FENOC™
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June 29, 2015
L-15-202

10 CFR 50.54(f)

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852

SUBJECT:
Beaver Valley Power Station, Unit Nos. 1 and 2
Docket No. 50-334, License No. DPR-66
Docket No. 50-412, License No. NPF-73
Response to Request for Additional Information on Expedited Seismic Evaluation Process (ESEP) Reports and Seismic Hazard and Screening Reports Submitted Pursuant to 10 CFR 50.54(f) Regarding Recommendation 2.1 of the Near-Term Task Force (NTTF) Review of Insights from the Fukushima Dai-ichi Accident (TAC Nos. MF5223, MF5224, MF3726, and MF3727)

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued Reference 1 to all power reactor licensees and holders of construction permits in active or deferred status. Enclosure 1 of Reference 1 requested each addressee to reevaluate the site seismic hazard using updated seismic information and present-day regulatory guidance and methodologies and, if necessary, to perform a risk evaluation.

In Reference 2, the Nuclear Energy Institute (NEI) requested NRC agreement to a path forward to complete the seismic reevaluations. This path forward included an augmented approach to responding to Reference 1. In Reference 3, the NRC agreed with the path forward and the augmented approach presented in the Electric Power Research Institute (EPRI) report that was subsequently issued as EPRI Report 3002000704 (Reference 4).

By letters dated March 31, 2014 and December 19, 2014 (respectively), FirstEnergy Nuclear Operating Company (FENOC) submitted the seismic hazard and screening reports and ESEP reports for Beaver Valley Power Station (BVPS), Unit No. 1, BVPS Unit No. 2, Davis-Besse Nuclear Power Station, and Perry Nuclear Power Plant.

By electronic mail dated May 1, 2015 and May 12, 2015, the NRC staff requested additional information to complete its review of the ESEP reports and seismic hazard and screening reports for BVPS Unit No. 1 and BVPS Unit No. 2. A teleconference was held on May 20, 2015 between FENOC and NRC staff to obtain clarification on the requested information. During this teleconference, FENOC agreed to provide the response to the requests for additional information (RAIs) in one submittal. The RAI responses are attached.

There are no new regulatory commitments contained in this letter. If there are any questions or if additional information is required, please contact Mr. Thomas A. Lentz, Manager – Fleet Licensing, at 330-315-6810.

I declare under penalty of perjury that the foregoing is true and correct. Executed on June 29, 2015.

Respectfully,

Eric A. Larson

Attachment
Response to Request for Additional Information

Enclosure:
Response to NRC RAI Control Point GMRS and Control Point Hazard Curves Beaver Valley Power Station

References:

1. NRC 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*, dated March 12, 2012, Agencywide Documents Access and Management System (ADAMS) Accession No. ML12053A340
2. NEI Letter, *Proposed Path Forward for NTTF Recommendation 2.1: Seismic Reevaluations*, dated April 9, 2013, ADAMS Accession No. ML13101A379
3. NRC Letter, *Electric Power Research Institute Final Draft Report XXXXXX, "Seismic Evaluation Guidance: Augmented Approach for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic," as an Acceptable Alternative to the March 12, 2012, Information Request for Seismic Reevaluations*, dated May 7, 2013, ADAMS Accession No. ML13106A331

4. EPRI Report 3002000704, S*eismic Evaluation Guidance: Augmented Approach for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic*, dated April 2013, ADAMS Accession No. ML13107B387

cc: Director, Office of Nuclear Reactor Regulation (NRR)
NRC Region I Administrator
NRC Resident Inspector
NRR Project Manager
Director BRP/DEP (without Enclosure)
Site BRP/DEP Representative (without Enclosure)

By letters dated March 31, 2014 and December 19, 2014, FirstEnergy Nuclear Operating Company (FENOC) submitted the seismic hazard and screening reports and Expedited Seismic Evaluation Process (ESEP) reports (respectively) for Beaver Valley Power Station (BVPS), Unit No. 1, BVPS Unit No. 2, Davis-Besse Nuclear Power Station, and Perry Nuclear Power Plant. By electronic mail dated May 1, 2015 and May 12, 2015, the Nuclear Regulatory Commission (NRC) staff requested additional information to complete its review of the ESEP reports and seismic hazard and screening reports for BVPS Unit No. 1 and BVPS Unit No. 2. The NRC requests are provided in bold type, followed by the FENOC response.

ESEP Clarification Question 1:

Section 3.1.5 of the ESEP Reports states:

> ***Critical indicators and recorders are typically physically located on panels/cabinets and are included as separate components; however, seismic evaluation of the instrument indication may be included in the panel/cabinet seismic evaluation (rule-of-the-box).***

Section 6.1 of the ESEP Reports states:

> ***A number of components on the ESEL are breakers and switches that are housed in a "parent" component, such as a motor control center (MCC) or switchgear. For the purpose of this evaluation, calculations are not explicitly performed for these housed components. Instead, their HCLPF is assigned based on the parent component.***

The information provided in both paragraphs is not clear. Please provide a more detailed description of both approaches, how they are different, when would each approach be applied, and examples for both approaches to show how the HCLPF values of the devices were determined, including consideration of cabinet amplification, if applicable. Also, describe whether any of these devices are sensitive to vibration as are relays and other devices with contacts, and if so, how they were evaluated. Lastly, if the qualification of the devices is based on the cabinet/panel they are housed in, which have been previously qualified as part of an equipment class ("parent" component), how is it known/confirmed that the parent component normally contains the particular device.

FENOC Response:

The above referenced sections of the ESEP Report describe the approach to the rule-of-the-box. Section 3.1.5 states that indicators and recorders are listed on the expedited seismic equipment list (ESEL) as distinct items, but that their seismic evaluation is based on the evaluation of the "parent" component. Section 6.1 reiterates that when an ESEL item is identified to be mounted on a parent component, the high confidence of low probability of failure (HCLPF) of the parent component is assigned to the item.

With the exception of the BVPS Unit No. 2 relays that automatically start the turbine driven auxiliary feed water pump (TDAFWP) (housed in Panel RK-2RC-PRT-A), no equipment or devices on the ESEL that are possibly sensitive to vibration, are identified as critical such that their spurious change of state affects the FLEX strategy. The HCLPF for this specific relay (Relay Model AR440AR) is calculated using the applicable test response spectrum (TRS) and includes cabinet amplification.

No specific relay evaluation is required for BVPS Unit No. 1 since the relay included in the Unit No. 1 ESEL is a slave relay in the solid state protection system and has no lockout function. This solid state relay is not prone to chatter in a seismic event, and the capacity of the relay is governed by the seismic capacity of the housed panel, as documented in Attachment B.

The other housed items on the ESEL are addressed on the basis of the rule-of-the-box. The HCLPF calculations are based on the guidance provided in Electric Power Research Institute (EPRI) TR-1002988, in which a generic capacity of 1.8g or use of generic equipment ruggedness data (GERS) is endorsed. The HCLPF developed for the parent component is assigned as the HCLPF value to all ESEL components housed therein, as documented in Attachment B.

For example, Unit No. 1 indicators TI-1RC-412A and LI-1RC-459A were walked down to confirm their location and mounting on the Control Room Vertical Board VB-B. These indicators are therefore assigned the HCLPF of VB-B. Similarly, a walkdown confirmed that the Terry Turbine FW-T-2 is mounted on the same skid as Feedwater Pump FW-P-2. As the HCLPF calculation for FW-P-2 considers everything within the boundary of the skid, FW-T-2 is assigned the HCLPF of FW-P-2.

ESEP Clarification Question 2:

Table 7-1 identifies seven (7) inaccessible items. Table 7-1 states that six of these items were resolved by calculating fragilities based on design documentation and installation drawings. One item is resolved by reviewing plant drawings to obtain information for structural/anchorage evaluation. The ESEP Reports indicate that no walk-down was planned because of high radioactive environments. The sentence prior to Table 7-1 states:

The criteria implemented to confirm the installed condition follows EPRI NP 6041, where a number of ways of confirming the installed condition of equipment, including follow up walkdowns, photographic or other confirmatory evidence is provided.

The licensee is requested to clarify the difference between the statements in Table 7-1, wherein it is stated that the inaccessible item is resolved through review of design documentation and installation drawings, and the statement in the sentence prior to the table, quoted above.

Please confirm that the installed condition of the equipment has been confirmed in accordance with the criteria in EPRI 6041. If not, since many inaccessible items were installed many years ago, the licensee is requested to clarify whether design documentation and installation drawings can reflect current conditions of those inaccessible items, and therefore ensure realistic fragility calculations.

FENOC Response:

Seismic walkdowns were performed in support of seismic probabilistic risk assessment (SPRA) evaluations in addition to ESEP evaluations as stated in Section 6.1 of the ESEP Report. Combining the scope of the SPRA and ESEP, more than 700 components per Unit were walked down, and the same Seismic Review Team (SRT) performed both walkdowns.

The current condition of the inaccessible items is assessed on the basis of the familiarity with the plant conditions and utilizing one or more of the following methods to ensure that the fragility calculations reflect the current plant conditions:

1. Similarity to other components – Most of the inaccessible ESEL items are similar to components that are found throughout the plant. For example, level transmitters were identified to have similar manufacturers and mounting configurations no matter which system they serve or in which structure they are located. The plant drawings show the inaccessible level transmitters to be consistent with the other observed level transmitters, so the SRT is confident that the drawings accurately reflect the plant conditions.

2. Mounting configuration from drawings – The SRT found that plant drawings for accessible components accurately reflect the as-installed conditions in the plant. Furthermore, the mounting configurations shown on drawings for inaccessible components were consistent with mounting configurations observed elsewhere in the plant.

3. Identification of plant modifications or seismic evaluations – For inaccessible components, the SRT performed a search of the plant file system for

modifications or previous seismic evaluations associated with the component. Examples of these types of files include seismic reevaluations performed in support of individual plant examination of external events (IPEEE) and A-46 programs. These files, when available, provide more detailed information about the component than is shown on plant design drawings.

These above methods were used as the basis to confirm the installed conditions of the inaccessible components consistent with the recommendation of EPRI 6041.

The fragility calculations and anchorage evaluation relied on the design information such as drawings and design basis analysis.

ESEP Clarification Question 3:

Section 5.2 of the ESEP Reports for Beaver Valley Power Station states the following:

> ***Subsequent equipment HCLPF calculations and fragility evaluations are based on the conservative deterministic failure margin (CDFM) approach. In accordance with EPRI 1019200 [10] "Seismic Fragility Applications Guide Update," the seismic analyses are performed using BE structure stiffness, mass and damping characteristics, and the BE subsurface Vs profile compatible with the expected seismic shear strains. The resulting ISRS approximately represent the 84th percentile response suitable for use in the CDFM calculations.***

Section 4 of the Seismic Evaluation Guidance, Augmented Approach (EPRI 3002000704) allows the development of ISRS [in-structure response spectrum] calculated from new SSI [soil structure interaction] models. The guidance document indicates that: EPRI 1025287 (SPID) and the ASME/ANS PRA Standard give guidance on acceptable methods to compute both the GMRS [ground motion response spectra] and the associated ISRS. Table 6-5 in the SPID document, under the SFR-C6 entry, indicates that ASME/ANS PRA Standard (Addendums A and B) requires consideration of the variation of soil properties (Vs profile). Also, the SFR-C5 entry indicates that if the median-centered response analysis is performed, the evaluation should estimate the median response (i.e., structural loads and ISRS) and variability in the response using established methods.

