



# Model Error Resolution Document

Complete only applicable items.

QA: QA  
Page 1 of 20

## INITIATION

1. Originator: Jerry McNeish	2. Date: June 24, 2008	3. ERD No. MDL-WIS-PA-000005 ERD 04
4. Document Identifier: MDL-WIS-PA-000005 REV 00 and AD 01	5. Document Title: Total System Performance Assessment Model/Analysis for the License Application	

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

This Error Resolution Document (ERD) is provided to update the *Total System Performance Assessment for the License Application* (TSPA-LA) Rev 00 document and addendum (AD 01) to correct issues identified in the following condition reports (CRs). The minor corrections identified are necessary to add clarity and strengthen the discussion within both Rev 00 and Addendum (AD01) of the TSPA-LA document. There is no impact on results or conclusions due to these clarifications.

An impact analysis was performed for TSPA-LA Rev00 [DIRS 178871] and the addendum [DIRS 183478]. A total of 17 documents were found, however, only four were listed as direct inputs. The sections referenced in the four documents (ANL-DSO-NU-000001 Rev 00, ANL-WIS-MD-000024 Rev 01, ANL-WIS-MD-000027 Rev 00, and ANL-WIS-MD-000027 Rev 00, ACN 01) are not affected by any of the changes from this ERD.

#### CR 12142—UZ Model Layer Assigned to Wrong Major Unit

An error in the unit classification (TSw) of the unsaturated zone was incorporated in the simplified TSPA model described in Appendix L. The error does not have a significant impact on the results of the simplified model which is only used for corroboration with the TSPA-LA Model. Thus, no correction of text, tables or figures is necessary in the TSPA-LA Rev00 document and addendum (AD 01), and therefore no impact on the SAR from changes in the TSPA-LA for this CR.

In Appendix L of the TSPA-LA Rev 00 document, related typographical errors were found in the source reference (DIRS 169855) listed for Table L-32 on page L-76, for Table L-33 on page L-78, and in Section L2.16.1 on page L-47 (last paragraph). For each occurrence, the reference cited Attachment II, Table II-1 when the appropriate citation should have been to Appendix B, Table B-1. The source reference should appear as BSC 2004 [DIRS 169855], Appendix B, Table B-1.

There is no impact associated with this typographical correction outside of the TSPA-LA document, but will require a change to the TSPA-LA Volume II DIRS report.

#### CR 12055—TSPA-LA Model Validation Clarification

Surveillance OQA-S1-08-048 made a recommendation that clarification could be provided in Section 7 of the TSPA-LA Model/Analysis Report in the categorization of validation methods applied during development and those applied post-development. Clarification of this material is provided in Attachment 1 by providing additional mapping of the activities to during/post-development validation as well as specific edits within the document.

There is no impact associated with this correction outside of the TSPA-LA document, with the exception of SAR Section 2.4, which will need to be evaluated for potential changes as a result of these clarifications. The SAR Section 2.4 changes, however, would be for clarification only, results or conclusions would not be impacted and does not affect the overall validity and confidence of the TSPA-LA Model.

## CONCURRENCE

	Printed Name	Signature	Date
7. Checker	David Mohr	<i>David E. Mohr</i>	7/23/08
8. QCS/QA Reviewer	Robert Spencer	<i>Robert Spencer</i>	7/23/08

## APPROVAL

9. Originator	Jerry McNeish	<i>Jerry McNeish</i>	7/23/08
10. Responsible Manager	Paul Dixon	<i>Paul Dixon</i>	7-23-08



# Model Error Resolution Document

Complete only applicable items.

QA: QA  
Page 2 of 20

## INITIATION

1. Originator: Jerry McNeish	2. Date: May 16, 2008	3. ERD No. MDL-WIS-PA-000005 ERD 04
4. Document Identifier: MDL-WIS-PA-000005 REV 00; and AD 01	5. Document Title: Total System Performance Assessment Model/Analysis for the License Application	
6. Description of and Justification for Change (continued):		

### CR 12165—Typo in Parameter Name

A typographical error was found in a parameter name listed in Table K9-1[a] on page K-35[a] of the TSPA-LA Addendum. The parameter name appears in the 4th row, 3rd column and is identified as *SEEPRM*. The parameter should appear as *SEEPPRM*. It appears correctly elsewhere in the TSPA-LA document and addendum. There are no impacts on results or conclusions of the TSPA-LA or SAR.

### CR 12304—TSPA AMR Plot Corrections

TSPA Plot DTN MO0710PLOTSFIG.000 does not contain all support information for the figures (plots) in Section 8.3[a] of the TSPA-LA addendum (AD01). Some information in the DTN was also not organized correctly. Output DTN MO0806TSPADCOR.000 contains the missing support information and has the correct organization for these plots. The figures and discussion that appear in the text are correct, and therefore, there is no impact on the results or conclusions of the TSPA-LA or SAR.

In Appendix J of the TSPA-LA document (Rev00), it has been discovered that several of the plots/figures are not displaying all the data that was available in the SigmaPlot file. The discussion and captions regarding the figures are correct, however, the plots themselves are only showing approximately 160 realizations when they should be displaying 300 realizations. Attachment 2 provides the replacement plots (part (a) on each figure) with all 300 realizations, and the SigmaPlot files are in output DTN: MO0806TSPADCOR.000. Only the figures themselves are affected by this change, therefore, there is no impact on the results or conclusions of the TSPA-LA or SAR.

### CR 12264—Duplicate Figure

In Appendix J of the TSPA-LA document, a duplicate figure was discovered in Figure J7.2-9 on page FJ-63. The plot illustrated in (b) is the same plot shown in (a). The figure and results are described correctly in the caption and text. However, plot (a) shows 300 realizations, while plot (b) was supposed to show only 50 realizations as indicated in the caption. The entire figure should be replaced with the corresponding one in Attachment 2. There is no impact on results or conclusions of the TSPA-LA or SAR.

### CR 12279—Additional DTN for TSPA-LA AMR

Within TSPA output DTN MO0710ADTSPAWO.000 there is an input file set called "Input\_File\_Set\_064.zip". This file set inadvertently does not include the latest version of a file named "MFCP\_LA\_input.txt" and also does not include two new files called "UZ\_Pa\_LA\_1000rlz\_rs1\_112007.txt" and "UZ\_Pa\_LA\_300rlz\_rs1\_112007.txt". Therefore, a new output DTN was created (MO0806TSPADCOR.000), which contains the corrected file set (Input\_File\_Set\_064\_corrected.zip). The TSPA-LA Model runs are not affected as the model did use the correct files which were downloaded from the TSPA Input Database. Therefore, the only correction needed is to reference the DTN in Appendix B[a] of the TSPA-LA Addendum. There is no impact to results or conclusions of the TSPA-LA or SAR.

In addition, during the extent of condition review it was noted other TSPA-LA output DTNs have been created in ERD02 and ERD03 that also need to be identified in Appendix B[a] of the TSPA-LA Addendum.

Add the following note to Figure B-3[a] on page B-5[a] of the TSPA-LA Addendum (above caption):

Note: In order to resolve condition reports, additional output DTNs were created after the TSPA-LA Addendum was completed to supplement or amend the DTNS shown above. These DTNS consist of the following: MO0803ADTSPASA.000 [DIRS 185302]; MO0803TSPAPSAR.000 [DIRS 185276]; MO0805TSPACPLT.000 [DIRS 185506]; and MO0806TSPADCOR.000 [DIRS 185575].

## ATTACHMENT 1—VALIDATION METHODS (CR 12055)

Surveillance OQA-S1-08-048 made a recommendation that clarification could be provided in Section 7 of the TSPA-LA Model/Analysis Report in the categorization of validation methods applied during development and those applied post-development. The following information provides that clarification with additional text, as well as specific edits to existing text.

### Executive Summary:

On page ES-30 in the first full sentence, replace the text “post-development” with “additional”.

On page ES-33, in the second sentence of the last paragraph, **delete** “post-development”.

On page ES-34, in the second sentence of the second paragraph of Section ES8.6, replace “Certain post-development” with “Other”.

On page ES-34, in the last sentence of the second paragraph of Section ES8.6, **delete** “post-development”.

On page ES-35, in the third sentence of Section ES8.7, **add** “(Independent Mathematical Model)” after “Simplified TSPA Analysis”.

On page ES-35, in the second subheading of Section ES8.7, **add** “(Independent Mathematical Model)” after the heading.

On page ES-36, in the subheading of Section ES8.7, **add** “(Independent Mathematical Model)”.

### Section 1:

On page 1-49 in the second full paragraph, **add** the following bullet:

- Section 7 model validation activities are categorized according to during-development, post-development, and additional confidence building activities, which deviates from what is described in the TWP.

On page 1-52 in the first full paragraph, **add** the following bullets:

- Evaluation of uncertainty commensurate with the intended use of the model.
- Corroboration of results with auxiliary analyses.
- Corroboration of results with independent mathematical models.

### Section 7:

Note: In order to clarify the validation activities, a new table has been added. The table number (7.1-2) and caption should be added to the Volume II Table of Contents.

On page 7-1, replace the last paragraph with the following text:

The verification activities were carried out during development of the TSPA-LA Model, where development follows the generalized approach shown on Figure 7.1-1. Note there were during development, post-development, and additional confidence building activities conducted to validate the TSPA-LA Model. The verification activities and the activities conducted for validation of the TSPA-LA Model after its development are shown on Figure 7.1-2. A summary of the analyses conducted for validation of the TSPA-LA Model is presented in Table 7.1-1. In addition, Table 7.1-2 provides further clarification of the categorization of the validation activities as during development, post-development, or as an additional confidence building activity. As shown in Table 7.1-2 and on Figure 7.1-2, some of the activities were conducted both during development and then again with the completed TSPA-LA Model.

On page 7-2, **delete** the first two bulleted paragraphs and the following one line paragraph.

On page 7-3, 1<sup>st</sup> paragraph, sentence with 4 subparts: Replace “separate numerical code” with independent mathematical model”. Replace “performance assessment model” with “independent mathematical model”.

