seismic damage probabilities  
**Attachments:** RE: Seismic/structural probability values; RE: Seismic/structural probability values

**Follow Up Flag:** Follow up  
**Flag Status:** Completed

All:

Based on the responses from ENG2 (Mechanical disruption of engineered barriers) and seismic teams (attached) we resolved most of our seismic questions. The only one remaining question for SAR Section 2.2.1.4.1.3.2.2 is: "Are the probability values of TAD and CDSP WP damage ( 0.118 and Table 2.1.14.19.0A-3 of the FEPs document, SNL, March 2008) have adequate technical basis and is the linear averaging between bin values is acceptable for probability of damage calculations?" These probabilities are under review by ENG2 team. The results will be documented in SER Section 2.2.1.3.2 MDEB-ENG2. These probability values directly affect probability of criticality. Therefore, we need to wait for the results of ENG2 review of these probabilities. We may finalize results of our review only after we receive their input. The only problem is that our SER Section is due on 01/06/09 and ENG2 Section is due on 01/30/09. I notified ENG2 on that and, hopefully, we'll receive their input before our due date. We may prepare draft RAI and combine it with the relevant ENG2 RAI if they send any before 01/30/09. If we don't receive their input by our due date we will issue our own RAI. Let me know on the best path forward regarding seismic damage probabilities and also if you have any unresolved seismic and structural questions.

Oleg.

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**From:** Luis Ibarra  
**Sent:** Friday, October 31, 2008 9:21 AM  
**To:** Oleg Povetko  
**Subject:** RE: Seismic/structural probability values

Oleg,

The review of the WP evaluation up to the computation of failure probability is in 2.2.1.3.2 MDEB-ENG2. PA staff review the implementation of the corresponding abstractions into the TSPA, but I don't know the number section.

Luis

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**From:** Oleg Povetko [mailto:opovetko@cnwra.swri.edu]  
**Sent:** Thursday, October 30, 2008 5:40 PM  
**To:** 'Luis Ibarra'  
**Subject:** RE: Seismic/structural probability values

Luis,

Thank you. Can you guess now in what SER section the WP damage probability evaluations will be discussed?

Oleg.

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**From:** Luis Ibarra [mailto:libarra@cnwra.swri.edu]  
**Sent:** Thursday, October 30, 2008 4:36 PM  
**To:** 'Tianqing Cao'; 'Oleg Povetko'; amitava.ghosh@swri.org  
**Cc:** 'Razvan Nes'; 'Roman Kazban'  
**Subject:** RE: Seismic/structural probability values

Oleg,

1. Is there an adequate technical basis for calculated probabilities in Tables 2.1.14.19.0A-1 and 2.1.14.19.0A-2?

Are these probabilities used appropriately in calculations on pages 6-822---6-823?

2. The damage probabilities on pages 6-822---6-823 are averaged between neighbouring row bin PGV values in Tables 2.1.14.19.0A-1 and 2.1.14.19.0A-2. Is this averaging (vs using point values) acceptable?

The probability values for 10,000 years appear to be right. For the second row of Table Table 2.1.14.19.0A-1, for instance, the annual probability of having a value between 2.44 and 4.07 m/s is  $4.52 \times 10^{-7} - 1.0 \times 10^{-8} = 4.42 \times 10^{-7}$ . And the probability in 10,000 years is  $(4.42 \times 10^{-7}) \times (1 \times 10^4) = 4.42 \times 10^{-3}$ .

The first row is not applicable because there is no damage for PGV levels below 2.44 m/s, according to DOE. Note that for  $\lambda_2$ , the probability is 1.0, but it does not matter in DOE's discussion.

Table 2.1.14.19.0A-1. Probability of Seismic Vibratory Ground Motion Events Causing Damage to TAD Canister-Bearing Waste Packages

PGV Value (m/s)	$\lambda_1$ (events/year)	$\lambda_2$ (events/year)	$t_1$ (years)	$t_2$ (years)	Probability
< 2.44	$4.52 \times 10^{-7}$	NA	NA	NA	NA
2.44 - 4.07	$1.0 \times 10^{-8}$	$4.52 \times 10^{-7}$	10,000	0	$4.41 \times 10^{-3}$

Source: DTN: MO0705CRITPROB.000 [DIRS 184958], file: *Fault Displacement Abstraction for Criticality Updated DTN 10-25-07.xls*, worksheet: "Tables by WP Type," rows 253 to 258.

3. Does the probability of TAD WP damage 0.118 invoked on page 6-822 of the FEPs document have adequate technical basis?
4. Do the probabilities of CDSP WP damage listed in the FEPs document Table 2.1.14.19.0A-3 for 90% RST have adequate technical basis?

The ultimate objective of ENG2 review is to evaluate whether the probabilities of failure for the WP have adequate technical basis. Then, we cannot comment on that until our evaluation of SAR and RAIs is complete.

The SAR tables addressing these issues are 2.3.4-29 and 2.3.4-30, and the SAR section is 2.3.4.5.2.1.4.2.

A linear intrapotation may be inadequate for highly nonlinear results such as those of the codisposal WPs. For the TAD WP, however, DOE intrapotation appears to be conservative, even though the results are also nonlinear. For this WP, DOE indicates that no damage is detected at 2.44 m/s and that damage at 4.07 m/s is 0.118. If more analyses were performed, DOE very likely find that the damage threshold is for a PGV higher than 2.44 m/s. Thus, finding the probability of failure using a lower bound value (2.44 m/s) increases the computed probability.

