Update of RASP Handbook Guidance on SDP Assessment of Seismic Issues

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Topics:

- Background
- Purpose of Revision
- Updated Information - Seismic Hazard Vectors and Seismically-Induced Loss of Offsite Power Frequency
- Addition Information for Modeling Considerations
- Development Timeline

Background:

RASP Handbooks

Establish methods and tools for performing risk assessments of inspection findings or reactor incidents for the ASP program, Phase 3 analysis of the SDP, and Incident Investigation Program.

Volume 1, Internal Events
Volume 2, External Events
Volume 3, SPAR Model Reviews
Volume 4, Shut Shut-Down Events

Volume 2

Section 1 Introduction

Section 2 Internal Fires

Section 3 Internal Flooding

Section 4 Seismic

Section 5 Other External Events

Appendix 1 Frequencies of Seismically-induced LOOP Events

Purpose of Revision:

1. Update Section 4 “Seismic” based on new information in the following areas:
   - Seismic Hazard Vectors
   - Frequency of Seismically-Induced Lost of Offsite Power

2. Provide additional discussions for Modeling Considerations in the following areas:
   - Adjusting Human Error Probabilities for Operator Actions during Seismic Event
   - Seismic Correlation Coefficients
   - Multi-Unit Effects

(1) Seismic Hazard Vectors & Frequency of Seismically-Induced Lost of Offsite Power

- Currently, Section 4 and Appendix 1 of Vol. 2 utilize seismic hazard vectors for sites east of the Rocky Mountains from NUREG-1488 (Apr 1994). The seismic hazard vectors for the remaining 4 western US sites are taken from their IPEEE submittals.

- New information for the seismic hazard vectors of all 61 U.S. nuclear power plant sites are obtained from licensees' submittal as part of the effort to address Near-Term Task Force (NTTF) Recommendation 2.1 in 2014 and 2015.

  - Update Table 4A-1 in Section 4 "**Seismic Hazard Vectors for the US Nuclear Power Plants"** for US nuclear power plant sites.

  - Update Table 1 in Appendix 1 "**Frequencies of Seismically-Induced LOOP Events"** for US nuclear power plant sites.

(2) Modeling Considerations

- **Adjusting Human Error Probabilities for Operator Actions**
  - Identify methods used in past IPEEEs and reference to EPRI 1025294, "*A Preliminary Approach to Human Reliability Analysis for External Events with a Focus on Seismic*", December 2012.

- **Seismic Correlation Coefficients**
  - Reference to NUREG/CR-4840 "*Procedures for the External Event Core Damage Frequency Analyses for NUREG-1150*", Nov 1990.

- **Multi-Unit Effects**
  - Briefly discuss credit for cross-ties between two units and credit for an off-site emergency AC power Source

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Development Timeline:

- Draft guidance will be sent to Regional Offices and RES for comments and concurrence - March 31, 2016

- Staff expects to revise the draft guidance based on received comments by June, 2016