On page 7.1-2 in the last full paragraph of Section 7.1, **add** the following text to the end of the paragraph:

Note that the categorization of validation and confidence building activities has been modified from the TWP as noted in Section 1.

On page 7.1-3 in the first full sentence of the first paragraph, add a space after Section in Section 7.1.3.

On page 7.1-3 in the first sentence of Section 7.1.2, **delete** the following text:

“, listed in Section 2.3.5.1 of the technical work plan (SNL 2008 [DIRS 184920].”

On page 7.1-3 in the second sentence of the second paragraph of Section 7.1.2, **add** “with model versions prior to the “frozen” model version 5.00” after the word “conducted”.

On page 7.1-7 after the second paragraph of Section 7.1.2.2, **add** the following:

Note that model stability testing was done both during-development (e.g., with v4.042) and post-development (v5.00 or later).

On page 7.1-8 in the last sentence of Section 7.1.2.4, change “applying” to “apply”.

On page 7.1-8, after the first paragraph of Section 7.1.2.4, **add** the following:

Note that this activity was conducted both during- and post-development, but documentation is only provided for post-development simulations and analyses.

On page 7.1-9 in the first sentence of the first paragraph of Section 7.1.3, **add** “and confidence building” after “post development”.

On page 7.1-9 in the fourth sentence of the first paragraph of Section 7.1.3, replace “Exceeding the procedural requirements, the” with “The”.

On page 7.1-9 after the first paragraph of Section 7.1.3, **add** the following:

The TWP plan was modified as described in Section 1.

On page 7.1-9 insert the following bullet to the second paragraph of Section 7.1.3:

- Comparing the surrogate DOE waste form submodels with the detailed DOE waste form analyses to confirm the abstracted waste form was appropriate. [Post-Development]. (Section 7.5).

On page 7.1-9 in the second paragraph of Section 7.1.3, **add** “[Confidence Building]” after the 1<sup>st</sup> and 3<sup>rd</sup> bullets.

On page 7.1-9 in the second paragraph of Section 7.1.3, **add** “[During-Development]” after the 4<sup>th</sup> bullet.

On page 7.1-9 in the second paragraph of Section 7.1.3, replace the 2<sup>nd</sup> bullet with the following two bullets:

- Performing auxiliary analyses to corroborate the results provided by the TSPA-LA Model or model abstractions and/or submodels used in the TSPA-LA Model (Section 7.7; Figure 7.1-2). The auxiliary analyses include comparison of the TSPA-LA Model results with analyses of single realizations that are significant contributors to dose (Section 7.7.1), and (2) results of performance margin analyses to provide objective evidence for assessing performance margin and degree of conservatism or non-conservatism in the TSPA-LA Model (Section 7.7.4).

- Performing comparison of TSPA-LA Model results with independent mathematical models including; (1) the results of the Simplified TSPA Analysis (Section 7.7.2), and (2) results calculated by EPRI for the repository using its own performance assessment code (Section 7.7.3).

On page 7.1-9, **delete** the last paragraph of Section 7.1.3.

On page 7.1-10, **add** the following after the first paragraph of Section 7.1.3.1:

Note this is a confidence building step not specifically a post-development activity for a system model.

On page 7.1-11 in the fourth sentence of Section 7.1.3.2, **delete** the following:

“; comparison of the results of the TSPA-LA Model with a Simplified TSPA Analysis (Section 7.7.2); a comparison of the TSPA-LA Model results with those from an independent organization (Section 7.7.3);”.

On page 7.1-11 in the first sentence of Section 7.1.3.3, **add** “for confidence building” to the end of the sentence.

On page 7.1-12, **add** the following to the end of the first paragraph of Section 7.1.3.4:

Thus, these reviews have been conducted “during-development” of the final TSPA-LA Model, as comments were made, resulting in updates to the model. The IVRT evaluation was conducted on a model that evolved into the TSPA-LA Model based primarily on their comments. However, it was conducted prior to the “freeze” of the TSPA-LA Model (v. 5.005), so is considered during-development as well.

On page T7.1-1 in Table 7.1-1, **delete** the second line (row) which starts “During-development...”

On page T7.1-6 in Table 7.1-1, **delete** the second line (row) which starts “Post-development...”

On page T7.1-7 in Table 7.1-1, **insert** the text “(independent mathematical model)” after “Simplified TSPA Analysis” (line 3) and after “IMARC” (line 4).

On page 7.7-1 in the third sentence of the second paragraph, **add** “(independent mathematical model)” after “Analysis results”.

On page 7.7-1 in the fifth sentence of the second paragraph, **add** “(independent mathematical model)” after “PA results”.

On page 7.7.3-1 in the second paragraph, **replace** the 2<sup>nd</sup> sentence with:

The purpose of the comparison is to corroborate the TSPA-LA Model with an independent mathematical model, the EPRI model.

On page 7.9-3, **delete** the last sentence of the first paragraph.

On page 7.9-3, **delete** the second paragraph.

On page 7.10-1 in the sixth sentence of the first paragraph, **delete** “of all four groups”.

On page 7.10-1 in the seventh sentence of the first paragraph, **delete** “As required by the technical work plan,” and capitalize “The”.

On page 7.10-1, **insert** the following text after the first sentence of the second paragraph:

Keep in mind the during- and post-development mapping provided in Table 7.1-2 when reading this summary.

On page 7.10-2, **delete** the first two sentences of the first full paragraph.

On page 7.10-2 in the fourth sentence of the last paragraph, **replace** “The subsequent post-development” with “Additional”. Add “listed in” after “activities”, and delete parentheses around Table 7.1-1.

On page 7.10-3, **modify** the first paragraph to read as follows:

This section summarizes the approach applied to validate the TSPA-LA Model as required by SCI-PRO-006, planned in the TSPA-LA technical work plan (SNL 2008 [DIRS 184920], and modified in this document. The technical work plan as modified in this document identifies ...in support of these validation activities.

On page 7.10-14, **add** the following text to the last sentence of the 2<sup>nd</sup> paragraph:

“, providing additional confidence in the model.”

On page 7.10-15, **add** “(Independent Mathematical Model)” to the subheading.

On page 7.10-17, **add** “(Independent Mathematical Model)” to the subheading.

On page 7.10-19, **add** the following text to the end of the first paragraph of Section 7.10.9:

They are considered to be during-development validation activities.

On page 7.10-21 in the second sentence of the first paragraph of Section 7.10.10, change “are” to “as”. Also, **add** “and modified herein” after “technical work plan”.

On page 7.10-22, in the 2<sup>nd</sup> and 3<sup>rd</sup> sentence of the first paragraph, **delete** “during development”.

On page 7.10-22 in the 1<sup>st</sup> and 2<sup>nd</sup> sentence of the second paragraph, **delete** “post-development”.

On page 7.10-22, in the 1<sup>st</sup> sentence of the second paragraph, **insert** “independent mathematical models including” before “a Simplified...”.

On page 7.10-22 after the last sentence of the second paragraph, **add** the following text:

As noted, the categorization of during- and post-development model validation activities has been modified. However, the technical basis and the full suite of model validation activities remains the same.

## Section 8:

On page 8.4-3, revise the Post-Development Model Validation subheading text and bullets as follows:

**Add** the following new bullet:

- Corroboration of TSPA-LA Model with independent mathematical models. (Section 7.7)

**Delete** the 4<sup>th</sup> bullet (i.e. Section 7.9).

**Move** the 1<sup>st</sup> and 3<sup>rd</sup> bullets to follow this new paragraph/sentence to be added after the second paragraph in this subheading. “Additional confidence building activities were also conducted in support of model validation including:”

## Addendum:

On page 7-2[a], **move** the 3<sup>rd</sup> and 4<sup>th</sup> sub-bullet located under the 4<sup>th</sup> main bullet under a new separate bullet (5<sup>th</sup>) entitled:

- Reevaluation of the corroboration of TSPA-LA Model results with independent mathematical models, including:

**Insert new table into Section 7.1:**

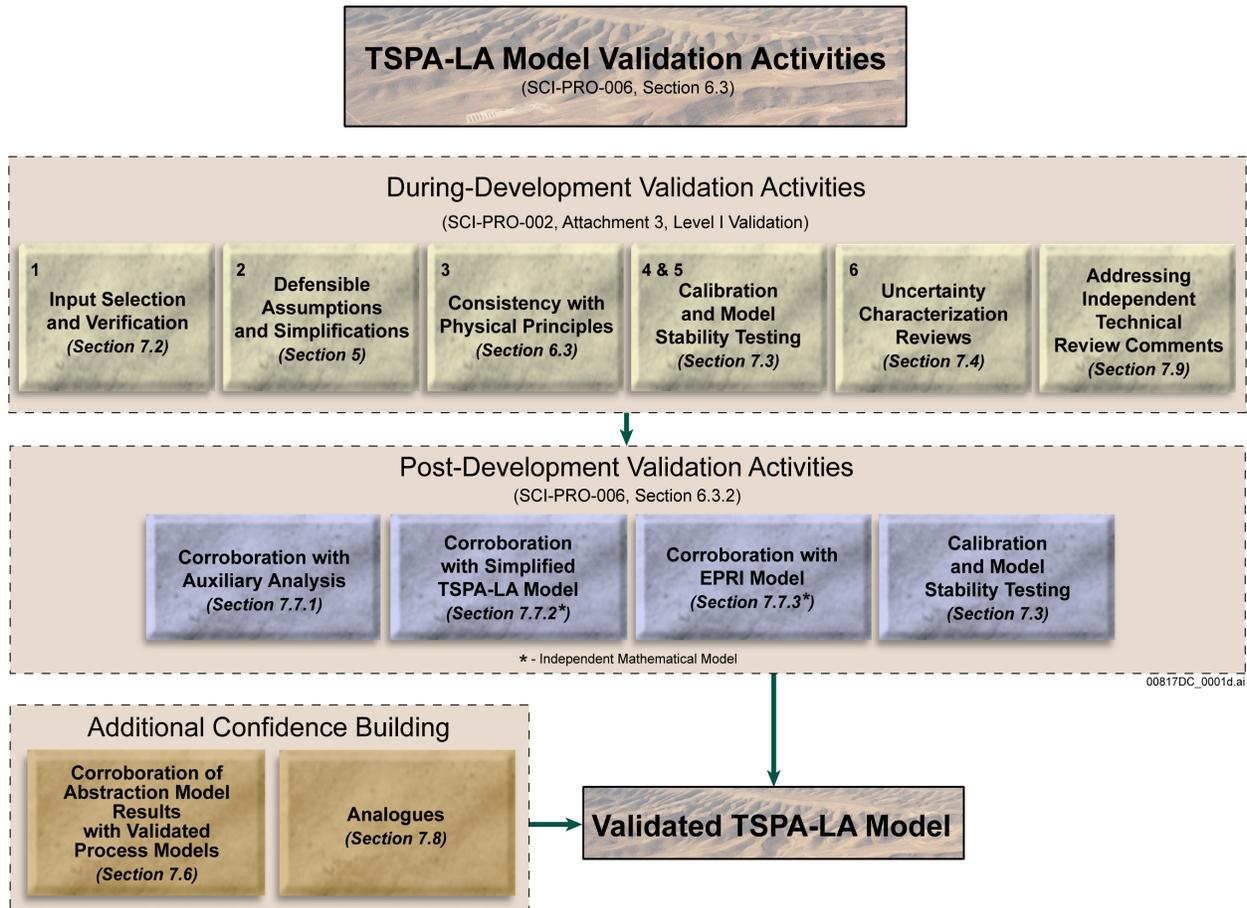
Table 7.1-2. TSPA-LA Model Validation Summary

