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UniStar
NUCLEAR ENERGY

10 CFR 50.4
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September 12, 2012

UN#12-093

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: UniStar Nuclear Energy, NRC Docket No. 52-016
Response to Request for Additional Information for the
Calvert Cliffs Nuclear Power Plant, Unit 3,
RAI 345, Vibratory Ground Motion

References:
1) Surinder Arora (NRC) to Paul Infanger (UniStar Nuclear Energy), "CCNPP3 - Final RAI 345 RGS1 6489," dated June 4, 2012

2) UniStar Nuclear Energy Letter UN#12-061, from Mark Finley to Document Control Desk, U.S. NRC, Response to Request for Additional Information for the Calvert Cliffs Nuclear Power Plant, Unit 3, RAI 345, Vibratory Ground Motion, dated July 3, 2012

The purpose of this letter is to respond to the request for additional information (RAI) identified in the NRC e-mail correspondence to UniStar Nuclear Energy, dated June 4, 2012 (Reference 1). This RAI addresses Vibratory Ground Motion, as discussed in Section 2.5.2 of the Final Safety Analysis Report (FSAR), as submitted in Part 2 of the Calvert Cliffs Nuclear Power Plant (CCNPP) Unit 3 Combined License Application (COLA), Revision 8.

Reference 2 indicated that a response to RAI 345, Question 02.05.02-24, would be provided to the NRC by September 13, 2012. Enclosure 1 provides our response to RAI No. 345 Question 02.05.02-24. Enclosure 2 provides the native Microsoft Excel data that was used to produce the tables and figures provided in Enclosure 1.

RAI responses normally provide a table of changes to the CCNPP Unit 3 COLA associated with the RAI response. RAI response transmittal letters also address any impact on earlier RAI responses. This table of changes and impact review on earlier RAI responses is not provided

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as there is no COLA markup or previous RAI response impact associated with this RAI 345 response. However, FSAR Section 2.5.2, Vibratory Ground Motion, will be updated with the responses to RAIs 284 (Incorporation of the New Madrid Fault System) and 322 (Evaluation of the Mineral Virginia Earthquake) to be consistent with this RAI 345 response. RAIs 284 and 322 are scheduled to be submitted by September 27, 2012.

There are no regulatory commitments identified in this letter. This letter does not contain any proprietary or sensitive information.

If there are any questions regarding this transmittal, please contact me at (410) 369-1907, or Mr. Wayne A. Massie at (410) 369-1910.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on September 12, 2012

Mark T. Finley

Enclosures: 1) Response to NRC Request for Additional Information RAI No. 345, Question 02.05.02-24, Vibratory Ground Motion, Calvert Cliffs Nuclear Power Plant, Unit 3

2) Native Data Used to Produce the RAI No. 345, Question 02.05.02-24 Response Figures and Tables (Disk), Calvert Cliffs Nuclear Power Plant, Unit 3

cc: Surinder Arora, NRC Project Manager, U.S. EPR Projects Branch
Laura Quinn-Willingham, NRC Environmental Project Manager, U.S. EPR COL Application (w/o enclosure 2)
Getachew Tesfaye, NRC Project Manager, U.S. EPR DC Application (w/o enclosure 2)
Patricia Holahan, Acting Deputy Regional Administrator, NRC Region II (w/o enclosure 2)
Silas Kennedy, U.S. NRC Resident Inspector, CCNPP, Units 1 and 2 (w/o enclosure 2)
David Lew, Deputy Regional Administrator, NRC Region I (w/o enclosure 2)

Enclosure 1

Response to NRC Request for Additional Information
RAI No. 345, Question 02.05.02-24, Vibratory Ground Motion
Calvert Cliffs Nuclear Power Plant, Unit 3