Based on EPRI 1019200, which was referenced by the ESEP Reports, parameter variation should be incorporated into SSI analyses in order to characterize the uncertainty in the SSI demands. EPRI 1019200 indicates that the SSI analyses in ASCE 4 be followed, which require that SSI evaluations include lower bound and upper bound soil profiles to account for parameter variation in SSI. EPRI 1019200

also indicates that for the structural model, the best estimate (median) and uncertainty variation in the frequency should be considered.

Therefore, please describe how parameter variation is incorporated into the SSI analyses for the structural model and subsurface while using only the best estimate (BE) structure stiffness, mass and damping characteristics, and the BE subsurface Vs profile. Related to the above discussion, if only the BE is used for the structural model and soil profile, explain how the ISRS would approximately represent the 84th percentile response, as stated in the ESEP report.

FENOC Response:

The recommended guidelines (EPRI 1019200) are used to obtain a deterministic response for the given shape of the foundation input response spectrum (FIRS), and using best estimate structure and soil stiffness and conservative estimate of median damping. This response approximates the 84th percentile relative to the statistical distribution that would result from, for example, a set of 30 calculations randomly varying stiffness and damping parameters and using a set of 30 time histories. The deterministic response is suitable for use in the CDFM calculation of fragilities of plant structures, systems, and components (SSCs).

EPRI 1019200 further states that the SSI analysis should address best estimate plus parameter variation, and that the peak shifting should be used instead of peak broadening recommended in ASCE 4-98. However, the reported analysis uses only the result from the BE soil column (stiffness and damping), and median structure stiffness and damping. The effects of variability of the soil column stiffness and damping are considered using the approach in EPRI 6041. This approach estimates the upper and lower bound SSI frequencies based on the fixed base frequency, the best estimate SSI frequency and a C_v factor in the soil column stiffness. Considering the depth to rock and the overlying basal gravel and engineered fill, the upper and lower bound SSI frequencies are estimated to be in the range of ± 15 percent of the best estimate SSI frequency.

Therefore, the upper and lower bound seismic responses are not expected to be significantly different from the best estimate response. Nevertheless, the variability in the SSI stiffness is accommodated in the CDFM method for calculating fragilities by peak shifting of at least ± 20 percent.

ESEP Clarification Question 4:

Section 6.4 of the ESEP Reports states that all HCLPF calculations were performed using the CDFM methodology. Table 7-1 states that "Fragility is calculated…". In addition, Appendix B provides information for β_C, β_R, and β_U, which would indicate that a fragility analyses has been performed.

The licensee is requested to confirm that only the CDFM methodology has been used, or to identify that fragility analysis has also been performed. If fragility analyses have been performed, then the description of the methods used to estimate HCLPF values should be updated to include a description of the fragility analyses methods used.

FENOC Response:

CDFM methodology has been used for the calculations as stated in Section 6.4 of the ESEP Report. The use of the word "fragility" in this context refers to the hybrid approach for fragilities where the HCLPF capacity is calculated first using CDFM methodology and the median capacity is then determined with an assumed composite variability (β_C). The hybrid approach to fragilities and the associated variabilities are described in Section 6.4.1 of EPRI 1025287.

ESEP Clarification Question 5:

Section 6.3.1 of the ESEP Reports states that

> ***The "similarity basis" was planned to be confirmed during walk-bys, which would also record anomalies in installation or presence of seismic interaction, if any.***

It is not clear from the discussion provided that these walk-bys have in fact been completed. The licensee is requested to confirm that the planned walk-bys have been completed, or provide a schedule for completion.

FENOC Response:

The "similarity basis" walk-bys have been completed. As mentioned in Section 6.3.1 of the ESEP Report, all representative and walk-by items are fully documented on Seismic Evaluation Work Sheets (SEWS).

ESEP Clarification Question 6:

Section 6.6 of the ESEP Report for Unit 1 states that "Attachment B tabulates the HCLPF values for all components on the ESEL." Attachment A, the ESEL, contains 263 items while Attachment B provides HCLPF values for 63 items. Since Section 6.2 states that no screening was performed, it is not clear how the additional 200 items are evaluated.

The licensee is requested to describe the process used to evaluate the 200 items listed in the ESEL (Attachment A) that are not addressed in Attachment B. This issue is also applicable for Unit 2.

FENOC Response:

Based on the guidance in EPRI 3002000704, 263 items in Unit No. 1 were identified as potential ESEL items. Following the EPRI screening process, described in Section 3.1 of the ESEP Report, 200 of these items were screened out. The final ESEL contains 63 screened in components. Attachment A summarizes and documents this screening process. No further screening was performed based on ruggedness, and all 63 items on the final ESEL were evaluated to obtain HCLPF values.

Similarly for Unit No. 2, 256 of the 313 potential ESEL items were screened out based on the guidance in EPRI 3002000704, resulting in 57 items on the final ESEL. No further screening was performed based on ruggedness, and all 57 items on the final ESEL were evaluated to obtain HCLPF values.

NRC Request Regarding Seismic Hazard and Screening Report:

Provide: Control point hazard curves at the Ground Motion Response Spectrum (GMRS) level and the GMRS itself.

FENOC Response:

The requested information is provided in the enclosed report, *Response to NRC RAI Control Point GMRS and Control Point Hazard Curves Beaver Valley Power Station*.

Enclosure
L-15-202

Response to NRC RAI Control Point GMRS and Control Point Hazard Curves
Beaver Valley Power Station
(31 pages follow)

ABS Consulting

RIZZO ASSOCIATES

3523003-R-002
Revision 0

Response to NRC RAI Control Point GMRS and Control Point Hazard Curves Beaver Valley Power Station

June 5, 2015

Prepared for:

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3523003-R-002
Revision 0

Response to NRC RAI Control Point GMRS and Control Point Hazard Curves Beaver Valley Power Station

June 5, 2015

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APPROVALS

Report Name: Response to NRC RAI
Control Point GMRS and Control Point Hazard Curves
Beaver Valley Power Station

Date: June 5, 2015

Revision No.: 0

Approval by the responsible manager signifies that the document is complete, all required reviews are complete, and the document is released for use.

Originator:	Nish Vaidya [signature] Nishikant R. Vaidya, V.P. Advanced Engineering Projects, RIZZO Associates Nish Vaidya, Ph.D., P.E. Principal	06/05/15 Date
Independent Technical Reviewer:	[signature] Farzin R. Beigi, P.E. Senior Consultant	06/05/15 Date
Approver:	[signature] Thomas R. Roche, P.E. Vice President	06/05/15 Date
FENOC Reviewer:	[signature] Eugene Ebeck Supervisor Nuc. Civil/Structural Engineering	6/8/15 Date
FENOC Approver:	[signature] Carmen Mancuso Manager Design Engineering	6-9-15 Date

Table of Revisions

Revision No.	Date	Description of Revision
0	June 5, 2015	Initial submittal.

RESPONSE TO NRC RAI
CONTROL POINT GMRS AND CONTROL POINT HAZARD CURVES
BEAVER VALLEY POWER STATION

BACKGROUND

U.S. Nuclear Regulatory Commission's (NRC) Request for Additional Information (RAI) of October 31, 2014, related to the March 2014 submittal requested "...the basis for total kappa values of 21.3 msec for P1, 23.7 msec for P2, and 19.3 msec for P3 calculated for the Beaver Valley Power Station."

In response to the above request, FirstEnergy Nuclear Operating Company (FENOC) provided a response dated November 5, 2014, which clarified that as part of developing the foundation input response spectra (FIRS) for use in the seismic probabilistic risk assessment (SPRA), "...The kappa values estimated for the Beaver Valley Probabilistic Seismic Hazard Analysis (PSHA) used for the Seismic Probabilistic Risk Assessment (SPRA) have been revised relative to the kappa values listed in the March submittal to NRC. The revised GMRS are being used in the BVPS SPRA as well as the ESEP Report."

In addition to revised kappa values, the updated PSHA/ground motion response spectra (GMRS) calculation completed for the SPRA incorporated (1) modified damping values for the top 500 ft of the Paleozoic rock section and (2) the soil above the foundation levels in the soil column analyzed to obtain the FIRS.

In a subsequent phone call of May 20, 2015, the NRC further requested the GMRS and hazard curves at the outcropping reactor building (RB) foundation level; i.e., without the presence of soil layer above this level. In response to this request, the Calculation presented here develops the hazard curves and the GMRS at the RB outcropping foundation level. The RB bottom of foundation is taken as the Control Point Elevation. At the Beaver Valley Power Station (BVPS) this level corresponds to EL 681.0.

SUBSURFACE SOIL COLUMN

Table 2-3 of Ref [1], shown below as ***Table 1*** describes the subsurface column underlying the site grade.

TABLE 1 (REF [1])
CHARACTERISTICS OF SUBSURFACE STRATIGRAPHIC UNITS – BVPS-1 SITE

ELEVATION [ft]	LAYER NO.	SOIL/ROCK DESCRIPTION	γ_{total}[D] [pcf]	Vs[A] [ft/s]	μ[E]
		Plant Grade (Surface Elevation)			
735		Structural Fill/ Natural and Densified Soil	136	730±183[B]	0.35[B]
720		Structural Fill/ Natural and Densified Soil	136	1015±254[B]	0.35[B]
680.9	1(d)	Pleistocene Upper and Lower Terrace	125	1100±275[B]	0.28[B]
680.9		**GMRS Elevation - SSE Control Point at Base of Nuclear Island Foundation**			
665		**Ground Water Elevation**			
665	1(e)	Pleistocene Upper and Lower Terrace	136	1200±300[B]	0.48[B]
625	2	Middle Pennsylvanian Allegheny Shale	160	5000±1000[B]	0.39[B]
550[C]	3	Lower Pennsylvanian Pottsville Sandstone, conglomerate	160	6,026	0.30
350	4	Upper Mississippian Mauch Chunk Shale	155	6,744	0.30
300	5	Lower Mississippian Pocono Sandstone conglomerate	155	6,744	0.30
-120	6	Upper Devonian Interbedded Shale, Sandstone, Siltstone	155	7,112	0.30
-2,994			155	6,416	0.30
-3,700	7	Middle Devonian Tully Limestone	168	9,856	0.30
-3,820	8	Middle Devonian Mahantango Shale	157	9,856	0.30
-3,900	9	Middle Devonian Marcellus Shale	157	9,856	0.30
-3,935	10	Middle Devonian Onondaga Limestone, Dolomite	170	9,856	0.30
-4,150	11	Lower Devonian Ridgeley Sandstone	160	9,856	0.30
-4,250	12	Lower Devonian Helderberg Limestone, Shale	170	9,856	0.30
-4,450	13	Upper Silurian Bass Island Dolomite, Limestone	170	8,352	0.30
-4,540	14	Upper Silurian Salina Dolomite, Limestone	170	8,352	0.30
-5,034			170	9,547	0.30
-5,330	15	Upper Silurian Wells Creek Shale	163	11,534	0.30
-5,550	16	Middle Silurian Lockport Dolomite	170	9,015	0.30
-5,900	17	Middle Silurian Rochester Shale	163	9,015	0.30
-5,980	18	Middle Silurian Rose Hill Shale	163	9,015	0.30
-6,170	19	Lower Silurian Tuscarora Sandstone	163	8,588	0.30
-6,390	20	Upper Ordovician Queenston Shale, Siltstone, Sandstone	163	8,588	0.30
-7,123	21		163	7,835	0.30
-7,455	21(a)	Upper Ordovician Reedsville Shale	163	7835	0.30
-7,698	21(b)		163	6834	0.30