<b>Section</b>	<b>Title</b>	<b>During-Development</b>	<b>Post-Development</b>	<b>Additional Confidence Building</b>
7.2	Computer Code and Input Verification	X		
7.3.1	Statistical Stability	X <sup>1</sup>	X	
7.3.2	Numerical Accuracy of Expected Annual Dose	X <sup>1</sup>	X	
7.3.3	Temporal Stability	X <sup>1</sup>	X	
7.3.4	Analysis of Spatial Discretization	X <sup>1</sup>	X	
7.3.5	Stability of FEHM Particle Tracking Model		X	
7.4	Uncertainty and Variability Characterization Reviews	X		
7.5	Surrogate Waste Form Validation	X <sup>1</sup>	X	
7.6	Corroboration of Abstraction Model Results with Validated Process Models			X
7.7.1	Analysis of Single Realizations		X	
7.7.2	Comparison with Simplified TSPA Analysis		X	
7.7.3	Comparison with Electric Power Research Institute Analysis		X	
7.7.4	Performance Margin Analysis		X	
7.8	Natural Analogues			X
7.9	Technical Reviews Summary	X		

Notes:

- 1 As part of the iterative process of building the TSPA-LA Model, work was performed with earlier versions of the model. However, the post development validation portion of this activity is the procedural confirmation used for model validation and confidence building.

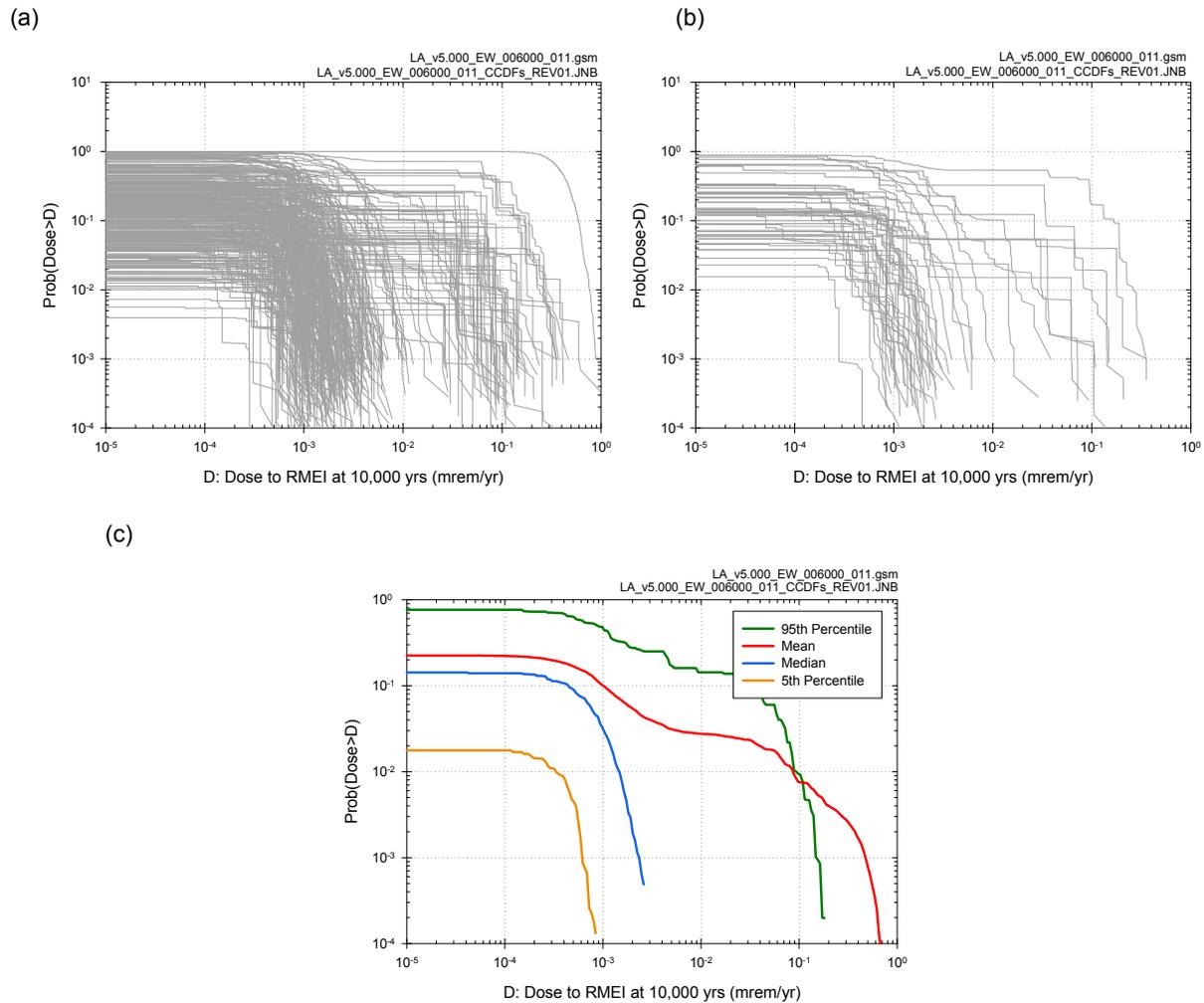
Replace Figure ES-32 on page FES-32 and Figure 7.1-2 on page F7.1-2 with the revised figure below. Remove the NOTE that appears in the caption of Figure 7.1-2.



Include the following note above the figure caption in each instance:

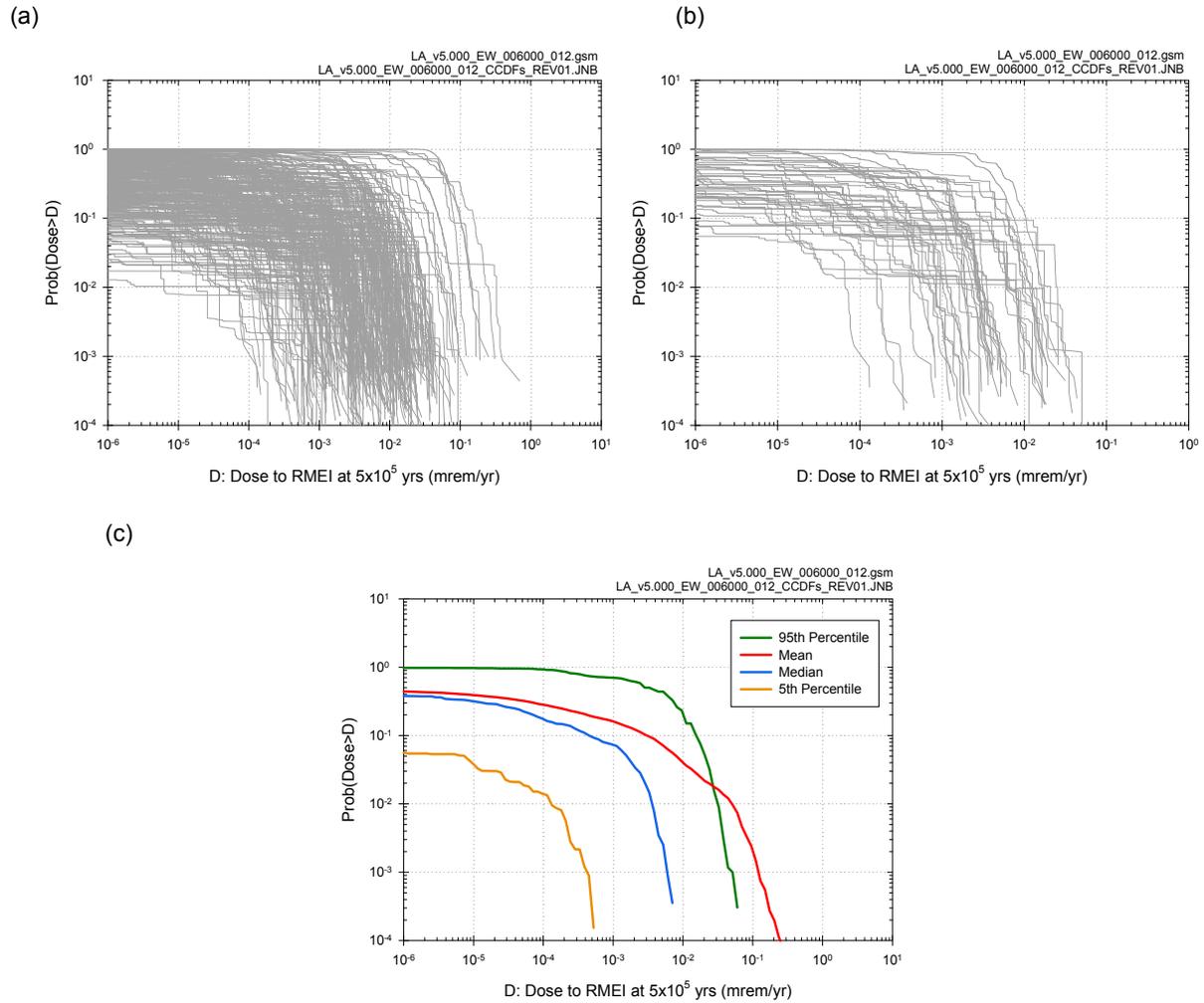
Note: Numbers located in the upper left corner of the during-development boxes, correspond to the list of Level 1 validation activities found in SCI-PRO-002.