RAI No. 345

Question 02.05.02-24

This request for additional information (RAI) specifically addresses Recommendation 2.1, of the Fukushima Near-Term Task Force recommendations contained in SECY-12-0025 as it pertains to the seismic hazard evaluation. This recommendation specifies the use of NUREG-2115, "Central and Eastern United States Seismic Source Characterization for Nuclear Facilities," (CEUS-SSC) in a site probabilistic seismic hazard analysis (PSHA). Consistent with Recommendation 2.1, as well as the need to consider the latest available information in the (PSHA) for Calvert Cliffs Unit 3 planned reactor site, the NRC staff requests that UniStar:

a) Evaluate the potential impacts of the newly released CEUS-SSC model, with potential local and regional refinements as identified in the CEUS-SSC model, on the seismic hazard curves and the site-specific ground motion response spectra (GMRS)/foundation input response spectra (FIRS). For re-calculation of the PSHA, please follow either the cumulative absolute velocity (CAV) filter or minimum magnitude specifications outlined in Attachment 1 to Seismic Enclosure 1 of the March 12, 2012 letter " Request for information pursuant to Title 10 of the Code of Federal Regulations 50.54(f) regarding Recommendations 2.1, 2.3, and 9.3, of the near-term task force review of insights from the Fukushima Dai-Ichi accident." (ML12053A340).
b) Modify the site-specific GMRS and FIRS if you determine changes are necessary given the evaluation performed in part a) above.

Response

Response to Part a)

The Probabilistic Seismic Hazard Analysis (PSHA) was updated for the Calvert Cliffs Nuclear Power Plant (CCNPP) Unit 3 Site using the new Seismic Source Characterization (SSC) model developed for the Central and Eastern United States (CEUS) (EPRI/DOE/NRC, 2012). The analysis included the distributed seismicity source zones (i.e., Mmax and Seismotectonic zones) that lie or extend to within 200 miles (320 km) of the Site. For these source zones, hazard integration was carried out to a distance of 435 miles (700 km). Alternative configurations for some source zones are used with the logic tree weights taken from the CEUS SSC model. The various alternative approaches and configurations result in six source zone models as indicated in Table 1.

In addition to the distributed seismicity zones, the CEUS SSC model also defines seismic sources for features or areas with a history of Repeated Large Magnitude Earthquakes (RLMEs). No RLME sources exist within 200 miles (320 km) of the Site. However, RLME sources beyond 200 miles (320 km) from the Site are included in the PSHA to account for potential hazard from distant large earthquakes. The Charleston, New Madrid Fault System (NMFS), Eastern Rift Margin-North, Eastern Rift Margin-South, Commerce, Marianna, and Wabash RLME sources (Table 1) are used in the PSHA. Alternative configurations defined in the CEUS model are incorporated using the recommended logic tree weights as indicated in Table 1.

No local seismic sources were identified for the CCNPP Unit 3 Site. Thus the regional seismic source characterization model of the CEUS SSC was not supplemented with additional sources. The PSHA implemented a minimum lower bound magnitude (Mw) cutoff of 5.0 as outlined in Attachment 1 to Seismic Enclosure 1 of U.S. Nuclear Regulatory Commission letter, dated March 12, 2012[1].

The PSHA adopted the Electrical Power Research Institute (EPRI) ground motion model (EPRI, 2004; EPRI, 2006). Specifically, the 2004 Model (EPRI, 2004) is used with the modified ground motion standard deviations (EPRI, 2006). Adjustment factors for conversion from epicentral distance to distance metrics for the ground motion model are not used. Rather, the appropriate distance metrics, including variability, are calculated directly from the information on rupture characteristics (magnitude-rupture area scaling model, strikes, dip angles, aspect ratio) and focal depth as indicated by the CEUS SSC model.

Recurrence rates are also taken from the CEUS SSC model. For distributed seismicity sources, the gridded values provided in the CEUS SSC are re-sampled and appropriately scaled for the grid used in the hazard integration.

The impact of the updated CEUS SSC model on the seismic hazard of the CCNPP Unit 3 Site is analyzed by comparing the Uniform Hazard Response Spectra (UHRS) obtained from the previous hazard analysis reported in the CCNPP Unit 3 FSAR Rev. 8, to the UHRS obtained with the new CEUS SSC model. Table 2 and Figure 1 provide the comparison for 10^{-4} and 10^{-5} Mean Annual Frequency of Exceedance (MAFE). For a 10^{-4} MAFE, the UHRS obtained with the use of the updated CEUS SSC presents an increase in the spectral acceleration values of about 40 to about 150 percent. A similar increase of about 55 to about 140 percent is observed for the 10^{-5} MAFE ground motion. The response at the low frequency range is primarily driven by the local source zone that hosts the site and the New Madrid Fault System RLME.