TABLE 1 (REF [1])
CHARACTERISTICS OF SUBSURFACE STRATIGRAPHIC UNITS – BVPS-1 SITE
(CONTINUED)

ELEVATION [ft]	LAYER NO.	SOIL/ROCK DESCRIPTION	γ_{total}[D] [pcf]	Vs[A] [ft/s]	μ[E]
-8,265	22	Middle Ordovician Utica Shale	163	6834	0.30
-8,565	23	Middle Ordovician Trenton Limestone	175	10,520	0.30
-9,305	24	Middle Ordovician Gull River Limestone, Dolomite	175	10,520	0.30
-9,455	25	Lower Ordovician Beekmantown Dolomite	175	10,520	0.30
-9,645	26	Upper Cambrian Gatesburg Dolomite Sandstone	170	10,520	0.30
-9,995	27	Middle Cambrian Rome Dolomite	175	10,520	0.30
-10,695	28	Lower Cambrian Mt. Simon Sandstone	170	10,520	0.30
-10,865	29	Precambrian Granite	175	10,520	0.30

Notes:

A. Variability in Vs of soil is based on SPT-V_s correlations (COV=25 percent). COV is assumed 20 percent as average of soil and rock for the rock at the top and for deeper rock units COV = 11 percent is assumed based on the information from deep wells; B. Appendix 2D, 2G, and 2H of BVPS-1 UFSAR; C. From this elevation down, soil parameters are estimates from sonic velocities of deep wells except unit weight. Unit weights are typical values from the literature. Poisson's ratio is calculated by following formula: Poisson's Ratio = $[(Vp/Vs)^2 - 2] / [2(Vp/Vs)^2 - 2]$; D. Unit weight; E. Poisson's ratio.

With reference to the ***Table 1***, three Base Case profiles are considered in the development of the GMRS and the hazard curves at the control point elevation as described in Ref [1]. However, in contrast to Ref [1], the nonlinear characteristics of the subsurface materials are as follows.

NON-LINEAR CHARACTERISTICS OF SUBSURFACE MATERIALS

For the lower Pleistocene Upper and Middle Terrace: Middle Unit 1D and Lower Unit 1E) which have Vs values for the randomized soil profiles generally exceeding 1,000 ft/s, the dynamic properties are based on the Electric Power Research Institute (EPRI) (1993, Ref [2]) soil curves for the appropriate depth range. The dynamic properties for these two layers are displayed in ***Table 2***.

TABLE 2
DYNAMIC PROPERTIES USED FOR THE PLEISTOCENE UPPER/MIDDLE TERRACE: UPPER UNIT FOR PROFILE P1 AT THE BVPS SITE

STRAIN (%)	G/GMAX [EPRI SOIL 21–50 ft] PROFILE P1	DAMPING (%) [EPRI SOIL 21–50 ft] PROFILE P1
1.00E-04	1.000	1.142
1.78E-04	1.000	1.196
3.16E-04	1.000	1.250
5.62E-04	0.999	1.304
1.00E-03	0.993	1.469
1.78E-03	0.979	1.670
3.16E-03	0.952	2.074
5.62E-03	0.903	2.658
1.00E-02	0.830	3.622
1.78E-02	0.733	5.066
3.16E-02	0.617	7.069
5.62E-02	0.488	9.569
1.00E-01	0.366	12.500
1.78E-01	0.258	15.688
3.16E-01	0.173	19.004
5.62E-01	0.108	22.022

STRAIN (%)	G/GMAX [BELL BEND] PROFILE P2	DAMPING (%) [BELL BEND] PROFILE P2	G/GMAX [PENINSULAR] PROFILE P3	DAMPING (%) [PENINSULAR] PROFILE P3
1.00E-04	0.9800	1.26000	1.00000	1.00000
3.16E-03	0.9564	1.26960	1.00000	0.97800
1.00E-03	0.8766	1.48239	0.99800	1.16500
2.00E-03	0.7972	1.84711	0.98435	1.41953
3.00E-03	0.7479	2.08253	0.97163	1.58836
5.00E-03	0.6656	2.70751	0.94131	1.95748
7.00E-03	0.6095	3.15046	0.91266	2.34474
1.00E-02	0.5500	3.62000	0.87800	2.83000
2.00E-02	0.4343	5.70949	0.77548	4.22423
3.00E-02	0.3665	6.93177	0.70060	5.34888
5.00E-02	0.2867	9.17047	0.59218	7.22164
7.00E-02	0.2345	10.6833	0.52013	8.69806
1.00E-01	0.1794	12.2950	0.44400	10.3810
2.00E-01	0.1076	16.3206	0.30709	14.0449
3.00E-01	0.0656	18.6754	0.23432	16.3479
1.00E-00	0.0200	24.7100	0.09200	22.5800

Note: The dynamic properties for Profiles P2 and P3 are as shown above but with the damping curve scaled to low-strain damping value based on the EPRI Soil (21–50 ft).

For the rock material, uncertainty is represented by modeling the material as either linear or non-linear in its dynamic behavior over the top 500 ft of rock. This material primarily consists of shale and sandstone.

The use of the EPRI rock curves, which exhibit a relatively high amount of low-strain damping (~3.2 percent), is limited to the upper 100 ft where the rock is considered as weathered and fractured. For the alternative linear analyses, the low-strain damping from the EPRI rock curves was used as the constant value of damping in the upper 100 ft. The EPRI rock dynamic properties are shown in ***Table 3.***

Within the depth range of 100 ft to 500 ft, non-linear dynamic behavior is based on the unweathered shale dynamic properties from Stokoe et al., (2003) (Ref [3]) for the Y-12 Site at Oak Ridge, Tennessee. For these curves the low-strain damping is about 1 percent. For the alternative linear analyses, the low strain damping from the Stokoe et al., (2003) (Ref [3]) unweathered shale curves was used as the constant damping value from 100 ft to 500 ft. The Stokoe et al., (2003) (Ref [3]) unweathered shale dynamic properties are displayed in ***Table 4.***

Given that there is no preference between the two degradation curves shown in ***Table 3 and 4***, and given the lack of direct laboratory testing for the Paleozoic rocks, these two curves are modeled with equal weight (0.5). Epistemic uncertainty in damping also considers linear damping assumptions using the low strain damping from either EPRI (1993) (Ref [2]) or DOE Y-12. There is also no preference between linear versus equivalent-linear assumptions, and as a result these two assumptions are modeled with equal weight.

Below a depth of 500 ft, linear material behavior is adopted, with the damping value specified consistent with the kappa estimate for the Site.

TABLE 3
ROCK DYNAMIC PROPERTIES FROM EPRI (1993)

Strain (%)	EPRI Rock 0–20 ft	EPRI Rock 21–50 ft	EPRI Rock 51–120 ft	EPRI Rock 121–250 ft	EPRI Rock 251–500 ft
	G/Gmax	G/Gmax	G/Gmax	G/Gmax	G/Gmax
1.00E-04	1.0000	1.0000	1.0000	1.0000	1.0000
3.00E-04	1.0000	1.0000	1.0000	1.0000	1.0000
1.00E-03	0.9716	0.9801	0.9898	0.9997	1.0000
3.00E-03	0.8614	0.8844	0.9121	0.9417	0.9668
1.00E-02	0.6294	0.6653	0.7118	0.7667	0.8324
3.00E-02	0.3830	0.4177	0.4655	0.5264	0.6119
1.00E-01	0.1747	0.1967	0.229	0.2735	0.3454
3.00E-01	0.0714	0.0821	0.0984	0.1224	0.1649
1.00E-00	0.0238	0.0277	0.0338	0.0431	0.0608
3.00E-00	0.0084	0.0098	0.012	0.0154	0.0222
Strain (%)	Damping (%)	Damping (%)	Damping (%)	Damping (%)	Damping (%)
1.00E-04	3.263	3.245	3.225	3.206	3.186
3.00E-04	3.390	3.339	3.282	3.227	3.167
1.00E-03	4.017	3.869	3.701	3.534	3.348
3.00E-03	5.580	5.250	4.865	4.463	3.995
1.00E-02	9.191	8.550	7.773	6.926	5.881
3.00E-02	14.397	13.532	12.429	11.140	9.398
1.00E-01	21.091	20.178	18.960	17.459	15.272
3.00E-01	26.578	25.853	24.838	23.509	21.413
1.00E-00	30.601	30.180	29.564	28.711	27.248
3.00E-00	32.530	32.317	31.998	31.540	30.712

TABLE 4
UNWEATHERED SHALE DYNAMIC PROPERTIES FROM STOKOE ET AL., (2003)

Strain (%)	G/Gmax Mean	G/Gmax Plus 1 Standard Deviation	G/Gmax Minus 1 Standard Deviation	Damping (%) Mean	Damping (%) Plus 1 Standard Deviation	Damping (%) Minus 1 Standard Deviation
1.00E-06	1.00	1.01	0.99	1.00	1.79	0.21
1.00E-05	1.00	1.02	0.98	1.00	1.79	0.21
1.00E-04	1.00	1.02	0.98	1.01	1.79	0.22
1.00E-03	1.00	1.02	0.97	1.06	1.87	0.25
3.00E-03	0.99	1.02	0.95	1.19	2.04	0.33
5.00E-03	0.98	1.02	0.94	1.31	2.21	0.41
1.00E-02	0.95	1.00	0.90	1.61	2.61	0.62
2.00E-02	0.91	0.97	0.85	2.19	3.35	1.03
3.00E-02	0.87	0.94	0.80	2.73	4.03	1.44
4.00E-02	0.83	0.91	0.76	3.25	4.66	1.84
5.00E-02	0.80	0.88	0.72	3.74	5.26	2.23
6.00E-02	0.77	0.85	0.69	4.21	5.82	2.61
7.00E-02	0.74	0.83	0.65	4.66	6.34	2.97
8.00E-02	0.71	0.80	0.63	5.08	6.84	3.32
8.50E-02	0.70	0.79	0.61	5.29	7.08	3.49
1.00E-01	0.67	0.76	0.57	5.88	7.77	3.98
1.50E-01	0.57	0.67	0.48	7.59	9.75	5.44
2.00E-01	0.50	0.60	0.40	9.02	11.36	6.67

SITE RESPONSE INPUT

Consistent with the guidance from EPRI (2013, Ref [4]), uncertainty and variability in material dynamic properties are included in the site response analysis. ***Table 5*** presents the full set of parameters used in the site response analysis.