**ATTACHMENT 2—REPLACEMENT FIGURES (CR 12304 AND CR 12264)**



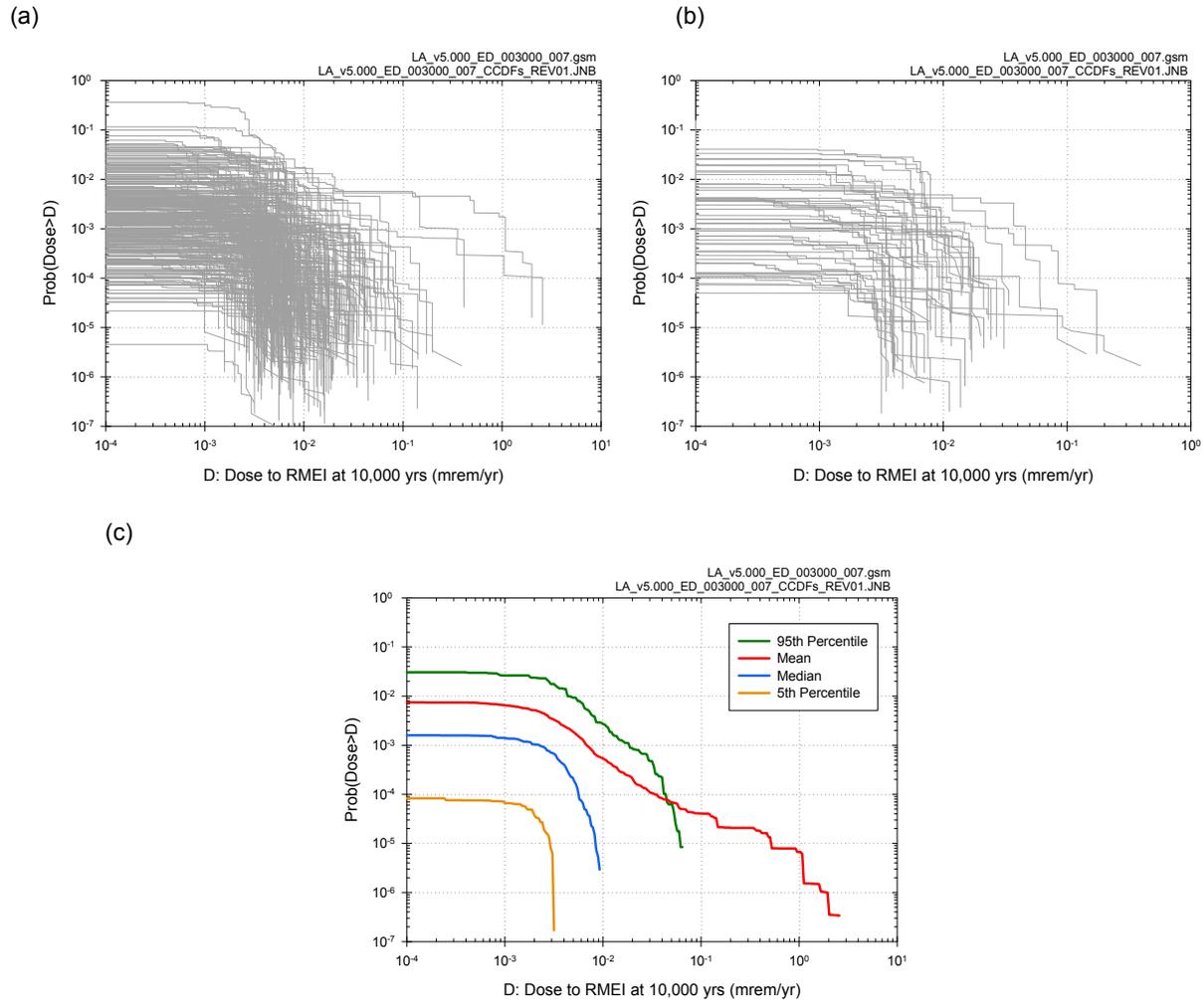
Source: Ouput DTNs: MO0806TSPADCOR.000 [DIRS 185575]; and MO0709TSPAREGS.000 [DIRS 182976].

Figure J6.2-10. Results associated with  $D_{EW}(10^4 \text{ yr} | \mathbf{a}_{EW}, \mathbf{e}_M)$  obtained with sampling-based (Monte Carlo) procedures for an LHS of size  $n_{LHS} = 300$ : (a) CCDFs for  $D_{EW}(10^4 \text{ yr} | \mathbf{a}_{EW}, \mathbf{e}_{Mi})$  with exceedance probabilities  $p_A[D < D_{EW}(10^4 \text{ yr} | \mathbf{a}_{EW}, \mathbf{e}_{Mi}) | \mathbf{e}_{Ai}]$  defined in Equation J6.2-12 for  $i = 1, 2, \dots, n_{LHS} = 300$ , (b) CCDFs for  $D_{EW}(10^4 \text{ yr} | \mathbf{a}_{EW}, \mathbf{e}_{Mi})$  with exceedance probabilities  $p_A[D < D_{EW}(10^4 \text{ yr} | \mathbf{a}_{EW}, \mathbf{e}_{Mi}) | \mathbf{e}_{Ai}]$  defined in Equation J6.2-13 for  $i = 1, 2, \dots, 50$ , and (c) expected (mean) CCDF and quantile curves,  $q = 0.05, 0.5, 0.95$ , for CCDFs in (a).



Source: Ouput DTNs: MO0806TSPADCOR.000 [DIRS 185575]; and MO0709TSPAREGS.000 [DIRS 182976].

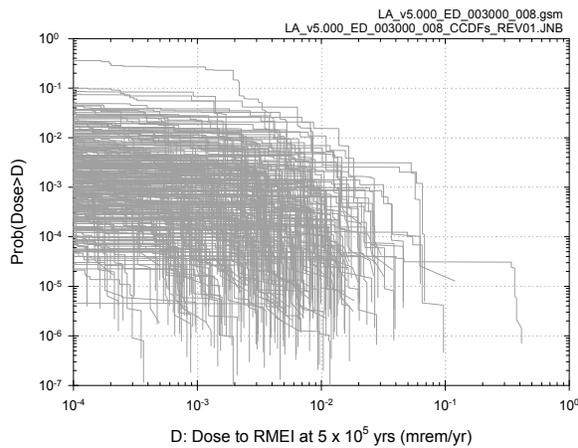
Figure J6.2-20. Results associated with  $D_{EW}(5 \times 10^5 \text{ yr} | \mathbf{a}_{EW}, \mathbf{e}_M)$  obtained with sampling-based (Monte Carlo) procedures for an LHS of size  $n_{LHS} = 300$ : (a) CCDFs for  $D_{EW}(5 \times 10^5 \text{ yr} | \mathbf{a}_{EW}, \mathbf{e}_{Mi})$  with exceedance probabilities  $p_A[D < D_{EW}(5 \times 10^5 \text{ yr} | \mathbf{a}_{EW}, \mathbf{e}_{Mi}) | \mathbf{e}_{Ai}]$  defined in Equation J66.2-12 for  $i = 1, 2, \dots, n_{LHS} = 300$ , (b) CCDFs for  $D_{EW}(10^4 \text{ yr} | \mathbf{a}_{EW}, \mathbf{e}_{Mi})$  with exceedance probabilities  $p_A[D < D_{EW}(5 \times 10^5 \text{ yr} | \mathbf{a}_{EW}, \mathbf{e}_{Mi}) | \mathbf{e}_{Ai}]$  defined in Equation J6.2-20 for  $i = 1, 2, \dots, 50$ , and (c) expected (mean) CCDF and quantile curves,  $q = 0.05, 0.5, 0.95$ , for CCDFs in (a).



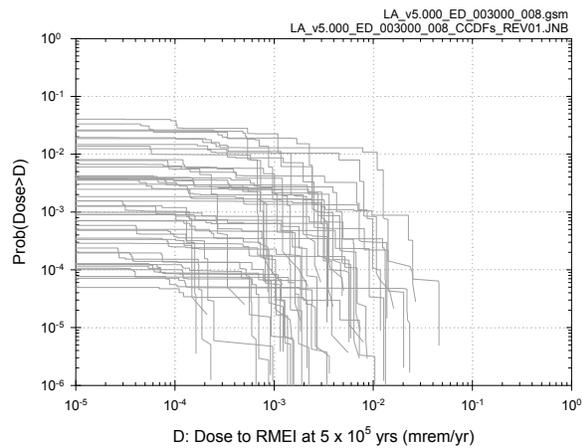
Source: Ouput DTNs: MO0806TSPADCOR.000 [DIRS 185575]; and MO0709TSPAREGS.000 [DIRS 182976].