Have a good day.

Luis

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**From:** Tianqing Cao [mailto:Tianqing.Cao@nrc.gov]  
**Sent:** Thursday, October 30, 2008 7:01 AM  
**To:** Oleg Povetko; amitava.ghosh@swri.org  
**Cc:** 'Razvan Nes'; Timothy Sippel; Sheena Whaley; Jack Guttman; Luis Ibarra  
**Subject:** RE: Seismic/structural probability values

Hi Oleg,  
I can show you how DOE did the calculation and explain what is the meaning of the probability in the last column of those tables. But let us talk over the phone.  
Tianqing

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**From:** Oleg Povetko [mailto:opovetko@cnwra.swri.edu]

**Sent:** Tuesday, October 28, 2008 4:44 PM

**To:** amitava.ghosh@swri.org

**Cc:** 'Razvan Nes'; Timothy Sippel; Sheena Whaley; Jack Guttmann; Luis Ibarra; Tianqing Cao

**Subject:** Seismic/structural probability values

Amit,

You are listed as the ENG2 coordinator for Scenario Analysis Team.

Please coordinate the following request to ENG2. This input is needed for the criticality portion of the Scenario Analysis in the draft SER. We need confirmation from the Center seismic/structural expert on two probability values involving TAD and CDSP waste packages: the probability of seismic event and on the probability of seismic damage given such an event occurred. Their values directly impact compliance with the Part 63 regulatory limit. We need this input as no more than one-two sentences for each item. Please have the reviewers included the corresponding SER sections where the review of these values might be presented or where approximately in SER they will be discussed, so we can include these SER references to our write-up.

1. In SAR 2.2.1.4.1.3.2.2 and FEPs document (N:\Oleg Povetko\Criticality\Misloads\FEPs for TSPA Analyses-DEN001584824.pdf\FEPs for TSPA Analyses-DEN001584824.pdf) in Tables 2.1.14.19.0A-1 and 2.1.14.19.0A-2 DOE presents probability values in last columns but does not explain the meaning of these probabilities and how these probabilities were calculated. What is needed in this column is frequencies of the events for the corresponding PGV row bin velocities occurring over 10,000 years. On pages 6-822---6-823 DOE presented calculations using these probabilities and damage probabilities averaged between PGV bins. If the bin frequencies are calculated as differences between bin frequencies multiplied by 10,000 years and point PGV values are used, the probability of criticality would approach the regulatory limit.

Is there an adequate technical basis for calculated probabilities in Tables 2.1.14.19.0A-1 and 2.1.14.19.0A-2?

Are these probabilities used appropriately in calculations on pages 6-822---6-823?

and (ii) averaging between PGV values instead of using point values in calculations on pages 6-822---6-823?

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(The Section 6.5.1.3 states that "It is not possible to extrapolate the conditional damage at this single point to the range of values for the TSPA. In this particular case, the single point results are an upper bound for all values of PGV less than 4.07 m/s...", but nevertheless the extrapolation (that looks like interpolation) from the single point is made on page 6-822).

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SAR used information from the FEPs document but downsized and compacted it, so the FEPs document (N:\Oleg Povetko\Criticality\Misloads\FEPs for TSPA Analyses-DEN001584824.pdf\FEPs for TSPA Analyses-DEN001584824.pdf), Screening Analysis (February 2008)(N:\Oleg Povetko\Criticality\Misloads\ScreeningAnalysisOfCriticalityFEPs\_Mar2008.pdf) or Seismic Abstraction are the better sources.

Please let me know of any problems with the request, so we can elevate it to the next level if necessary.

Thanks.  
Oleg.

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**From:** Cao, Tianqing  
**Sent:** Friday, October 31, 2008 7:53 AM  
**To:** Luis Ibarra; Oleg Povetko; amitava.ghosh@swri.org  
**Cc:** 'Razvan Nes'; Roman Kazban  
**Subject:** RE: Seismic/structural probability values

Hi All,

It is not convenient to give my opinions through email. We can discuss in other format. Yesterday Oleg emailed me and told me he has figured out how DOE calculated the damage probability in the last column of those tables so I did not tell him what I think how DOE did the calculation. DOE did not simply average between neighboring rows. If you do that you will find you don't get their numbers. What DOE did is as follows:

damage probability(last column)=  $1 - \exp(-10000(\lambda_2 - \lambda_1))$

It is truly the damage probability for PGV in a range, for example, 2.44 and 4.07. ( $\lambda_2 - \lambda_1$ ) is the occurrence rate of PGV between 2.44 and 4.07. The above formula is to calculate the 10000-year probability of a Poisson process with annual occurrence rate of ( $\lambda_2 - \lambda_1$ ). You will find that using the above formula you will get DOE's every damage probability in the last column exactly.

In your (Luis) calculation for range 2.44 to 4.07, you seem to get their number just differ by little (4.42 instead of 4.41). It is not because you did right. It is because when the occurrence rate is very small the probability is almost the same as the rate. If you do Taylor expansion to the above formula you can confirm this.

But DOE did average the damage rates in the last step of calculations. It in the last line of page 6-822 of the report ANL-WIS-MD-000027, such as 0.0+0.03, 0.03+0.56, 0.56+0.94, and 0.94+1.0.

Good luck.

Tianqing

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**From:** Luis Ibarra [mailto:libarra@cnwra.swri.edu]  
**Sent:** Thursday, October 30, 2008 5:36 PM  
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