TABLE 5
SITE RESPONSE INPUT BVPS SITE NUCLEAR ISLAND

Input Parameter	Value					
Seismic Source Input	M = 6.5 with distances and depths resulting in at 11 PGA values from 0.01 g to 1.5 g at the Site					
	Single-corner Table B-4 SPID	Double-corner Table B-6 SPID	Single-corner Table B-4 SPID	Double-corner Table B-6 SPID	Single-corner Table B-4SPID	Double-corner Table B-6 SPID
Source Model	Additional parameters used in the point source model found below Table B-4					
Profile	Best Estimate (P1)		Lower Range (P2)		Upper Range (P3)	
Vs	Table 2-4, Ref [1] (P1) W = 0.40 30 Randomized Realizations		Table 2-4, Ref [1] (P2) BE divided by 1.15 W = 0.30 30 Randomized Realizations		Table 2-4, Ref [1] (P3) BE multiplied by 1.15 W = 0.30 30 Randomized Realizations	
Site Kappa (k1)	Total Thickness 4435 ft (k1) = 0.0167s W = 1.0		Total Thickness 4435 ft (k1) = 0.0191s W = 0.60		Total Thickness 4435 ft (k1) = 0.0146 s W = 0.60	

TABLE 5
SITE RESPONSE INPUT BVPS SITE NUCLEAR ISLAND
(CONTINUED)

Input Parameter		Value					
Shear Modulus and Damping With (k1)	Pleistocene Upper/Middle Terrace: Middle Unit 16 ft	EPRI Soil 21-50 ft					
	Pleistocene Upper/Middle Terrace: Lower Unit 40 ft	EPRI Soil 51-120 ft					
	Rock Top 100 ft	EPRI Rock	3.2% Linear damping	EPRI Rock	3.2% Linear damping	EPRI Rock	3.2% Linear damping
	Rock 101 to 500 ft	Y-12 Rock	1.0 % Linear damping	Y-12 Rock	1.0 % Linear damping	Y-12 Rock	1.0 % Linear damping
	Rock 501 ft to profile base	0.52 % Linear damping	0.52 % Linear damping	0.58 % Linear damping	0.58 % Linear damping	0.44 % Linear damping	0.44 % Linear damping
	Weight	W = 0.50	W = 0.50	W = 0.50	W = 0.50	W = 0.50	W = 0.50
Site Kappa (k2)		Not Applicable		Total Thickness 4435 ft (k2) = 0.0286s W = 0.40		Total Thickness 4435 ft (k2) = 0.0097s W = 0.40	

TABLE 5
SITE RESPONSE INPUT BVPS SITE NUCLEAR ISLAND
(CONTINUED)

Input Parameter		Value				
Shear Modulus and Damping With (k2)	Pleistocene Upper/Middle Terrace: Middle Unit 16 ft	Not Applicable	EPRI Soil 21-50 ft			
	Pleistocene Upper/Middle Terrace: Lowe Unit 40 ft	Not Applicable	EPRI Soil 51-120 ft			
	Rock Top 100 ft	Not Applicable	EPRI Rock scaled up to get low strain damping of 4.8%	4.8% Linear Damping	EPRI Rock scaled down to get low strain damping of 1.6%	1.6% Linear damping
	Rock 101 to 500 ft	Not Applicable	Y-12 Rock+1 STD	1.79% Linear damping	Y-12 Rock-1 STD	0.2% Linear damping
	Rock 501 ft to profile base	Not Applicable	1.12% Linear damping	1.12% Linear damping	0.15% Linear damping	0.15% Linear damping
	Weight	Not Applicable	W = 0.50	W = 0.50	W = 0.50	W = 0.50

RESULTS

Table 6 presents the statistics of the site amplification functions (AF) for seven frequencies at which the rock hazard is developed.

BVPS CONTROL POINT HAZARD CURVES (EL 681)

The site AFs obtained from the site response analysis, and the hard-rock PSHA curves are used to develop the seismic hazard curves and GMRS at the Control Point. The procedure to develop the seismic hazard curves follows the methodology described in McGuire et al., (2001) and EPRI (2013b). This procedure, referred to as Approach 3, computes a site-specific control point hazard curve for a broad range of S_A given the site-specific bedrock hazard curve and site-specific estimates of soil or soft-rock response and associated uncertainties.

The above procedure is executed to generate the mean hazard curve and the fractiles at EL 681. ***Figures 1 through 7*** present the mean and fractile hazard curves at EL 681 for spectral frequencies of 0.5 Hz, 1 Hz, 2.5 Hz, 5 Hz, 10 Hz, 25 Hz, and 100 Hz, respectively. ***Tables 7 through 13*** present numerical values of the mean hazard curve and the fractiles of the hazard distribution. The entries, which are labeled as " ---- " represent ground motions that are not realizable for a given fractile.

TABLE 6
AMPLIFICATION FUNCTIONS FOR BVPS SITE AT EL 681

100 Hz SA [g]	MEDIAN AF	SIGMA Ln(AF)	25 Hz S_A [g]	MEDIAN AF	SIGMA Ln(AF)	10 Hz S_A [g]	MEDIAN AF	SIGMA Ln(AF)	5 Hz SA [g]	MEDIAN AF	SIGMA Ln(AF)
1.02E-02	2.43E+00	1.25E-01	1.31E-02	2.12E+00	1.29E-01	2.07E-02	1.91E+00	1.72E-01	2.35E-02	3.63E+00	2.31E-01
5.45E-02	1.98E+00	1.31E-01	1.07E-01	1.52E+00	2.49E-01	1.13E-01	1.72E+00	2.15E-01	9.41E-02	3.59E+00	2.32E-01
1.15E-01	1.65E+00	1.50E-01	2.26E-01	1.35E+00	2.83E-01	2.10E-01	1.66E+00	2.33E-01	1.64E-01	3.50E+00	2.44E-01
2.52E-01	1.34E+00	1.66E-01	4.73E-01	1.17E+00	3.10E-01	4.04E-01	1.60E+00	2.44E-01	3.02E-01	3.28E+00	2.68E-01
3.97E-01	1.18E+00	1.74E-01	7.19E-01	1.05E+00	3.16E-01	5.93E-01	1.55E+00	2.46E-01	4.35E-01	3.06E+00	2.78E-01
5.48E-01	1.07E+00	1.79E-01	9.70E-01	9.47E-01	3.21E-01	7.83E-01	1.51E+00	2.39E-01	5.68E-01	2.87E+00	2.87E-01
7.03E-01	9.81E-01	1.85E-01	1.22E+00	8.66E-01	3.31E-01	9.75E-01	1.47E+00	2.22E-01	7.02E-01	2.68E+00	3.03E-01
1.10E+00	8.32E-01	1.97E-01	1.86E+00	7.16E-01	3.54E-01	1.45E+00	1.36E+00	2.05E-01	1.03E+00	2.26E+00	3.43E-01
1.51E+00	7.35E-01	2.04E-01	2.53E+00	6.14E-01	3.65E-01	1.95E+00	1.24E+00	2.18E-01	1.38E+00	1.96E+00	3.59E-01
1.95E+00	6.57E-01	2.16E-01	3.23E+00	5.32E-01	3.78E-01	2.47E+00	1.12E+00	2.53E-01	1.74E+00	1.73E+00	3.80E-01
2.37E+00	5.98E-01	2.25E-01	3.89E+00	4.69E-01	3.86E-01	2.97E+00	1.03E+00	2.70E-01	2.09E+00	1.54E+00	4.05E-01

2.5 Hz S_A [g]	MEDIAN AF	SIGMA Ln(AF)	1 Hz SA [g]	MEDIAN AF	SIGMA Ln(AF)	0.5 Hz S_A [g]	MEDIAN AF	SIGMA Ln(AF)	0.1 Hz S_A [g]	Median AF	Sigma Ln(AF)
2.16E-02	1.69E+00	2.31E-01	1.46E-02	1.30E+00	1.73E-01	8.44E-03	1.23E+00	7.07E-02	3.66E-04	1.13E+00	6.41E-02
6.85E-02	1.75E+00	2.56E-01	3.72E-02	1.31E+00	1.75E-01	1.87E-02	1.25E+00	7.28E-02	6.86E-04	1.19E+00	7.91E-02
1.14E-01	1.81E+00	2.79E-01	5.86E-02	1.32E+00	1.77E-01	2.84E-02	1.26E+00	7.44E-02	1.04E-03	1.22E+00	8.56E-02
2.03E-01	1.90E+00	3.20E-01	1.01E-01	1.34E+00	1.80E-01	4.77E-02	1.26E+00	7.58E-02	1.77E-03	1.24E+00	8.91E-02
2.88E-01	1.98E+00	3.40E-01	1.41E-01	1.35E+00	1.84E-01	6.59E-02	1.27E+00	7.66E-02	2.48E-03	1.25E+00	9.01E-02
3.73E-01	2.06E+00	3.47E-01	1.81E-01	1.36E+00	1.87E-01	8.39E-02	1.27E+00	7.71E-02	3.18E-03	1.26E+00	9.00E-02
4.59E-01	2.13E+00	3.47E-01	2.21E-01	1.37E+00	1.91E-01	1.02E-01	1.27E+00	7.75E-02	3.89E-03	1.26E+00	8.92E-02
6.71E-01	2.30E+00	3.41E-01	3.20E-01	1.39E+00	2.01E-01	1.47E-01	1.28E+00	7.82E-02	5.64E-03	1.26E+00	8.71E-02
8.92E-01	2.42E+00	3.17E-01	4.23E-01	1.42E+00	2.15E-01	1.93E-01	1.29E+00	7.90E-02	7.47E-03	1.27E+00	8.54E-02
1.12E+00	2.47E+00	2.84E-01	5.31E-01	1.45E+00	2.42E-01	2.42E-01	1.29E+00	8.05E-02	9.38E-03	1.27E+00	8.38E-02
1.34E+00	2.46E+00	2.64E-01	6.34E-01	1.49E+00	2.74E-01	2.88E-01	1.30E+00	8.32E-02	1.12E-02	1.27E+00	8.31E-02

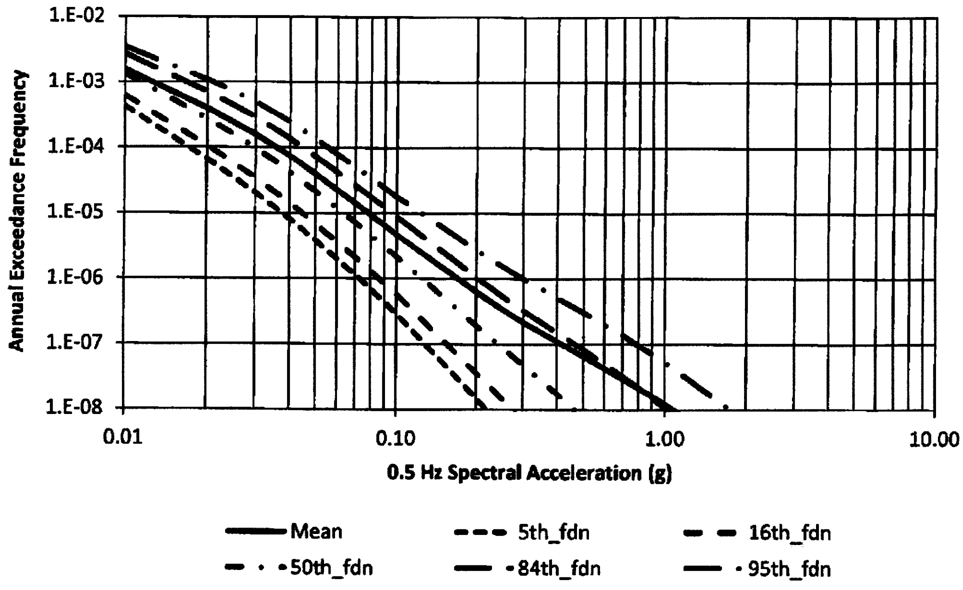

FIGURE 1
0.5-HZ SA MEAN AND FRACTILE HAZARD CURVES FOR BVPS SITE AT EL 681 (BASE OF BVPS-1 AND BVPS-2 REACTOR BUILDING FOUNDATION)

Note:

_fnd indicates the seismic hazard at the RB foundation level.