- Staff expects to make the draft guidance publicly available in Aug 2016

Backup Slides

Table 4A-1 Seismic Hazard Vectors for the 68 SPAR Plants

mean frequency of exceedance (per year)									
	1/2	3/4	5	6/7/8	8	9	10	11	12
	ANO	Beaver Valley	Braidwood	Browns Ferry	Brunswick	Byron	Callaway	Calvert Cliffs	Catawba
g value	mean f per year	mean f per year	mean f per year	mean f per year	mean f per year	mean f per year	mean f per year	mean f per year	mean f per year
0.05	.1273E-02	.8778E-03	.4297E-03	.9121E-03	.1527E-02	.5091E-03	.1083E-02	.7674E-03	.1199E-02
0.08	.6698E-03	.4919E-03	.2313E-03	.4560E-03	.8013E-03	.2864E-03	.4763E-03	.4321E-03	.6295E-03
0.15	.2016E-03	.1686E-03	.7032E-04	.1247E-03	.2428E-03	.9093E-04	.9878E-04	.1459E-03	.1840E-03
0.25	.7274E-04	.7056E-04	.2448E-04	.4190E-04	.9380E-04	.3227E-04	.2739E-04	.5891E-04	.6334E-04
0.30	.4858E-04	.5056E-04	.1595E-04	.2724E-04	.6580E-04	.2116E-04	.1684E-04	.4141E-04	.4130E-04
0.40	.2442E-04	.2901E-04	.7622E-05	.1309E-04	.3690E-04	.1021E-04	.7532E-05	.2292E-04	.1987E-04
0.50	.1369E-04	.1832E-04	.4067E-05	.7065E-05	.2311E-04	.5489E-05	.3900E-05	.1402E-04	.1072E-04
0.65	.6568E-05	.1027E-04	.1825E-05	.3231E-05	.1306E-04	.2488E-05	.1723E-05	.7565E-05	.4910E-05
0.80	.3522E-05	.6292E-05	.9232E-06	.1663E-05	.8121E-05	.1269E-05	.8721E-06	.4498E-05	.2546E-05
1.00	.1729E-05	.3589E-05	.4239E-06	.7792E-06	.4751E-05	.5885E-06	.4048E-06	.2490E-05	.1215E-05
	13	14	15	16	17	~~18~~	19	20	21
	Clinton	Columbia	Comanche Peak	Cook	Cooper	~~Crystal River~~	Davis Besse	Diablo Canyon	Dresden
g value	mean f per year	mean f per year	mean f per year	mean f per year	mean f per year	~~mean f per year~~	mean f per year		mean f per year
0.05	.1547E-02		.1410E-03	.5010E-03	.1155E-02	~~.1482E-03~~	.1070E-02		.4576E-03
0.08	.8083E-03		.6790E-04	.2729E-03	.7283E-03	~~.8403E-04~~	.5745E-03		.2539E-03
0.15	.2457E-03		.1880E-04	.8900E-04	.2924E-03	~~.2765E-04~~	.1631E-03		.8120E-04
0.25	.9422E-04		.6420E-05	.3578E-04	.1335E-03	~~.1039E-04~~	.5326E-04		.2927E-04
0.30	.6543E-04		.4190E-05	.2528E-04	.9828E-04	~~.7035E-05~~	.3413E-04		.1929E-04
0.40	.3573E-04		.2020E-05	.1421E-04	.5867E-04	~~.3625E-05~~	.1604E-04		.9355E-05
0.50	.2171E-04		.1100E-05	.8843E-05	.3813E-04	~~.2083E-05~~	.8537E-05		.5034E-05
0.65	.1165E-04		.5080E-06	.4890E-05	.2211E-04	~~.1039E-05~~	.3868E-05		.2272E-05
0.80	.6894E-05		.2660E-06	.2969E-05	.1392E-04	~~.5796E-06~~	.1990E-05		.1150E-05
1.00	.3794E-05		.1280E-06	.1681E-05	.8187E-05	~~.2992E-06~~	.9390E-06		.5266E-06

UPDATE

Table 1 Frequencies of Seismically-Induced LOOP Events

	Plant	Seismic IEV Frequency	Cond. Prob. of LOOP	Seis. Indu. LOOP Frequency	Plant Type	
		A	B	A*B		
1-2	ANO 1 & 2	1.27E-03	6.59E-02	8.38E-05	B&	
3-4	Beaver Valley 1 & 2	8.78E-04	8.52E-02	7.48E-05		
5	Braidwood 1 & 2	4.30E-04	6.64E-02	2.85E-05		
6-7	Browns Ferry 2 & 3	9.11E-04	5.63E-02	5.14E-05	B	
8	Brunswick 1 & 2	1.53E-03	6.95E-02	1.06E-04	B	
9	Byron 1 & 2	5.09E-04	7.23E-02	3.68E-05		
10	Callaway	1.08E-03	3.82E-02	4.14E-05		
11	Calvert Cliffs 1 & 2	7.67E-04	8.24E-02	6.33E-05		
12	Catawba 1 & 2	1.20E-03	6.27E-02	7.52E-05		
13	Clinton	1.55E-03	6.87E-02	1.06E-04	B	
14	Columbia (ex-WNP-2)	1.30E-03	1.37E-01	1.78E-04	B	
15	Comanche Peak 1 & 2	1.41E-04	5.52E-02	7.78E-06		
16	Cook 1 & 2	5.01E-04	7.77E-02	3.89E-05		
17	Cooper	1.16E-03	1.15E-01	1.33E-04	B	

UPDATE

Table AA-1 Seismic Initiating Event Frequencies

	mean frequency of exceedance (per year)					
g value	Clinton	Comanche Peak	Duane Arnold	Limerick	Pilgrim	
0.05	1.55E-03	1.41E-04	1.55E-04	1.22E-03	2.81E-03	
0.08	8.08E-04	6.79E-05	8.11E-05	6.99E-04	1.78E-03	
0.15	2.46E-04	1.88E-05	2.38E-05	2.29E-04	7.15E-04	
0.25	9.42E-05	6.42E-06	8.21E-06	8.35E-05	3.27E-04	
0.30	6.54E-05	4.19E-06	5.36E-06	5.55E-05	2.41E-04	
0.40	3.57E-05	2.02E-06	2.58E-06	2.75E-05	1.44E-04	
0.50	2.17E-05	1.10E-06	1.40E-06	1.52E-05	9.38E-05	
0.65	1.17E-05	5.08E-07	6.42E-07	7.10E-06	5.45E-05	
0.80	6.89E-06	2.66E-07	3.34E-07	3.73E-06	3.43E-05	
1.00	3.79E-06	1.28E-07	1.59E-07	1.79E-06	2.02E-05	
Seismic IE Freq. =	1.55E-03	1.41E-04	1.55E-04	1.22E-03	2.81E-03	

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