Tabulated values of the CEUS 2012 MAFE hazard curves are provided in Table 3. Native data used to elaborate figures and tables are in a Microsoft EXCEL format file located on a disk provided with this submittal (Enclosure 2).

Response to Part b)

The evaluation performed in part a) above indicated that the site-specific Ground Motion Response Spectra (GMRS) would be impacted by the implementation of the CEUS 2012 SSC model. The GMRS was therefore recalculated by performing a new site response analysis consistent with Sections 2.5.2.5 and 2.5.2.6 of the CCNPP Unit 3 FSAR. Table 4 and Figures 1 and 2 provide the comparison of the GMRS obtained with the implementation of the 2012 CEUS SSC model and the GMRS currently reported in Section 2.5.2 of the CCNPP Unit 3 FSAR. Native data used to elaborate figures and tables are in a Microsoft EXCEL format file located on a disk provided with this submittal (Enclosure 2).

There is significant impact to the GMRS, and therefore the CCNPP Unit 3 Safe Shutdown Earthquake (SSE) and related Foundation Input Response Spectra (FIRS) will be re-evaluated prior to the development of the seismic reconciliation process. Subsequent structural response

[1] U.S. Nuclear Regulatory Commission Letter (ADAMS Accession Number ML12053A340), Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-Ichi Accident, dated March 12, 2012.

analyses will use seismic motion input that is consistent with the outcome of the CEUS 2012 updated PSHA analysis reported in this request for additional information (RAI) response.

There is no COLA markup associated with this RAI 345 response. However, FSAR Section 2.5.2, Vibratory Ground Motion, will be updated with the responses to RAIs 284 (Incorporation of the New Madrid Fault System) and 322 (Evaluation of the Mineral Virginia Earthquake) to be consistent with this RAI 345 response. RAIs 284 and 322 are scheduled to be submitted by September 27, 2012.

TABLE 1: Alternative Seismic Source Model Configurations used for the Updated Probabilistic Seismic Hazard Analysis of the CCNPP Unit 3 Site

ALTERNATIVE SOURCE MODELS		M_{MAX} MODEL/SEISMOTECTONIC MODEL		RLME SOURCES
NAME	WEIGHT	NAME	SOURCE ZONES	
Source Model I	0.160	M-I	STUDY-R	NMFS Commerce ERM-S ERM-N Marianna Wabash Charleston
Source Model II	0.048	M-II	MESE-W	
Source Model III	0.192	M-III	MESE-N, NMESE-N	
Source Model IV	0.320	M-IV	AHEX, ECC-AM, PEZ-N, MidC-A	
Source Model V	0.160	M-V	AHEX, ECC-AM, PEZ-N, MidC-B	
Source Model VI	0.120	M-VI	AHEX, ECC-AM, PEZ-W	

TABLE 2: Comparison of the UHRS obtained from the CCNPP Unit 3 FSAR Rev. 8 and the UHRS obtained with the use of the CEUS SSC model

FREQ [Hz]	ACCELERATION (10^{-4} MAFE) [g]			ACCELERATION (10^{-5} MAFE) [g]		
	2012 CEUS (NEW)	FSAR Rev. 8 (OLD)	Δ [%]	2012 CEUS (NEW)	FSAR Rev. 8 (OLD)	Δ [%]
0.5	0.0419	0.0164	155.37	0.1185	0.0488	142.83
1.0	0.0540	0.0269	100.67	0.1429	0.0722	97.92
2.5	0.0985	0.0577	70.64	0.2936	0.1580	85.82
5.0	0.1567	0.1020	53.63	0.5275	0.3090	70.71
10.0	0.2175	0.1490	45.97	0.7974	0.4930	61.74
25.0	0.3171	0.2280	39.08	1.1820	0.7670	54.11
100.0	0.1108	0.0766	44.65	0.4308	0.2710	58.97

TABLE 3: CCNPP Unit 3 MAFE hazard curves obtained with the use of the CEUS SSC model