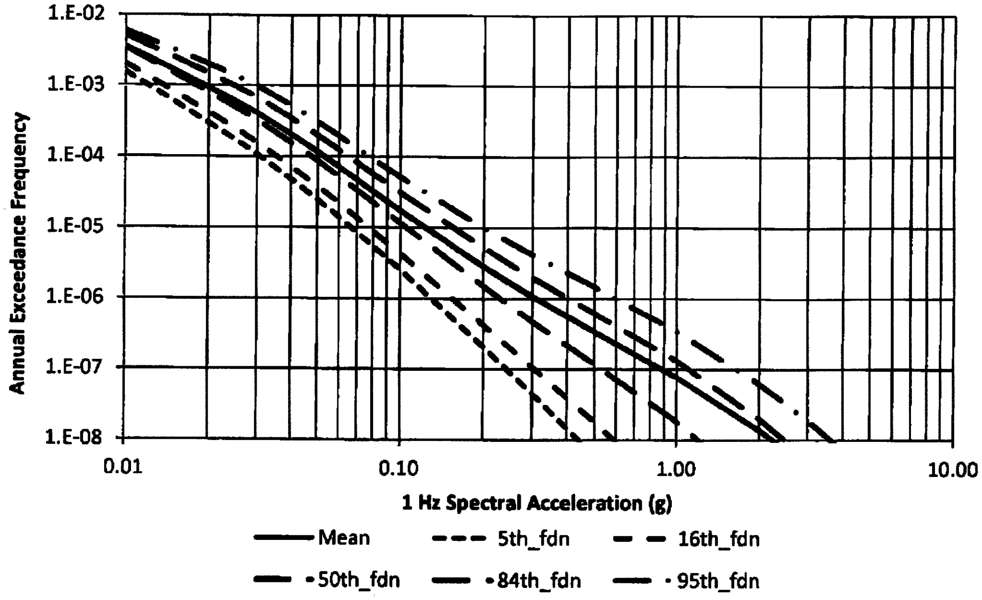

FIGURE 2
1-HZ SA MEAN AND FRACTILE HAZARD CURVES FOR BVPS SITE AT EL 681 (BASE OF BVPS-1 AND BVPS-2 REACTOR BUILDING FOUNDATION)

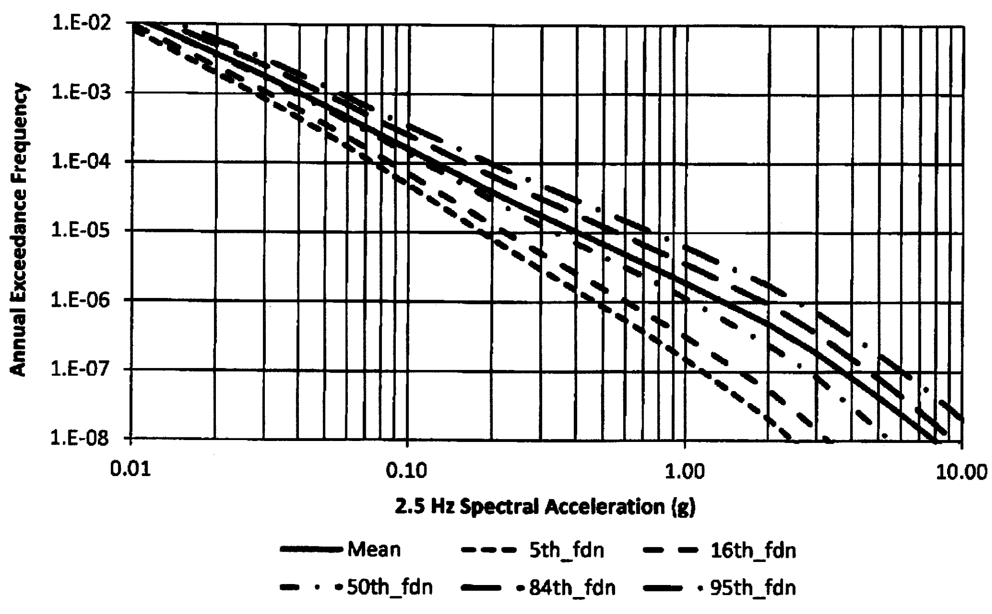

FIGURE 3
2.5-HZ SA MEAN AND FRACTILE HAZARD CURVES FOR BVPS SITE AT EL 681 (BASE OF REACTOR BUILDING FOUNDATION)

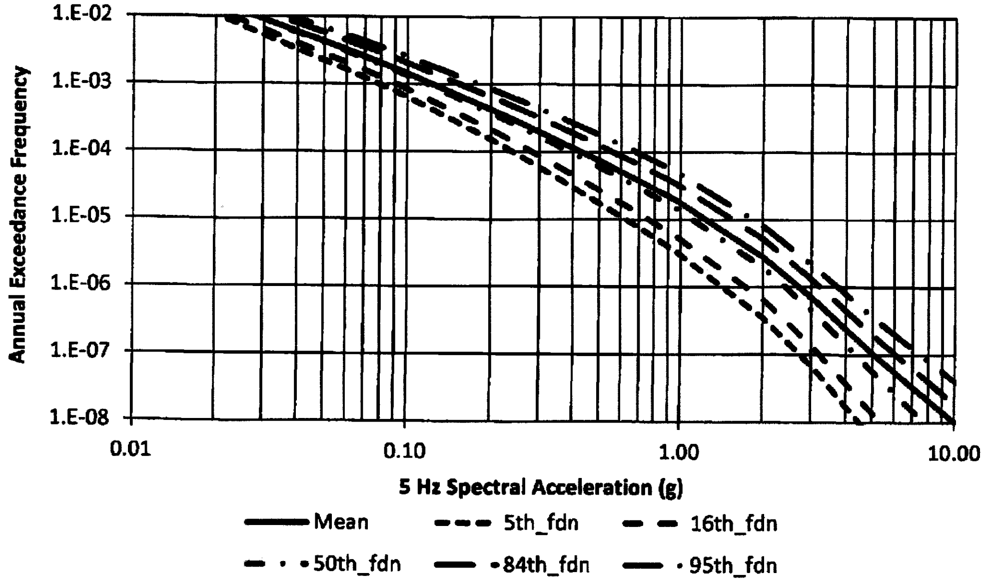

FIGURE 4
5-HZ SA MEAN AND FRACTILE HAZARD CURVES FOR BVPS SITE AT EL 681 (BASE OF BVPS-1 AND BVPS-2 REACTOR BUILDING FOUNDATION)

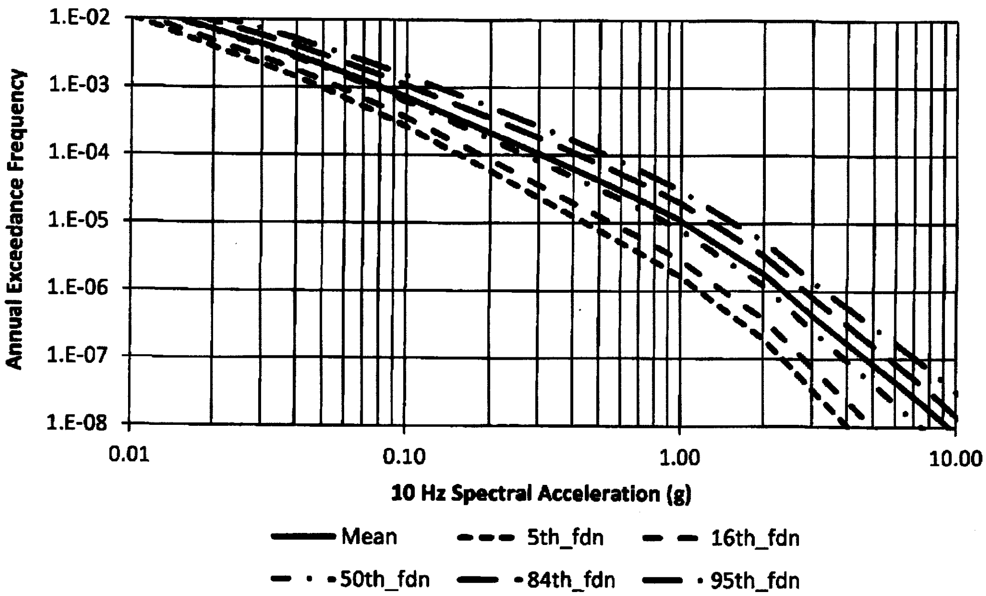

FIGURE 5
10-HZ SA MEAN AND FRACTILE HAZARD CURVES FOR BVPS SITE AT EL 681 (BASE OF BVPS-1 AND BVPS-2 REACTOR BUILDING FOUNDATION)

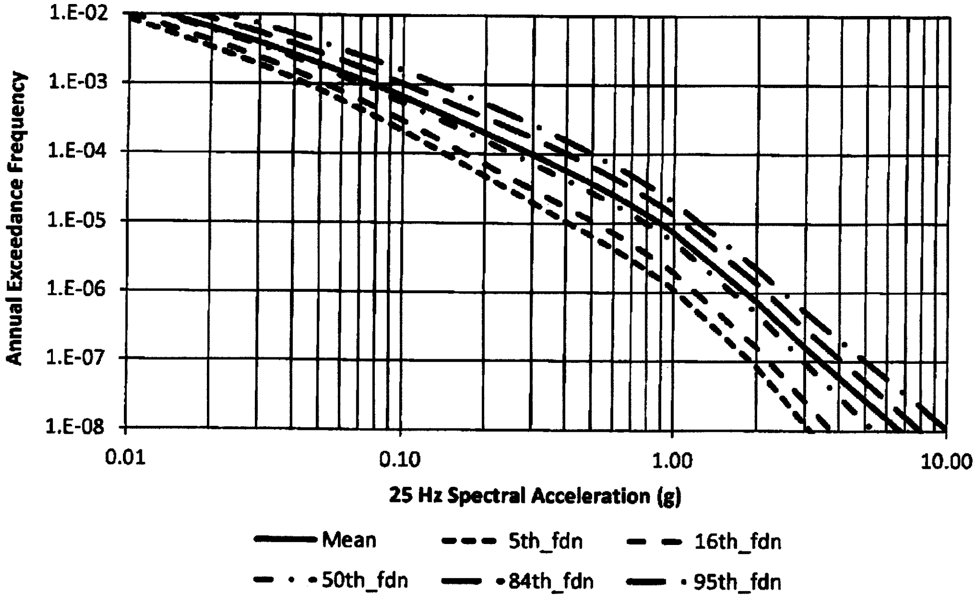

FIGURE 6
25-HZ SA MEAN AND FRACTILE HAZARD CURVES FOR BVPS SITE AT EL 681 (BASE OF BVPS-1 AND BVPS-2 REACTOR BUILDING FOUNDATION)

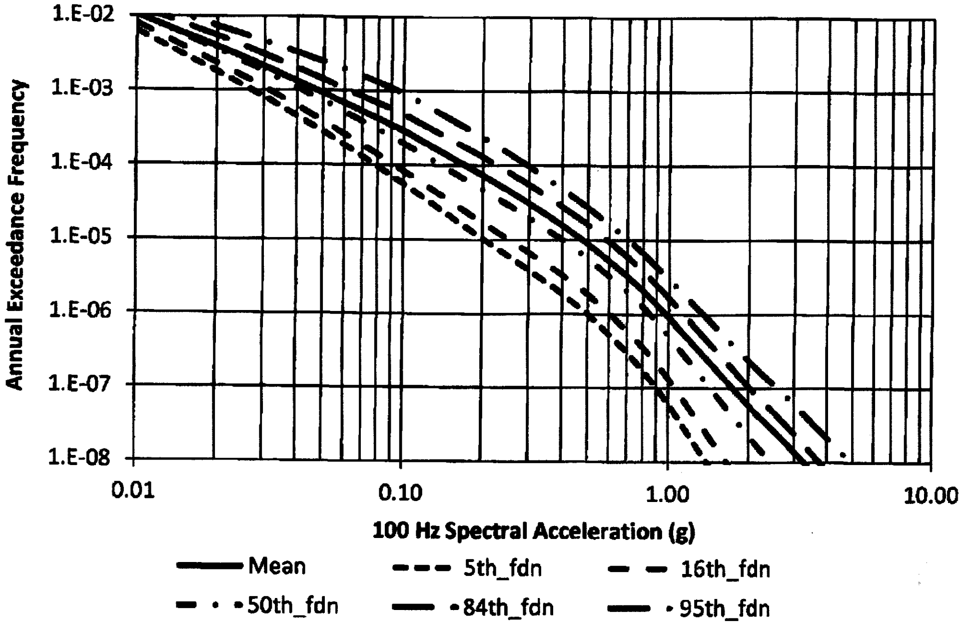

FIGURE 7
100-HZ SA MEAN AND FRACTILE HAZARD CURVES FOR BVPS SITE AT EL 681 BASE OF BVPS-1 AND BVPS-2 REACTOR BUILDING FOUNDATION)

Note:
_fnd indicates the seismic hazard at the RB foundation level.