Figure J6.3-10. Results associated with  $D_{ED}(10^4 \text{ yr} | \mathbf{a}_{ED}, \mathbf{e}_M)$  obtained with sampling-based (Monte Carlo) procedures for an LHS of size  $n_{LHS} = 300$ : (a) CCDFs for  $D_{ED}(10^4 \text{ yr} | \mathbf{a}_{ED}, \mathbf{e}_M)$  with exceedance probabilities  $p_A[D < D_{ED}(10^4 \text{ yr} | \mathbf{a}_{ED}, \mathbf{e}_M) | \mathbf{e}_{A_i}]$  defined similarly to  $p_A[D < D_{EW}(\tau | \mathbf{a}, \mathbf{e}_{M1}) | \mathbf{e}_{A1}]$  in Equation (J6.2-12) for  $i = 1, 2, \dots, n_{LHS} = 300$ , (b) CCDFs for  $D_{ED}(10^4 \text{ yr} | \mathbf{a}_{ED}, \mathbf{e}_M)$  with exceedance probabilities  $p_A[D < D_{ED}(10^4 \text{ yr} | \mathbf{a}_{ED}, \mathbf{e}_M) | \mathbf{e}_{A_i}]$  defined similarly to  $p_A[D < D_{EW}(\tau | \mathbf{a}, \mathbf{e}_{M1}) | \mathbf{e}_{A1}]$  in Equation (J6.2-12) for  $i = 1, 2, \dots, 50$ , and (c) expected (mean) CCDF and quantile curves,  $q = 0.05, 0.5, 0.95$ , for CCDFs in (a).

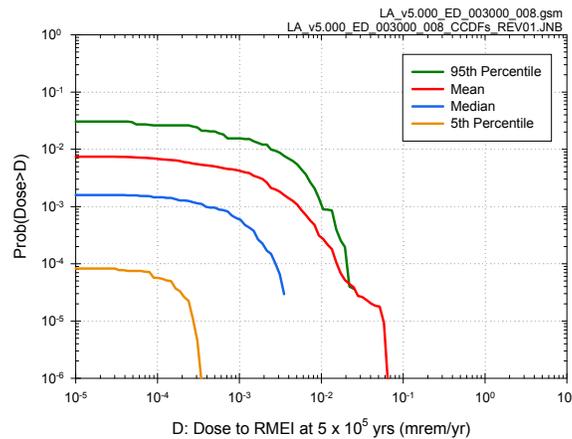
(a)



(b)

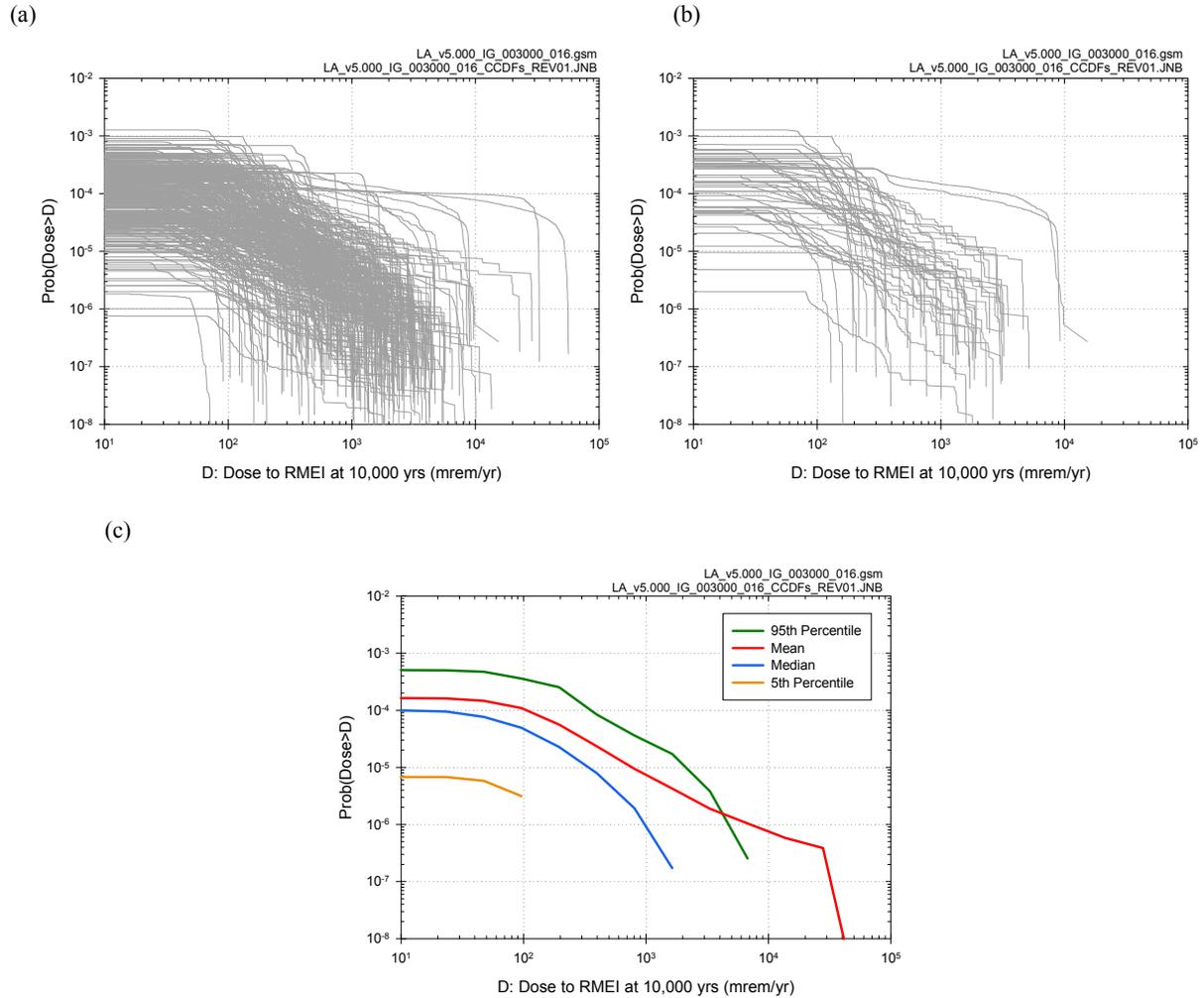


(c)



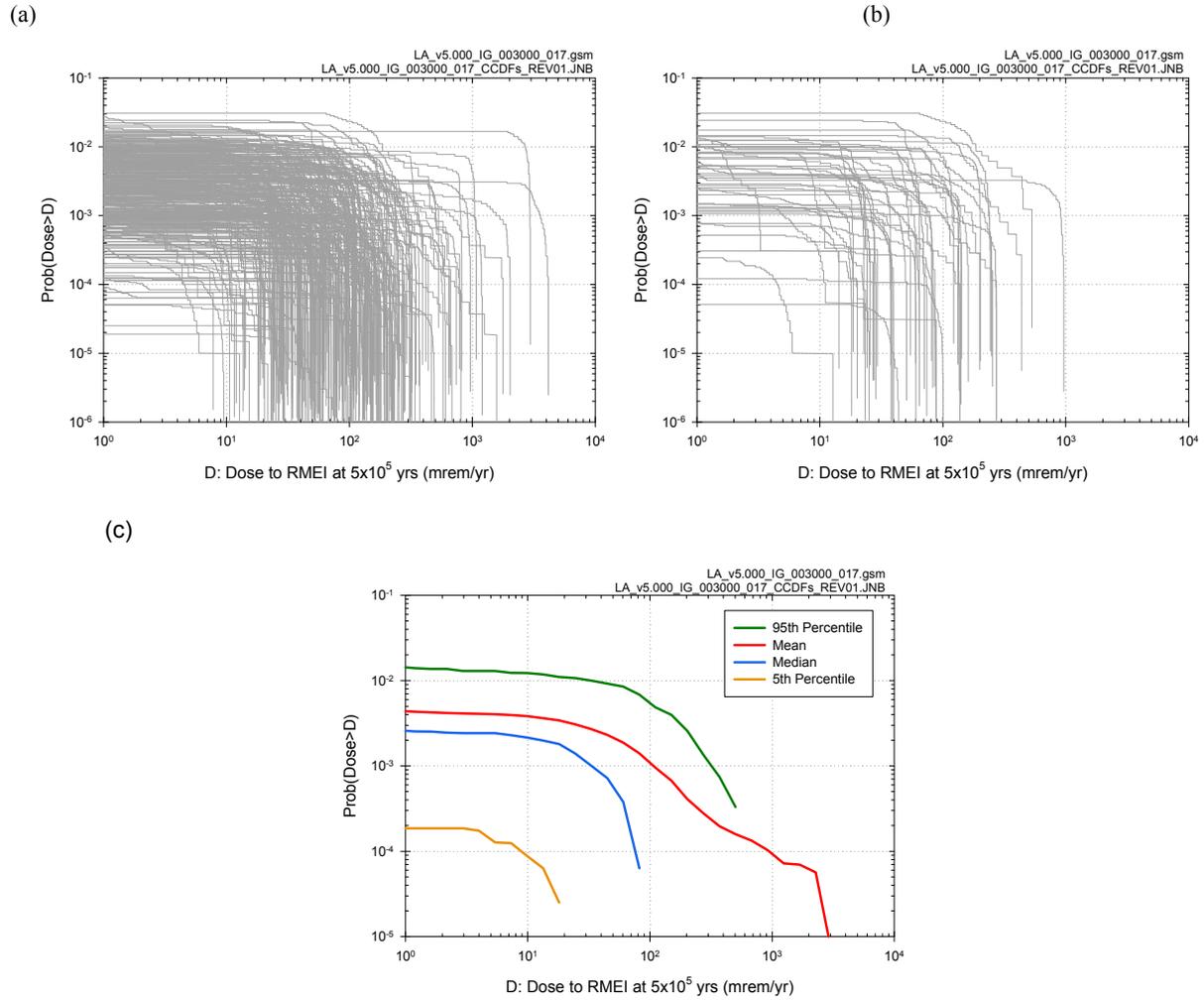
Source: Ouput DTNs: MO0806TSPADCOR.000 [DIRS 185575]; and MO0709TSPAREGS.000 [DIRS 182976].