ACC [g]	FREQUENCY [Hz]						
	0.5	1	2.5	5	10	25	100
	MEAN ANNUAL FREQUENCY OF EXCEEDANCE (MAFE)						
0.010	1.03E-03	1.99E-03	4.99E-03	7.39E-03	8.19E-03	7.95E-03	4.11E-03
0.020	3.60E-04	6.72E-04	1.87E-03	3.24E-03	4.07E-03	4.44E-03	1.71E-03
0.030	1.83E-04	3.25E-04	9.62E-04	1.82E-03	2.50E-03	2.98E-03	9.34E-04
0.040	1.09E-04	1.86E-04	5.78E-04	1.16E-03	1.69E-03	2.18E-03	5.85E-04
0.050	7.17E-05	1.18E-04	3.83E-04	8.02E-04	1.22E-03	1.67E-03	4.00E-04
0.060	4.98E-05	7.96E-05	2.70E-04	5.87E-04	9.22E-04	1.33E-03	2.91E-04
0.070	3.59E-05	5.64E-05	1.99E-04	4.47E-04	7.20E-04	1.08E-03	2.23E-04
0.080	2.67E-05	4.15E-05	1.52E-04	3.51E-04	5.77E-04	9.00E-04	1.76E-04
0.090	2.04E-05	3.14E-05	1.20E-04	2.84E-04	4.73E-04	7.61E-04	1.43E-04
0.100	1.58E-05	2.44E-05	9.69E-05	2.33E-04	3.95E-04	6.53E-04	1.19E-04
0.200	2.43E-06	4.32E-06	2.25E-05	6.32E-05	1.16E-04	2.18E-04	3.68E-05
0.250	1.25E-06	2.47E-06	1.40E-05	4.14E-05	7.81E-05	1.50E-04	2.54E-05
0.300	7.15E-07	1.58E-06	9.56E-06	2.94E-05	5.67E-05	1.10E-04	1.87E-05
0.400	2.99E-07	7.89E-07	5.21E-06	1.70E-05	3.43E-05	6.71E-05	1.14E-05
0.500	1.55E-07	4.64E-07	3.25E-06	1.11E-05	2.31E-05	4.56E-05	7.69E-06
0.600	9.19E-08	3.00E-07	2.19E-06	7.78E-06	1.68E-05	3.32E-05	5.52E-06
0.700	5.98E-08	2.07E-07	1.56E-06	5.73E-06	1.27E-05	2.54E-05	4.14E-06
0.800	4.15E-08	1.49E-07	1.16E-06	4.38E-06	9.94E-06	2.01E-05	3.19E-06
0.900	3.00E-08	1.11E-07	8.86E-07	3.44E-06	7.99E-06	1.63E-05	2.53E-06
1.000	2.25E-08	8.49E-08	6.94E-07	2.75E-06	6.55E-06	1.36E-05	2.04E-06
2.000	3.06E-09	1.22E-08	1.20E-07	5.65E-07	1.57E-06	3.79E-06	4.11E-07
3.000	8.14E-10	3.26E-09	3.69E-08	1.96E-07	6.02E-07	1.70E-06	1.31E-07
5.000	1.22E-10	4.93E-10	6.80E-09	4.30E-08	1.50E-07	5.57E-07	2.29E-08

TABLE 4: Comparison of the GMRS obtained from the CCNPP Unit 3 FSAR Rev. 8 and the GMRS obtained with the use of the CEUS SSC model