TABLE 7
0.5-HZ SA MEAN AND FRACTILE HAZARD FOR BVPS SITE AT EL 681 (BASE OF BVPS-1 AND BVPS-2 REACTOR BUILDING FOUNDATION)

SPECTRAL ACCELERATION [g]	ANNUAL FREQUENCY OF EXCEEDANCE					
	MEAN	5TH	16TH	50TH	84TH	95TH
0.01	1.57E-03	4.25E-04	6.22E-04	1.35E-03	2.67E-03	3.42E-03
0.02	3.95E-04	6.74E-05	1.07E-04	2.76E-04	7.14E-04	1.09E-03
0.03	1.59E-04	2.09E-05	3.50E-05	9.95E-05	2.93E-04	4.96E-04
0.04	7.55E-05	8.29E-06	1.44E-05	4.38E-05	1.38E-04	2.49E-04
0.05	4.00E-05	3.88E-06	6.89E-06	2.20E-05	7.34E-05	1.36E-04
0.06	2.33E-05	2.03E-06	3.69E-06	1.22E-05	4.30E-05	8.06E-05
0.07	1.45E-05	1.15E-06	2.15E-06	7.31E-06	2.71E-05	5.15E-05
0.08	9.53E-06	6.94E-07	1.32E-06	4.67E-06	1.80E-05	3.48E-05
0.09	6.57E-06	4.41E-07	8.51E-07	3.12E-06	1.25E-05	2.46E-05
0.10	4.71E-06	2.92E-07	5.75E-07	2.17E-06	8.93E-06	1.80E-05
0.20	6.32E-07	1.51E-08	3.65E-08	1.94E-07	1.06E-06	2.74E-06
0.25	3.43E-07	5.64E-09	1.46E-08	9.00E-08	5.40E-07	1.56E-06
0.30	2.18E-07	2.41E-09	6.66E-09	4.83E-08	3.27E-07	1.00E-06
0.40	1.11E-07	5.62E-10	1.81E-09	1.76E-08	1.53E-07	5.17E-07
0.50	6.55E-08	1.62E-10	5.99E-10	7.66E-09	8.27E-08	3.07E-07
0.60	4.26E-08	5.49E-11	2.36E-10	3.89E-09	4.99E-08	1.99E-07
0.70	2.95E-08	2.08E-11	1.03E-10	2.19E-09	3.23E-08	1.37E-07
0.80	2.13E-08	8.69E-12	4.89E-11	1.31E-09	2.18E-08	9.77E-08
0.90	1.60E-08	3.94E-12	2.48E-11	8.13E-10	1.51E-08	7.15E-08
1.00	1.23E-08	1.88E-12	1.31E-11	5.24E-10	1.07E-08	5.39E-08
2.00	1.89E-09	----	1.39E-13	2.12E-11	9.09E-10	6.64E-09
3.00	5.85E-10	----	6.40E-15	2.75E-12	1.85E-10	1.70E-09
5.00	1.12E-10	----	----	1.48E-13	1.88E-11	2.18E-10
6.00	6.00E-11	----	----	4.90E-14	7.96E-12	9.86E-11
7.00	3.49E-11	----	----	1.85E-14	3.80E-12	4.99E-11
8.00	2.15E-11	----	----	7.42E-15	1.95E-12	2.72E-11
9.00	1.38E-11	----	----	3.11E-15	1.07E-12	1.57E-11
10.00	9.25E-12	----	----	1.29E-15	6.18E-13	9.64E-12
12.00	4.54E-12	----	----	----	2.37E-13	4.10E-12
15.00	1.86E-12	----	----	----	6.99E-14	1.36E-12
20.00	5.68E-13	----	----	----	1.33E-14	3.19E-13
25.00	2.22E-13	----	----	----	3.48E-15	9.91E-14
30.00	1.02E-13	----	----	----	1.01E-15	3.76E-14
40.00	2.94E-14	----	----	----	----	7.94E-15

TABLE 8
1-HZ SA MEAN AND FRACTILE HAZARD FOR BVPS SITE AT EL 681 (BASE OF BVPS-1 AND BVPS-2 REACTOR BUILDING FOUNDATION)

SPECTRAL ACCELERATION [g]	ANNUAL FREQUENCY OF EXCEEDANCE					
	MEAN	5TH	16TH	50TH	84TH	95TH
0.01	3.53E-03	1.55E-03	2.04E-03	3.42E-03	5.10E-03	5.98E-03
0.02	9.39E-04	2.96E-04	4.19E-04	8.02E-04	1.49E-03	2.00E-03
0.03	4.10E-04	1.07E-04	1.58E-04	3.28E-04	6.82E-04	9.83E-04
0.04	2.07E-04	4.81E-05	7.25E-05	1.59E-04	3.51E-04	5.29E-04
0.05	1.17E-04	2.47E-05	3.81E-05	8.68E-05	2.00E-04	3.10E-04
0.06	7.15E-05	1.40E-05	2.20E-05	5.20E-05	1.24E-04	1.95E-04
0.07	4.68E-05	8.49E-06	1.36E-05	3.34E-05	8.22E-05	1.31E-04
0.08	3.22E-05	5.47E-06	8.90E-06	2.26E-05	5.73E-05	9.20E-05
0.09	2.32E-05	3.69E-06	6.08E-06	1.59E-05	4.17E-05	6.75E-05
0.10	1.73E-05	2.58E-06	4.32E-06	1.16E-05	3.14E-05	5.13E-05
0.20	2.86E-06	2.10E-07	4.27E-07	1.51E-06	5.29E-06	1.00E-05
0.25	1.67E-06	9.10E-08	2.01E-07	7.97E-07	3.07E-06	6.19E-06
0.30	1.08E-06	4.56E-08	1.08E-07	4.77E-07	1.99E-06	4.20E-06
0.40	5.65E-07	1.47E-08	3.96E-08	2.17E-07	1.03E-06	2.33E-06
0.50	3.44E-07	5.87E-09	1.80E-08	1.19E-07	6.22E-07	1.47E-06
0.60	2.31E-07	2.76E-09	9.38E-09	7.25E-08	4.14E-07	1.00E-06
0.70	1.65E-07	1.46E-09	5.42E-09	4.78E-08	2.94E-07	7.26E-07
0.80	1.24E-07	8.45E-10	3.39E-09	3.34E-08	2.20E-07	5.52E-07
0.90	9.69E-08	5.24E-10	2.25E-09	2.43E-08	1.69E-07	4.34E-07
1.00	7.73E-08	3.41E-10	1.55E-09	1.82E-08	1.33E-07	3.49E-07
2.00	1.38E-08	1.28E-11	8.90E-11	1.81E-09	2.00E-08	6.31E-08
3.00	4.31E-09	1.22E-12	1.14E-11	3.47E-10	5.33E-09	1.89E-08
5.00	8.82E-10	----	6.58E-13	3.41E-11	8.31E-10	3.44E-09
6.00	4.80E-10	----	2.17E-13	1.36E-11	4.00E-10	1.76E-09
7.00	2.83E-10	----	8.12E-14	6.07E-12	2.10E-10	9.72E-10
8.00	1.77E-10	----	----	2.94E-12	1.18E-10	5.74E-10
9.00	1.16E-10	----	----	1.53E-12	7.05E-11	3.56E-10
10.00	7.86E-11	----	----	8.39E-13	4.40E-11	2.31E-10
12.00	3.96E-11	----	----	2.88E-13	1.90E-11	1.06E-10
15.00	1.67E-11	----	----	7.32E-14	6.54E-12	3.99E-11
20.00	5.23E-12	----	----	----	1.53E-12	1.08E-11
25.00	2.07E-12	----	----	----	4.67E-13	3.87E-12
30.00	9.62E-13	----	----	----	1.69E-13	1.65E-12
40.00	2.82E-13	----	----	----	3.13E-14	4.24E-13

TABLE 9
2.5-HZ SA MEAN AND FRACTILE HAZARD FOR BVPS SITE AT EL 681 (BASE OF BVPS-1 AND BVPS-2 REACTOR BUILDING FOUNDATION)

SPECTRAL ACCELERATION [g]	ANNUAL FREQUENCY OF EXCEEDANCE					
	MEAN	5TH	16TH	50TH	84TH	95TH
0.01	1.26E-02	8.06E-03	9.53E-03	1.25E-02	1.58E-02	1.77E-02
0.02	3.66E-03	1.93E-03	2.40E-03	3.51E-03	4.96E-03	5.92E-03
0.03	1.77E-03	8.30E-04	1.06E-03	1.66E-03	2.50E-03	3.09E-03
0.04	1.03E-03	4.45E-04	5.85E-04	9.48E-04	1.49E-03	1.90E-03
0.05	6.64E-04	2.68E-04	3.60E-04	6.02E-04	9.82E-04	1.27E-03
0.06	4.59E-04	1.74E-04	2.39E-04	4.11E-04	6.91E-04	9.03E-04
0.07	3.34E-04	1.19E-04	1.67E-04	2.96E-04	5.11E-04	6.75E-04
0.08	2.53E-04	8.53E-05	1.21E-04	2.22E-04	3.93E-04	5.23E-04
0.09	1.98E-04	6.32E-05	9.10E-05	1.72E-04	3.12E-04	4.19E-04
0.10	1.59E-04	4.82E-05	7.02E-05	1.36E-04	2.54E-04	3.44E-04
0.20	3.86E-05	8.15E-06	1.31E-05	2.97E-05	6.60E-05	9.89E-05
0.25	2.50E-05	4.65E-06	7.74E-06	1.86E-05	4.34E-05	6.68E-05
0.30	1.76E-05	2.97E-06	5.06E-06	1.28E-05	3.10E-05	4.86E-05
0.40	1.03E-05	1.48E-06	2.62E-06	7.13E-06	1.85E-05	2.96E-05
0.50	6.82E-06	8.62E-07	1.58E-06	4.58E-06	1.24E-05	2.03E-05
0.60	4.88E-06	5.52E-07	1.04E-06	3.20E-06	8.97E-06	1.49E-05
0.70	3.68E-06	3.77E-07	7.33E-07	2.36E-06	6.80E-06	1.15E-05
0.80	2.87E-06	2.69E-07	5.39E-07	1.81E-06	5.35E-06	9.14E-06
0.90	2.31E-06	1.99E-07	4.11E-07	1.42E-06	4.33E-06	7.46E-06
1.00	1.90E-06	1.51E-07	3.21E-07	1.15E-06	3.58E-06	6.21E-06
2.00	4.86E-07	2.10E-08	5.50E-08	2.47E-07	9.49E-07	1.76E-06
3.00	1.87E-07	5.06E-09	1.49E-08	8.34E-08	3.62E-07	7.15E-07
5.00	4.28E-08	4.85E-10	1.74E-09	1.45E-08	7.97E-08	1.77E-07
6.00	2.47E-08	1.94E-10	7.54E-10	7.33E-09	4.49E-08	1.04E-07
7.00	1.53E-08	8.81E-11	3.66E-10	4.06E-09	2.73E-08	6.60E-08
8.00	1.00E-08	4.38E-11	1.92E-10	2.38E-09	1.75E-08	4.36E-08
9.00	6.84E-09	2.33E-11	1.07E-10	1.46E-09	1.16E-08	2.99E-08
10.00	4.82E-09	1.30E-11	6.21E-11	9.31E-10	7.96E-09	2.12E-08
12.00	2.58E-09	4.53E-12	2.35E-11	4.12E-10	4.03E-09	1.13E-08
15.00	1.17E-09	----	6.77E-12	1.44E-10	1.68E-09	5.11E-09
20.00	4.00E-10	----	----	3.41E-11	5.01E-10	1.72E-09
25.00	1.67E-10	----	----	1.03E-11	1.85E-10	6.98E-10
30.00	8.04E-11	----	----	3.64E-12	7.84E-11	3.26E-10
40.00	2.45E-11	----	----	----	1.87E-11	9.43E-11