Figure J6.3-20. Results associated with  $D_{ED}(5 \times 10^5 \text{ yr} | \mathbf{a}_{ED}, \mathbf{e}_M)$  obtained with sampling-based (Monte Carlo) procedures for an LHS of size  $nLHS = 300$ : (a) CCDFs for  $D_{ED}(5 \times 10^5 \text{ yr} | \mathbf{a}_{ED}, \mathbf{e}_{Mi})$  with exceedance probabilities  $p_A[D < D_{ED}(5 \times 10^5 \text{ yr} | \mathbf{a}_{ED}, \mathbf{e}_{Mi}) | \mathbf{e}_{Ai}]$  defined similarly to  $p_A[D < D_{EW}(\tau | \mathbf{a}, \mathbf{e}_{M1}) | \mathbf{e}_{A1}]$  in Equation (J6.2-12) for  $i = 1, 2, \dots, nLHS = 300$ , (b) CCDFs for  $D_{ED}(10^4 \text{ yr} | \mathbf{a}_{ED}, \mathbf{e}_{Mi})$  with exceedance probabilities  $p_A[D < D_{ED}(5 \times 10^5 \text{ yr} | \mathbf{a}_{ED}, \mathbf{e}_{Mi}) | \mathbf{e}_{Ai}]$  defined similarly to  $p_A[D < D_{EW}(\tau | \mathbf{a}, \mathbf{e}_{M1}) | \mathbf{e}_{A1}]$  in Equation (J6.2-12) for  $i = 1, 2, \dots, 50$ , and (c) expected (mean) CCDF and quantile curves,  $q = 0.05, 0.5, 0.95$ , for CCDFs in (a).



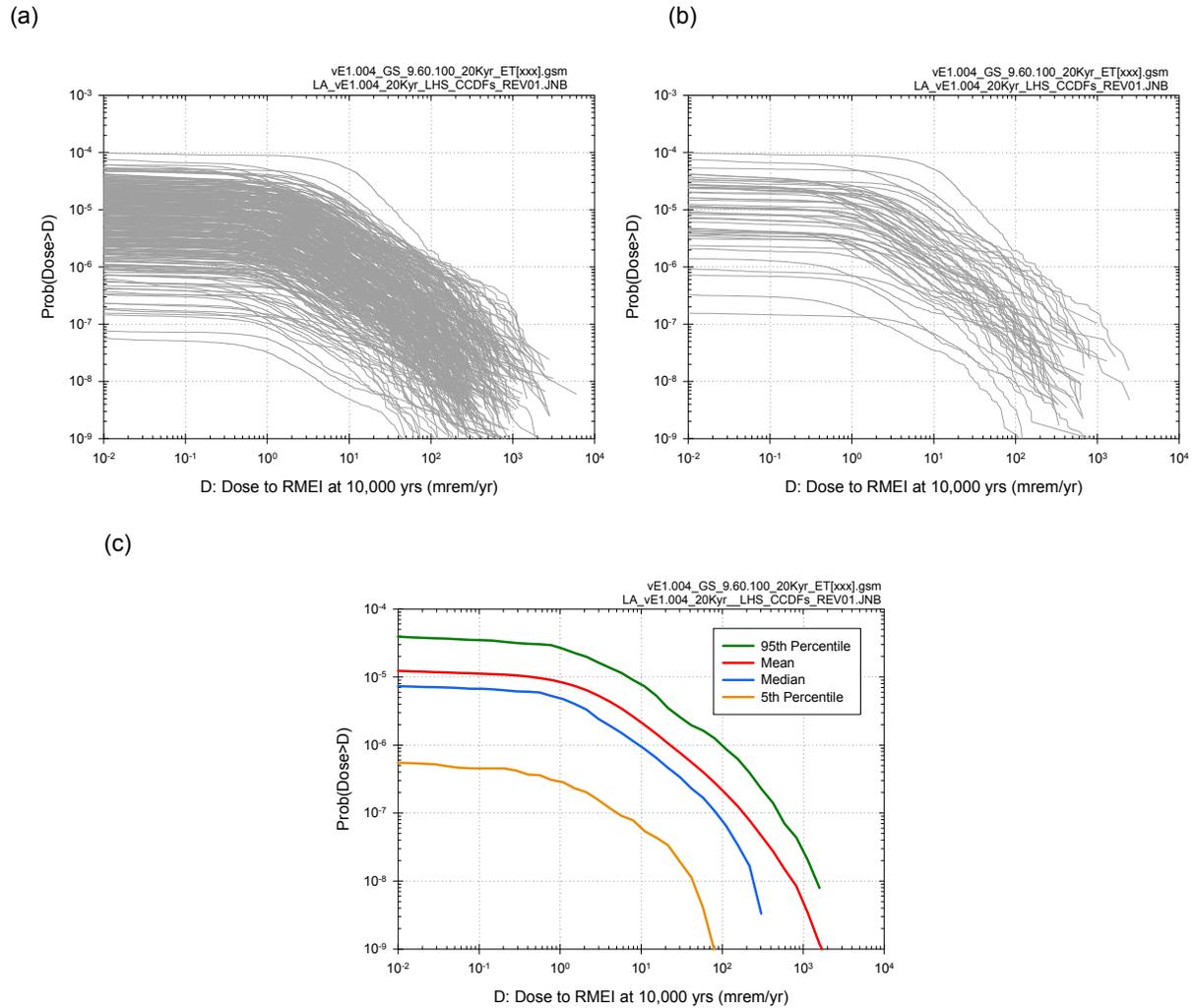
Source: Ouput DTNs: MO0806TSPADCOR.000 [DIRS 185575]; and MO0709TSPAREGS.000 [DIRS 182976].

Figure J7.2-9. Results associated with  $D_{II}(10^4 \text{ yr}|\mathbf{a}_{II}, \mathbf{e}_M)$  obtained with sampling-based (Monte Carlo) procedures for an LHS of size  $nLHS = 300$ : (a) CCDFs for  $D_{II}(10^4 \text{ yr}|\mathbf{a}_{II}, \mathbf{e}_{Mi})$  with exceedance probabilities  $p_A[D < D_{II}(10^4 \text{ yr}|\mathbf{a}, \mathbf{e}_{Mi})|\mathbf{a}_{Ai}]$  defined in Equation J7.2-23 for  $i = 1, 2, \dots, nLHS = 300$ , (b) CCDFs for  $D_{II}(10^4 \text{ yr}|\mathbf{a}_{II}, \mathbf{e}_{Mi})$  with exceedance probabilities  $p_A[D < D_{II}(10^4 \text{ yr}|\mathbf{a}, \mathbf{e}_{Mi})|\mathbf{a}_{Ai}]$  defined in Equation J7.2-23 for  $i = 1, 2, \dots, 50$ , and (c) expected (mean) CCDF and quantile curves,  $q = 0.05, 0.5, 0.95$ , for CCDFs in (a).



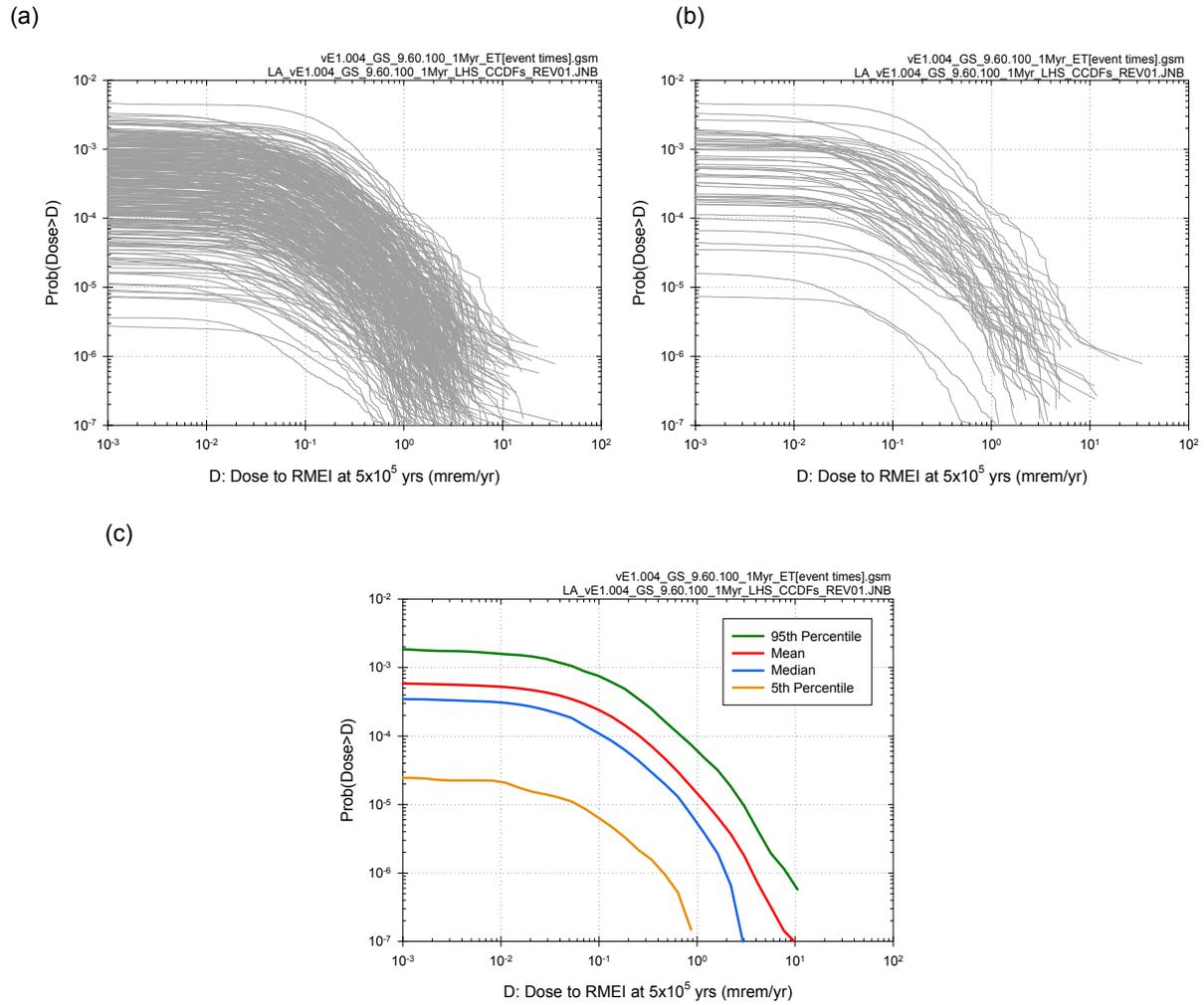
Source: Ouput DTNs: MO0806TSPADCOR.000 [DIRS 185575]; and MO0709TSPAREGS.000 [DIRS 182976].