F [Hz]	HORIZONTAL ACC [g]		VERTICAL ACC [g]	
	CEUS 2012	CCNPP UNIT 3 FSAR REV. 8	CEUS 2012	CCNPP UNIT 3 FSAR REV. 8
0.100	0.0074	0.0027	0.0055	0.0020
0.125	0.0122	0.0047	0.0092	0.0035
0.150	0.0198	0.0079	0.0148	0.0059
0.200	0.0434	0.0202	0.0326	0.0152
0.300	0.0605	0.0335	0.0454	0.0251
0.400	0.0717	0.0357	0.0537	0.0268
0.500	0.1160	0.0425	0.0871	0.0319
0.600	0.1480	0.0673	0.1110	0.0504
0.700	0.1580	0.0819	0.1180	0.0614
0.800	0.1690	0.0914	0.1270	0.0685
0.900	0.1790	0.0955	0.1340	0.0716
1.000	0.1840	0.1030	0.1380	0.0769
1.250	0.2150	0.1230	0.1610	0.0923
1.500	0.2170	0.1280	0.1630	0.0964
2.000	0.1990	0.1230	0.1500	0.0926
2.500	0.2170	0.1290	0.1630	0.0970
3.000	0.2580	0.1510	0.1930	0.1140
4.000	0.2860	0.1690	0.2150	0.1270
5.000	0.2840	0.1720	0.2130	0.1290
6.000	0.2730	0.1800	0.2120	0.1400
7.000	0.2650	0.1720	0.2130	0.1380
8.000	0.2550	0.1640	0.2100	0.1350
9.000	0.2400	0.1570	0.2020	0.1320
10.000	0.2290	0.1500	0.1970	0.1280
12.500	0.2040	0.1380	0.1820	0.1230
15.000	0.1820	0.1280	0.1680	0.1180
20.000	0.1540	0.1090	0.1480	0.1050
25.000	0.1380	0.0980	0.1380	0.0980
30.000	0.1290	0.0877	0.1290	0.0877
35.000	0.1230	0.0827	0.1230	0.0827
40.000	0.1200	0.0797	0.1200	0.0797
45.000	0.1180	0.0781	0.1180	0.0781
50.000	0.1170	0.0773	0.1170	0.0773
60.000	0.1160	0.0763	0.1160	0.0763
70.000	0.1150	0.0759	0.1150	0.0759
80.000	0.1150	0.0757	0.1150	0.0757
90.000	0.1150	0.0756	0.1150	0.0756
100.000	0.1150	0.0755	0.1150	0.0755

FIGURE 1: Comparison of the UHRS obtained from the CCNPP Unit 3 FSAR Rev. 8 and the UHRS obtained with the use of the CEUS SSC model