TABLE 10
5-HZ SA MEAN AND FRACTILE HAZARD FOR BVPS SITE AT EL 681 (BASE OF BVPS-1 AND BVPS-2 REACTOR BUILDING FOUNDATION)

SPECTRAL ACCELERATION [g]	ANNUAL FREQUENCY OF EXCEEDANCE					
	MEAN	5TH	16TH	50TH	84TH	95TH
0.01	4.58E-02	3.42E-02	3.75E-02	4.64E-02	5.48E-02	5.91E-02
0.02	1.65E-02	1.06E-02	1.23E-02	1.63E-02	2.08E-02	2.34E-02
0.03	9.06E-03	5.31E-03	6.39E-03	8.82E-03	1.18E-02	1.36E-02
0.04	5.92E-03	3.26E-03	4.02E-03	5.71E-03	7.87E-03	9.24E-03
0.05	4.26E-03	2.23E-03	2.80E-03	4.08E-03	5.75E-03	6.85E-03
0.06	3.25E-03	1.64E-03	2.08E-03	3.08E-03	4.45E-03	5.35E-03
0.07	2.57E-03	1.25E-03	1.61E-03	2.43E-03	3.56E-03	4.33E-03
0.08	2.08E-03	9.82E-04	1.28E-03	1.96E-03	2.93E-03	3.59E-03
0.09	1.72E-03	7.88E-04	1.03E-03	1.61E-03	2.45E-03	3.02E-03
0.10	1.45E-03	6.44E-04	8.48E-04	1.34E-03	2.08E-03	2.58E-03
0.20	4.25E-04	1.52E-04	2.13E-04	3.74E-04	6.51E-04	8.59E-04
0.25	2.81E-04	9.11E-05	1.32E-04	2.43E-04	4.41E-04	5.95E-04
0.30	2.00E-04	5.92E-05	8.72E-05	1.70E-04	3.20E-04	4.40E-04
0.40	1.15E-04	2.96E-05	4.50E-05	9.52E-05	1.90E-04	2.68E-04
0.50	7.44E-05	1.73E-05	2.70E-05	6.02E-05	1.26E-04	1.80E-04
0.60	5.17E-05	1.11E-05	1.77E-05	4.10E-05	8.85E-05	1.29E-04
0.70	3.78E-05	7.56E-06	1.23E-05	2.95E-05	6.54E-05	9.59E-05
0.80	2.86E-05	5.40E-06	8.90E-06	2.20E-05	5.00E-05	7.39E-05
0.90	2.22E-05	3.99E-06	6.66E-06	1.70E-05	3.92E-05	5.83E-05
1.00	1.76E-05	3.03E-06	5.10E-06	1.33E-05	3.14E-05	4.68E-05
2.00	2.82E-06	3.54E-07	6.56E-07	1.97E-06	5.22E-06	8.15E-06
3.00	7.08E-07	6.83E-08	1.37E-07	4.58E-07	1.32E-06	2.18E-06
5.00	1.06E-07	6.02E-09	1.38E-08	5.72E-08	2.02E-07	3.70E-07
6.00	5.59E-08	2.46E-09	6.00E-09	2.76E-08	1.06E-07	2.04E-07
7.00	3.32E-08	1.18E-09	3.00E-09	1.51E-08	6.27E-08	1.25E-07
8.00	2.13E-08	6.26E-10	1.66E-09	9.04E-09	3.99E-08	8.23E-08
9.00	1.44E-08	3.60E-10	9.83E-10	5.74E-09	2.68E-08	5.68E-08
10.00	1.01E-08	2.18E-10	6.14E-10	3.80E-09	1.86E-08	4.06E-08
12.00	5.46E-09	9.02E-11	2.67E-10	1.83E-09	9.78E-09	2.24E-08
15.00	2.49E-09	2.91E-11	9.20E-11	7.19E-10	4.29E-09	1.05E-08
20.00	8.68E-10	6.18E-12	2.14E-11	1.99E-10	1.39E-09	3.73E-09
25.00	3.70E-10	----	6.43E-12	6.89E-11	5.47E-10	1.60E-09
30.00	1.80E-10	----	2.28E-12	2.76E-11	2.47E-10	7.82E-10
40.00	5.62E-11	----	----	5.96E-12	6.63E-11	2.41E-10

TABLE 11
10-HZ SA MEAN AND FRACTILE HAZARD FOR BVPS SITE AT EL 681 (BASE OF BVPS-1 AND BVPS-2 REACTOR BUILDING FOUNDATION)

SPECTRAL ACCELERATION [g]	ANNUAL FREQUENCY OF EXCEEDANCE					
	MEAN	5TH	16TH	50TH	84TH	95TH
0.01	1.68E-02	1.08E-02	1.27E-02	1.65E-02	2.09E-02	2.43E-02
0.02	7.14E-03	3.98E-03	4.89E-03	6.81E-03	9.40E-03	1.14E-02
0.03	4.32E-03	2.22E-03	2.79E-03	4.05E-03	5.88E-03	7.31E-03
0.04	2.96E-03	1.42E-03	1.83E-03	2.74E-03	4.12E-03	5.23E-03
0.05	2.15E-03	9.71E-04	1.27E-03	1.97E-03	3.04E-03	3.93E-03
0.06	1.63E-03	6.99E-04	9.25E-04	1.48E-03	2.35E-03	3.09E-03
0.07	1.28E-03	5.26E-04	7.01E-04	1.15E-03	1.88E-03	2.51E-03
0.08	1.04E-03	4.09E-04	5.48E-04	9.17E-04	1.54E-03	2.09E-03
0.09	8.55E-04	3.26E-04	4.39E-04	7.48E-04	1.28E-03	1.77E-03
0.10	7.18E-04	2.64E-04	3.59E-04	6.21E-04	1.09E-03	1.52E-03
0.20	2.17E-04	5.86E-05	8.66E-05	1.75E-04	3.55E-04	5.18E-04
0.25	1.46E-04	3.55E-05	5.35E-05	1.15E-04	2.46E-04	3.61E-04
0.30	1.06E-04	2.36E-05	3.61E-05	8.14E-05	1.82E-04	2.68E-04
0.40	6.32E-05	1.26E-05	1.98E-05	4.76E-05	1.11E-04	1.66E-04
0.50	4.22E-05	7.73E-06	1.25E-05	3.15E-05	7.45E-05	1.13E-04
0.60	3.01E-05	5.18E-06	8.61E-06	2.24E-05	5.32E-05	8.12E-05
0.70	2.25E-05	3.69E-06	6.23E-06	1.66E-05	3.99E-05	6.09E-05
0.80	1.73E-05	2.74E-06	4.68E-06	1.27E-05	3.09E-05	4.73E-05
0.90	1.37E-05	2.10E-06	3.63E-06	9.97E-06	2.46E-05	3.76E-05
1.00	1.10E-05	1.64E-06	2.87E-06	7.96E-06	1.99E-05	3.05E-05
2.00	1.81E-06	2.00E-07	3.91E-07	1.21E-06	3.34E-06	5.46E-06
3.00	4.37E-07	3.56E-08	7.65E-08	2.68E-07	8.18E-07	1.41E-06
5.00	8.23E-08	4.12E-09	9.97E-09	4.29E-08	1.56E-07	2.97E-07
6.00	4.60E-08	1.91E-09	4.82E-09	2.23E-08	8.71E-08	1.73E-07
7.00	2.78E-08	9.70E-10	2.55E-09	1.26E-08	5.21E-08	1.08E-07
8.00	1.77E-08	5.28E-10	1.43E-09	7.53E-09	3.28E-08	7.05E-08
9.00	1.17E-08	3.02E-10	8.43E-10	4.70E-09	2.15E-08	4.78E-08
10.00	8.03E-09	1.80E-10	5.16E-10	3.04E-09	1.46E-08	3.34E-08
12.00	4.09E-09	7.11E-11	2.11E-10	1.38E-09	7.25E-09	1.76E-08
15.00	1.74E-09	2.12E-11	6.59E-11	4.99E-10	2.96E-09	7.72E-09
20.00	5.47E-10	3.94E-12	1.32E-11	1.21E-10	8.70E-10	2.50E-09
25.00	2.16E-10	9.64E-13	3.45E-12	3.71E-11	3.19E-10	9.98E-10
30.00	9.98E-11	2.84E-13	1.09E-12	1.33E-11	1.36E-10	4.59E-10
40.00	2.89E-11	3.50E-14	1.56E-13	2.36E-12	3.31E-11	1.30E-10

TABLE 12
25-HZ SA MEAN AND FRACTILE HAZARD FOR BVPS SITE AT EL 681
(BASE OF BVPS-1 AND BVPS-2 REACTOR BUILDING FOUNDATION)