Figure J7.2-19. Results associated with  $D_{IJ}(5 \times 10^5 \text{ yr} | \mathbf{a}_{IJ}, \mathbf{e}_M)$  obtained with sampling-based (Monte Carlo) procedures for an LHS of size  $nLHS = 300$ : (a) CCDFs for  $D_{IJ}(5 \times 10^5 \text{ yr} | \mathbf{a}_{IJ}, \mathbf{e}_{Mi})$  with exceedance probabilities  $p_A[D < D_{IJ}(5 \times 10^5 \text{ yr} | \mathbf{a}, \mathbf{e}_{Mi}) | \mathbf{e}_{Ai}]$  defined in Equation J7.2-23 for  $i = 1, 2, \dots, nLHS = 300$ , (b) CCDFs for  $D_{IJ}(5 \times 10^5 \text{ yr} | \mathbf{a}_{IJ}, \mathbf{e}_{Mi})$  with exceedance probabilities  $p_A[D < D_{IJ}(5 \times 10^5 \text{ yr} | \mathbf{a}, \mathbf{e}_{Mi}) | \mathbf{a}_{Ai}]$  defined in Equation J7.2-23 for  $i = 1, 2, \dots, 50$ , and (c) expected (mean) CCDF and quantile curves,  $q = 0.05, 0.5, 0.95$ , for CCDFs in (a).



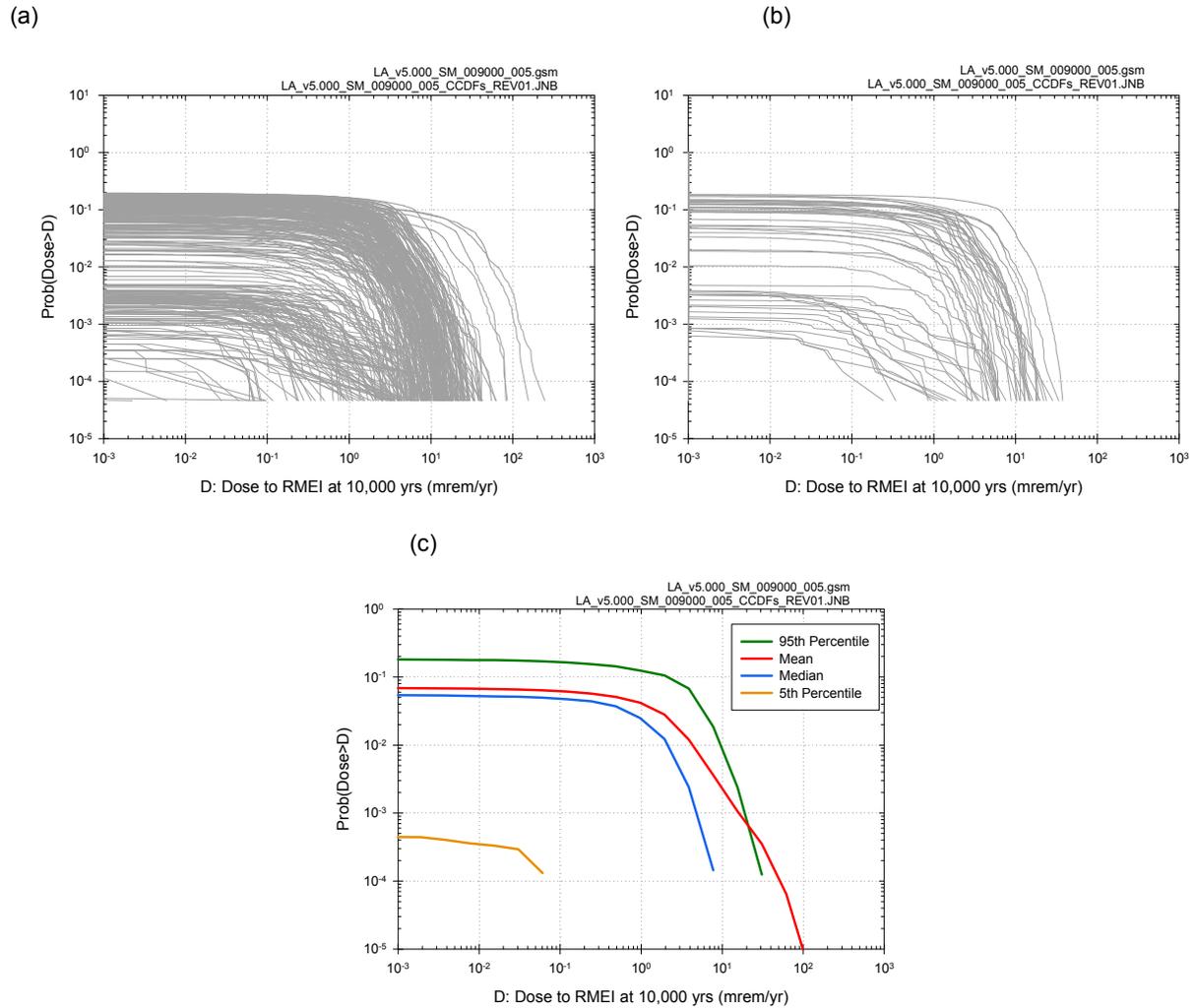
Source: Ouput DTNs: MO0806TSPADCOR.000 [DIRS 185575]; and MO0709TSPAREGS.000 [DIRS 182976].

Figure J7.3-8. Results associated with  $D_{IE}(10^4 \text{ yr} | \mathbf{a}_{IE}, \mathbf{e}_M)$  obtained with sampling-based (Monte Carlo) procedures for an LHS of size  $nLHS = 300$ : (a) CCDFs for  $D_{IE}(10^4 \text{ yr} | \mathbf{e}_{IE}, \mathbf{e}_{Mi})$  with exceedance probabilities  $p_A[D < D_{IE}(10^4 \text{ yr} | \mathbf{a}, \mathbf{e}_{Mi}) | \mathbf{e}_{Ai}]$  defined in Equation J7.3-20 for  $i = 1, 2, \dots, nLHS = 300$ , (b) CCDFs for  $D_{IE}(10^4 \text{ yr} | \mathbf{a}_{IE}, \mathbf{e}_{Mi})$  with exceedance probabilities  $p_A[D < D_{IE}(10^4 \text{ yr} | \mathbf{a}, \mathbf{e}_{Mi}) | \mathbf{e}_{Ai}]$  defined in Equation J7.3-20 for  $i = 1, 2, \dots, 50$ , and (c) expected (mean) CCDF and quantile curves,  $q = 0.05, 0.5, 0.95$ , for CCDFs in (a).



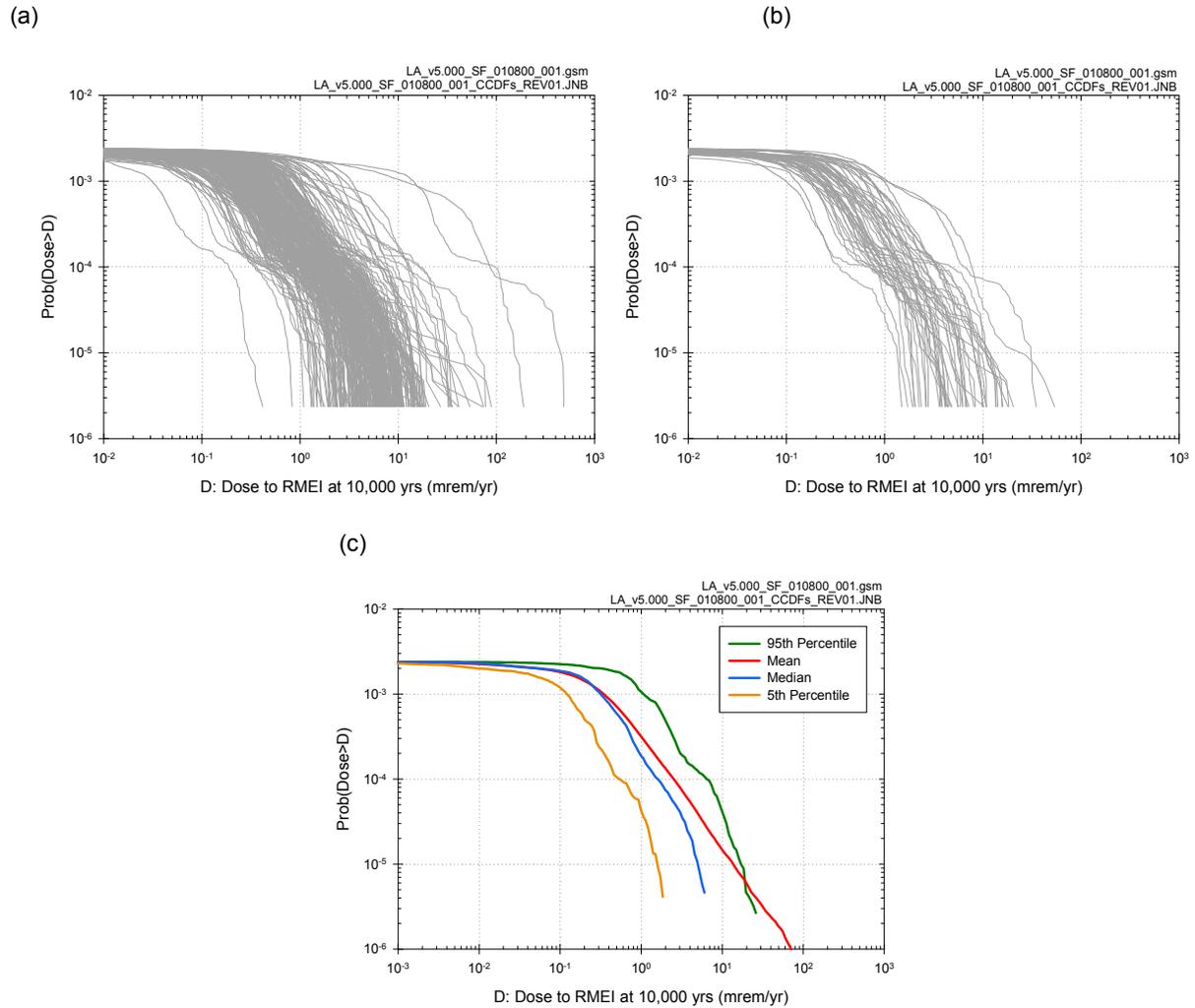
Source: Ouput DTNs: MO0806TSPADCOR.000 [DIRS 185575]; and MO0709TSPAREGS.000 [DIRS 182976].