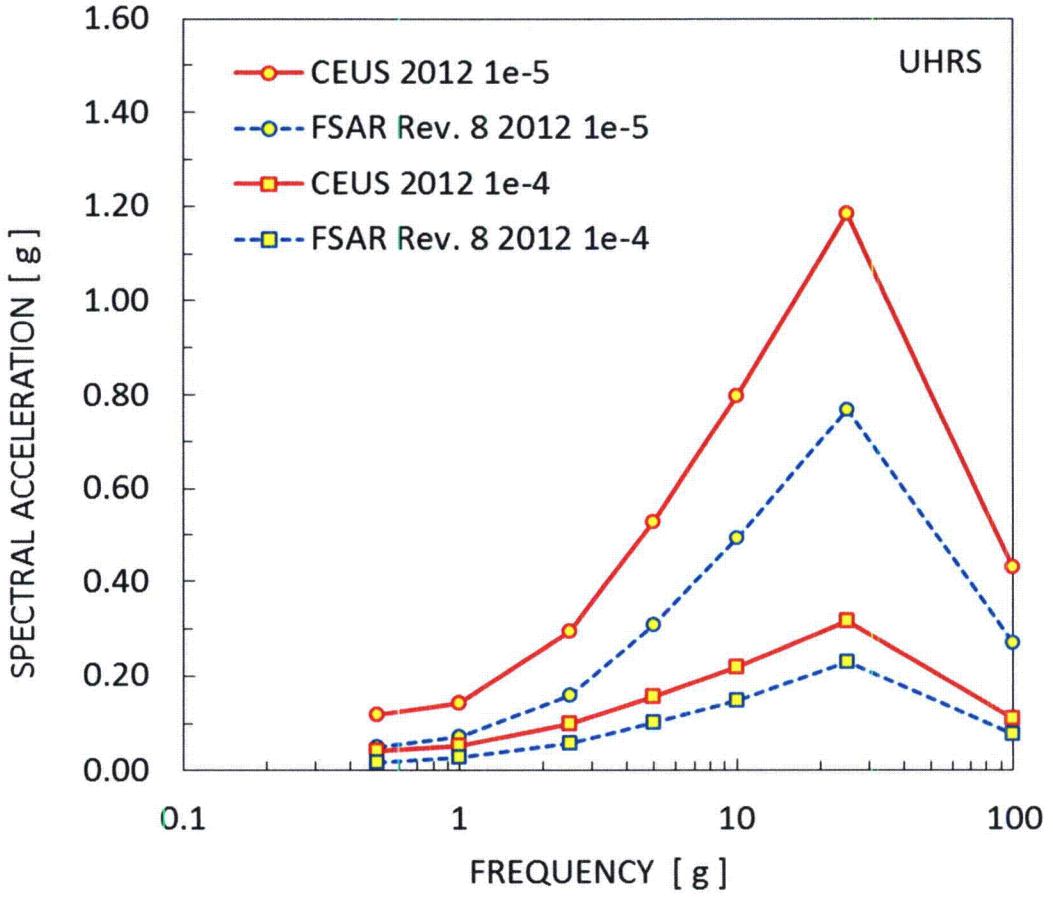
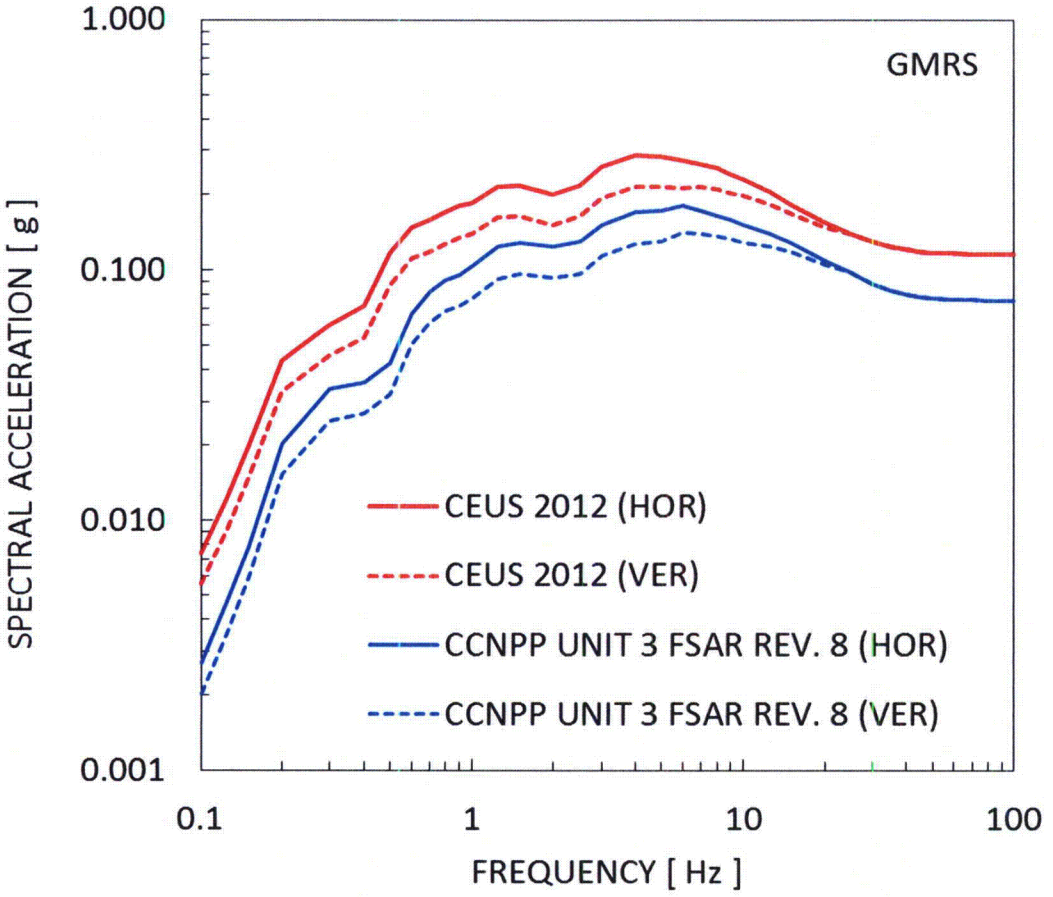


FIGURE 2: Comparison of the GMRS obtained from the CCNPP Unit 3 FSAR Rev. 8 and the GMRS obtained with the use of the CEUS SSC model



Enclosure 2

Native Data Used to Produce the RAI No. 345, Question 02.05.02-24 Response Figures and Tables (Disk), Calvert Cliffs Nuclear Power Plant, Unit 3