SPECTRAL ACCELERATION [g]	ANNUAL FREQUENCY OF EXCEEDANCE					
	MEAN	5TH	16TH	50TH	84TH	95TH
0.01	1.42E-02	8.64E-03	1.02E-02	1.36E-02	1.83E-02	2.19E-02
0.02	6.53E-03	3.42E-03	4.26E-03	6.04E-03	8.81E-03	1.12E-02
0.03	4.00E-03	1.91E-03	2.45E-03	3.63E-03	5.55E-03	7.37E-03
0.04	2.72E-03	1.20E-03	1.57E-03	2.42E-03	3.85E-03	5.29E-03
0.05	1.98E-03	8.14E-04	1.08E-03	1.74E-03	2.84E-03	4.04E-03
0.06	1.51E-03	5.85E-04	7.85E-04	1.30E-03	2.20E-03	3.21E-03
0.07	1.19E-03	4.38E-04	5.93E-04	1.00E-03	1.77E-03	2.62E-03
0.08	9.58E-04	3.39E-04	4.62E-04	7.98E-04	1.45E-03	2.19E-03
0.09	7.91E-04	2.69E-04	3.68E-04	6.51E-04	1.21E-03	1.86E-03
0.10	6.65E-04	2.17E-04	2.99E-04	5.42E-04	1.03E-03	1.60E-03
0.20	2.03E-04	4.81E-05	7.16E-05	1.55E-04	3.37E-04	5.34E-04
0.25	1.37E-04	2.95E-05	4.50E-05	1.03E-04	2.34E-04	3.67E-04
0.30	9.90E-05	1.99E-05	3.09E-05	7.32E-05	1.72E-04	2.67E-04
0.40	5.82E-05	1.07E-05	1.72E-05	4.27E-05	1.03E-04	1.58E-04
0.50	3.77E-05	6.58E-06	1.09E-05	2.78E-05	6.68E-05	1.02E-04
0.60	2.59E-05	4.34E-06	7.30E-06	1.91E-05	4.58E-05	6.97E-05
0.70	1.84E-05	3.00E-06	5.09E-06	1.36E-05	3.26E-05	4.95E-05
0.80	1.34E-05	2.12E-06	3.64E-06	9.86E-06	2.38E-05	3.61E-05
0.90	9.88E-06	1.53E-06	2.65E-06	7.28E-06	1.76E-05	2.69E-05
1.00	7.41E-06	1.12E-06	1.96E-06	5.44E-06	1.33E-05	2.03E-05
2.00	7.41E-07	8.32E-08	1.60E-07	5.04E-07	1.37E-06	2.22E-06
3.00	1.61E-07	1.26E-08	2.70E-08	9.74E-08	3.02E-07	5.29E-07
5.00	2.74E-08	1.16E-09	2.91E-09	1.33E-08	5.13E-08	1.02E-07
6.00	1.48E-08	5.06E-10	1.33E-09	6.58E-09	2.75E-08	5.72E-08
7.00	8.75E-09	2.47E-10	6.70E-10	3.58E-09	1.60E-08	3.47E-08
8.00	5.47E-09	1.30E-10	3.64E-10	2.08E-09	9.88E-09	2.22E-08
9.00	3.58E-09	7.26E-11	2.09E-10	1.27E-09	6.39E-09	1.49E-08
10.00	2.44E-09	4.25E-11	1.25E-10	8.04E-10	4.29E-09	1.03E-08
12.00	1.23E-09	1.62E-11	5.00E-11	3.55E-10	2.11E-09	5.39E-09
15.00	5.21E-10	4.71E-12	1.53E-11	1.24E-10	8.57E-10	2.37E-09
20.00	1.66E-10	8.61E-13	3.02E-12	2.90E-11	2.53E-10	7.88E-10
25.00	6.72E-11	2.12E-13	7.94E-13	8.78E-12	9.42E-11	3.25E-10
30.00	3.16E-11	6.35E-14	2.53E-13	3.16E-12	4.08E-11	1.54E-10
40.00	9.08E-12	8.48E-15	3.82E-14	5.84E-13	1.02E-11	4.43E-11

TABLE 13
100-HZ SA MEAN AND FRACTILE HAZARD FOR BVPS SITE AT EL 681
(BASE OF BVPS-1 AND BVPS-2 REACTOR BUILDING FOUNDATION)

SPECTRAL ACCELERATION [g]	ANNUAL FREQUENCY OF EXCEEDANCE					
	MEAN	5TH	16TH	50TH	84TH	95TH
0.01	1.03E-02	6.30E-03	7.93E-03	1.05E-02	1.34E-02	1.54E-02
0.02	3.91E-03	1.80E-03	2.36E-03	3.57E-03	5.44E-03	7.37E-03
0.03	2.12E-03	8.20E-04	1.10E-03	1.81E-03	3.08E-03	4.63E-03
0.04	1.34E-03	4.54E-04	6.20E-04	1.09E-03	2.01E-03	3.26E-03
0.05	9.33E-04	2.83E-04	3.91E-04	7.28E-04	1.43E-03	2.48E-03
0.06	6.91E-04	1.89E-04	2.65E-04	5.20E-04	1.07E-03	1.97E-03
0.07	5.35E-04	1.32E-04	1.90E-04	3.90E-04	8.46E-04	1.61E-03
0.08	4.28E-04	9.66E-05	1.41E-04	3.04E-04	6.89E-04	1.33E-03
0.09	3.51E-04	7.29E-05	1.07E-04	2.44E-04	5.74E-04	1.11E-03
0.10	2.91E-04	5.66E-05	8.38E-05	1.99E-04	4.85E-04	9.26E-04
0.20	7.45E-05	1.05E-05	1.72E-05	4.74E-05	1.32E-04	2.42E-04
0.25	4.65E-05	6.17E-06	1.04E-05	2.99E-05	8.25E-05	1.50E-04
0.30	3.12E-05	3.98E-06	6.84E-06	2.01E-05	5.55E-05	9.85E-05
0.40	1.59E-05	1.91E-06	3.39E-06	1.02E-05	2.84E-05	4.86E-05
0.50	8.90E-06	9.95E-07	1.85E-06	5.63E-06	1.62E-05	2.74E-05
0.60	5.30E-06	5.42E-07	1.05E-06	3.32E-06	9.66E-06	1.66E-05
0.70	3.29E-06	3.05E-07	6.08E-07	2.03E-06	6.00E-06	1.04E-05
0.80	2.10E-06	1.76E-07	3.62E-07	1.27E-06	3.84E-06	6.73E-06
0.90	1.37E-06	1.04E-07	2.20E-07	8.02E-07	2.52E-06	4.45E-06
1.00	9.13E-07	6.19E-08	1.36E-07	5.16E-07	1.68E-06	3.02E-06
2.00	5.88E-08	1.36E-09	3.78E-09	2.32E-08	1.06E-07	2.35E-07
3.00	1.42E-08	1.63E-10	5.19E-10	4.29E-09	2.48E-08	6.15E-08
5.00	2.06E-09	8.13E-12	3.15E-11	3.91E-10	3.22E-09	9.69E-09
6.00	9.83E-10	2.45E-12	1.01E-11	1.50E-10	1.45E-09	4.68E-09
7.00	5.16E-10	8.38E-13	3.67E-12	6.42E-11	7.18E-10	2.48E-09
8.00	2.93E-10	3.15E-13	1.46E-12	2.97E-11	3.85E-10	1.41E-09
9.00	1.77E-10	1.27E-13	6.29E-13	1.46E-11	2.21E-10	8.56E-10
10.00	1.12E-10	5.37E-14	2.88E-13	7.62E-12	1.33E-10	5.46E-10
12.00	5.12E-11	1.05E-14	6.91E-14	2.35E-12	5.43E-11	2.51E-10
15.00	2.00E-11	9.75E-16	1.02E-14	5.18E-13	1.77E-11	9.66E-11
20.00	6.31E-12	2.14E-17	5.83E-16	6.34E-14	4.05E-12	2.79E-11
25.00	2.74E-12	----	4.35E-17	1.07E-14	1.25E-12	1.07E-11
30.00	1.41E-12	----	----	2.23E-15	4.65E-13	4.89E-12
40.00	4.79E-13	----	----	1.63E-16	9.39E-14	1.38E-12

CONTROL POINT GMRS

The Control Point GMRS is developed following the performance-based approach described in Regulatory Guide 1.208. ***Figure 8*** presents the performance-based GMRS at EL 681, and the 1E-4 and 1E-5 uniform hazard response spectra (UHRS). ***Table 14*** presents numerical values of the S_A for the GMRS at EL 681.

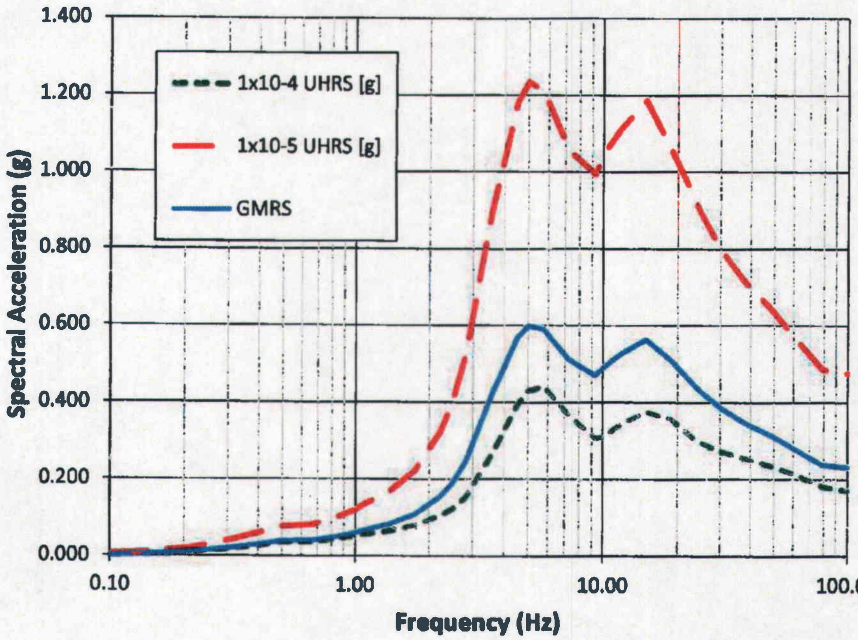

FIGURE 8
UHRS AND GMRS AT THE BVPS SITE AT EL 681

TABLE 14
UHRS AND GMRS AT THE BVPS SITE AT EL 681

FREQUENCY (Hz)	HORIZONTAL SPECTRAL ACCELERATION (g) AT THE FOUNDATION ELEVATION		
	1x10^{-4} MAFE UHRS	1x10^{-5} MAFE UHRS	GMRS
0.10	0.0027	0.0067	0.0034
0.13	0.0039	0.0097	0.0048
0.16	0.0057	0.0142	0.0071
0.20	0.0087	0.0212	0.0106
0.26	0.0135	0.0322	0.0162
0.33	0.0204	0.0474	0.0240
0.42	0.0287	0.0647	0.0330
0.50	0.0358	0.0789	0.0404
0.53	0.0357	0.0792	0.0405
0.67	0.0373	0.0839	0.0428
0.85	0.0455	0.1047	0.0532
1.00	0.0529	0.1226	0.0622
1.08	0.0575	0.1360	0.0687
1.37	0.0669	0.1704	0.0848
1.74	0.0809	0.2246	0.1099
2.21	0.1061	0.3249	0.1559
2.50	0.1253	0.4071	0.1930
2.81	0.1545	0.5264	0.2472
3.56	0.2633	0.8939	0.4200
4.52	0.3941	1.1839	0.5701
5.00	0.4303	1.2364	0.6007
5.74	0.4431	1.2103	0.5940
7.28	0.3676	1.0567	0.5133
9.24	0.3086	0.9959	0.4727
10.00	0.3094	1.0463	0.4920
11.72	0.3434	1.1127	0.5277
14.87	0.3762	1.1868	0.5659
18.87	0.3573	1.0559	0.5101
23.95	0.2998	0.9175	0.4401
25.00	0.2960	0.8924	0.4294
30.39	0.2729	0.7944	0.3849
38.57	0.2534	0.7094	0.3464
48.94	0.2364	0.6436	0.3161
62.10	0.2123	0.5653	0.2789
78.80	0.1841	0.4895	0.2415
100.00	0.1723	0.4782	0.2339

Note:
MAFE = mean annual frequency of exceedance.

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