Figure J7.3-17. Results associated with  $D_{IE}(500,000\ yr|a_{IE}, e_M)$  obtained with sampling-based (Monte Carlo) procedures for an LHS of size  $nLHS = 300$ : (a) CCDFs for  $D_{IE}(10^4\ yr|a_{IE}, e_{Mi})$  with exceedance probabilities  $p_A[D < D_{IE}(500,000\ yr|a, e_{Mi})|e_{Ai}]$  defined in Equation J7.3-20 for  $i = 1, 2, \dots, nLHS = 300$ , (b) CCDFs for  $D_{IE}(500,000\ yr|a_{IE}, e_{Mi})$  with exceedance probabilities  $p_A[D < D_{IE}(500,000\ yr|a, e_{Mi})|e_{Ai}]$  defined in Equation J7.3-20 for  $i = 1, 2, \dots, 50$ , and (c) expected (mean) CCDF and quantile curves,  $q = 0.05, 0.5, 0.95$ , for CCDFs in (a).



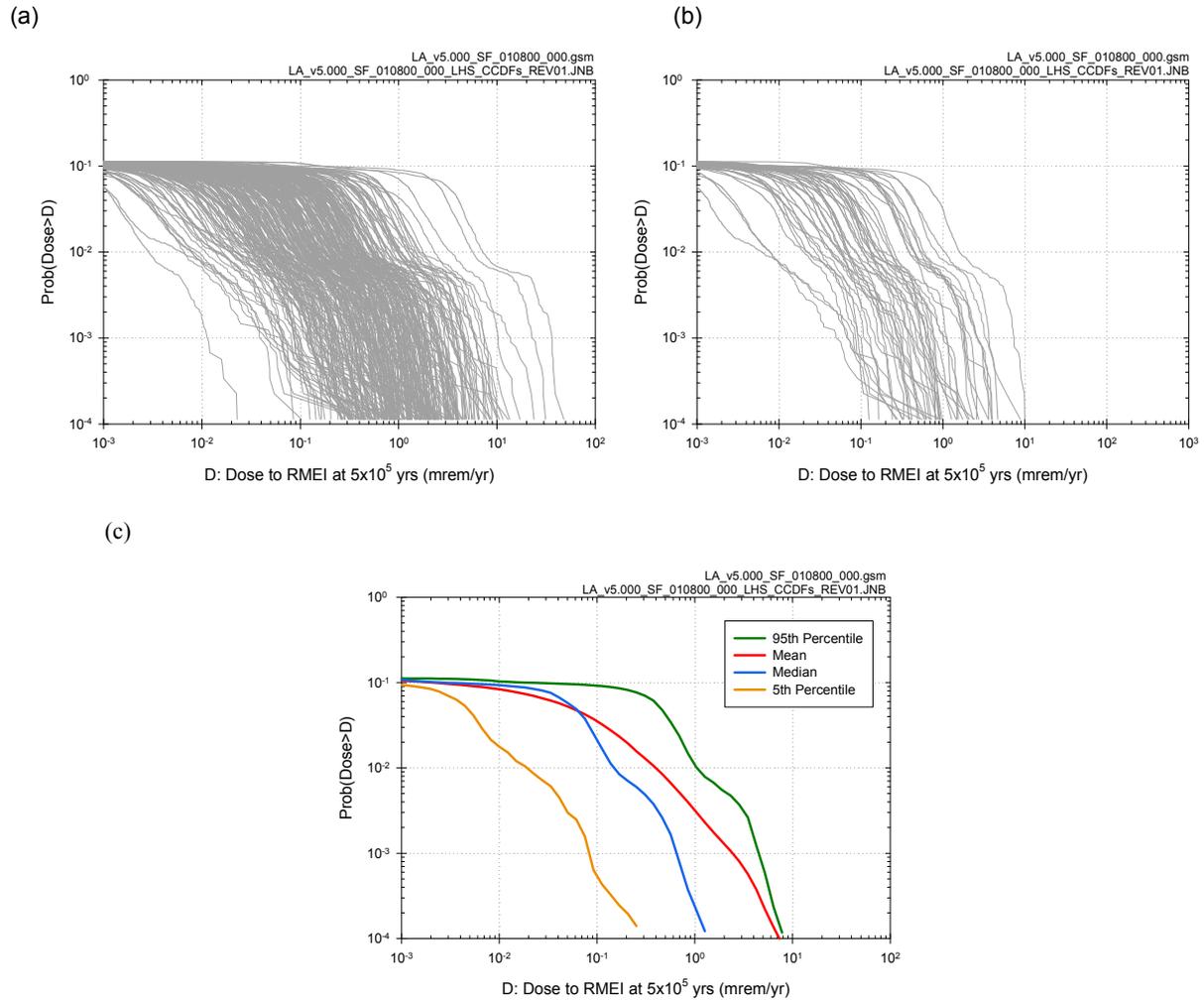
Source: Ouput DTNs: MO0806TSPADCOR.000 [DIRS 185575]; and MO0709TSPAREGS.000 [DIRS 182976].

Figure J8.3-10. Results associated with  $D_{SG}(10^4 \text{ yr} | \mathbf{a}_{SG}, \mathbf{e}_M)$  obtained with sampling-based (Monte Carlo) procedures for an LHS of size  $n_{LHS} = 300$ : (a) CCDFs for  $D_{SG}(10^4 \text{ yr} | \mathbf{a}_{SG}, \mathbf{e}_{Mi})$  with exceedance probabilities  $p_A[D < D_{SG}(10^4 \text{ yr} | \mathbf{a}, \mathbf{e}_{Mi}) | \mathbf{e}_{Ai}]$  defined in Equation J4.5-19 for  $i = 1, 2, \dots, n_{LHS} = 300$ , (b) CCDFs for  $D_{SG}(10^4 \text{ yr} | \mathbf{a}_{SG}, \mathbf{e}_{Mi})$  with exceedance probabilities  $p_A[D < D_{SG}(10^4 \text{ yr} | \mathbf{a}, \mathbf{e}_{Mi}) | \mathbf{e}_{Ai}]$  defined in Equation J4.5-19 for  $i = 1, 2, \dots, 50$ , and (c) expected (mean) CCDF and quantile curves,  $q = 0.05, 0.5, 0.95$ , for CCDFs in (a).



Source: Ouput DTNs: MO0806TSPADCOR.000 [DIRS 185575]; and MO0709TSPAREGS.000 [DIRS 182976].

Figure J8.6-10. Results associated with  $D_{SF}(10^4 \text{ yr} | \mathbf{a}_{SF}, \mathbf{e}_M)$  obtained with sampling-based (Monte Carlo) procedures for an LHS of size  $n_{LHS} = 300$ : (a) CCDFs for  $D_{SF}(10^4 \text{ yr} | \mathbf{a}_{SF}, \mathbf{e}_{Mi})$  with exceedance probabilities  $p_A[D < D_{SF}(10^4 \text{ yr} | \mathbf{a}, \mathbf{e}_{Mi}) | \mathbf{e}_{Ai}]$  defined in Equation J4.5-19 for  $i = 1, 2, \dots, n_{LHS} = 300$ , (b) CCDFs for  $D_{SF}(10^4 \text{ yr} | \mathbf{a}_{SF}, \mathbf{e}_{Mi})$  with exceedance probabilities  $p_A[D < D_{SF}(10^4 \text{ yr} | \mathbf{a}, \mathbf{e}_{Mi}) | \mathbf{e}_{Ai}]$  defined in Equation J4.5-19 for  $i = 1, 2, \dots, 50$ , and (c) expected (mean) CCDF and quantile curves,  $q = 0.05, 0.5, 0.95$ , for CCDFs in (a).



Source: Ouput DTNs: MO0806TSPADCOR.000 [DIRS 185575]; and MO0709TSPAREGS.000 [DIRS 182976].

Figure J8.6-21. Results associated with  $D_{SG}(5 \times 10^5 \text{ yr} | \mathbf{a}_{SF}, \mathbf{e}_M)$  obtained with sampling-based (Monte Carlo) procedures for an LHS of size  $nLHS = 300$ : (a) CCDFs for  $D_{SF}(5 \times 10^5 \text{ yr} | \mathbf{a}_{SF}, \mathbf{e}_{Mi})$  with exceedance probabilities  $p_A[D < D_{SF}(5 \times 10^5 \text{ yr} | \mathbf{a}_{SF}, \mathbf{e}_{Mi}) | \mathbf{e}_{Ai}]$  defined in Equation J4.5-19 for  $i = 1, 2, \dots, nLHS = 300$ , (b) CCDFs for  $D_{SF}(10^4 \text{ yr} | \mathbf{a}_{SF}, \mathbf{e}_{Mi})$  with exceedance probabilities  $p_A[D < D_{SF}(5 \times 10^5 \text{ yr} | \mathbf{a}_{SF}, \mathbf{e}_{Mi}) | \mathbf{e}_{Ai}]$  defined in Equation J4.5-19 for  $i = 1, 2, \dots, 50$ , and (c) expected (mean) CCDF and quantile curves,  $q = 0.05, 0.5, 0.95$ , for CCDFs in (a).

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