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10 CFR 50.54(f)

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

Duke Energy Carolinas, LLC (Duke Energy)
Oconee Nuclear Station, Units 1, 2 and 3
Docket Numbers 50-269, 50-270, 50-287
Renewed License Numbers DPR-38, DPR-47, and DPR-55

Subject: Response to Request for Additional Information dated March 27, 2015, Related to the Oconee Expedited Seismic Evaluation Process (ESEP) Report

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, ADAMS Accession No. ML12053A340
2. Duke Energy letter: "*Oconee Nuclear Station, Submittal of the Expedited Seismic Evaluation Process Report (CEUS Sites)*"(for Oconee) dated December 18, 2014 (ADAMS Accession Number ML14364A028)
3. NRC E-mail from Nicholas DiFrancesco to David Haile: "*Inquiry RE: Oconee ESEP Report Clarifications,*" dated March 27, 2015

Ladies and Gentlemen,

Duke Energy submitted the Oconee Expedited Seismic Evaluation Process (ESEP) Report on December 18, 2014 (Reference 2) pursuant to the NRC's 10 CFR 50.54(f) request (Reference 1) and in accordance with NRC approved guidance

The NRC submitted several questions via an E-mail to Duke Energy (Reference 3) seeking clarifications in support of the NRC's review of Oconee's ESEP report. Because the E-mail stated that Duke Energy's response would be placed on the docket this response is being processed as a 10 CFR 50.54(f) Request for Additional Information (RAI). Enclosure 1 to this letter contains Duke Energy's response to the NRC's questions. Enclosure 2 provides a correction for a previously discovered editorial error in the ESEP report. The NRC has reviewed an information copy of the errata and affirmed that it had no effect on the technical validity of the report or its conclusions.

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This letter does not create or revise a Regulatory Commitment.

Should you have any questions concerning this letter, or require additional information, please contact David Haile at (864) 873-4742.

I declare under penalty of perjury that the foregoing is true and correct. Executed on April 24, 2015.

Sincerely,

Scott L. Batson
Vice President
Oconee Nuclear Station

Enclosure

1. Oconee Nuclear Station Units 1, 2, and 3, Duke Energy Response to Questions from NRC E-mail dated March 27, 2015, Related to the Oconee Expedited Seismic Evaluation Process (ESEP) Report
2. Errata sheet for ESEP Report.

cc:
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Enclosure 1

Oconee Nuclear Station Units 1, 2, and 3

Duke Energy Response to Questions from NRC E-mail dated March 27, 2015, Related to the Oconee Expedited Seismic Evaluation Process (ESEP) Report

Question 1

ESEP Report Section 5.2 states, "[in-structure response spectra] ISRS for ESEP evaluation of components located outside the SSF [Standby Shutdown Facility] were estimated by scaling the ONS [Oconee Nuclear Station] design-basis SSE [Safe Shutdown Earthquake] ISRS by the RLGM [Review Level Ground Motion] scale factor of 2.0." However, ESEP Report Section 6.4, "Functional Capacity Screening Using [Electric Power Research Institute] EPRI NP-6041-SL," states, "The SSE ISRS were amplified by a factor of 2.0 throughout the frequency range and were then clipped (per EPRI 1019200), using the methodology in EPRI NP-6041-SL, Appendix Q,..." It appears that raw ISRS with sharp peaks and valleys, but with peaks clipped, were used for screening. The staff expected that the "ONS design-basis SSE ISRS" used for screening would be typical broadened, enveloped ISRS used for seismic design of Category I SSCs.

Please clarify how raw ISRS and peak clipping were used in the screening process, and provide the technical basis. Additionally, provide the range of calculated clipping factors, the reference for the equation used, and an example showing representative raw ISRS and the corresponding clipped ISRS.

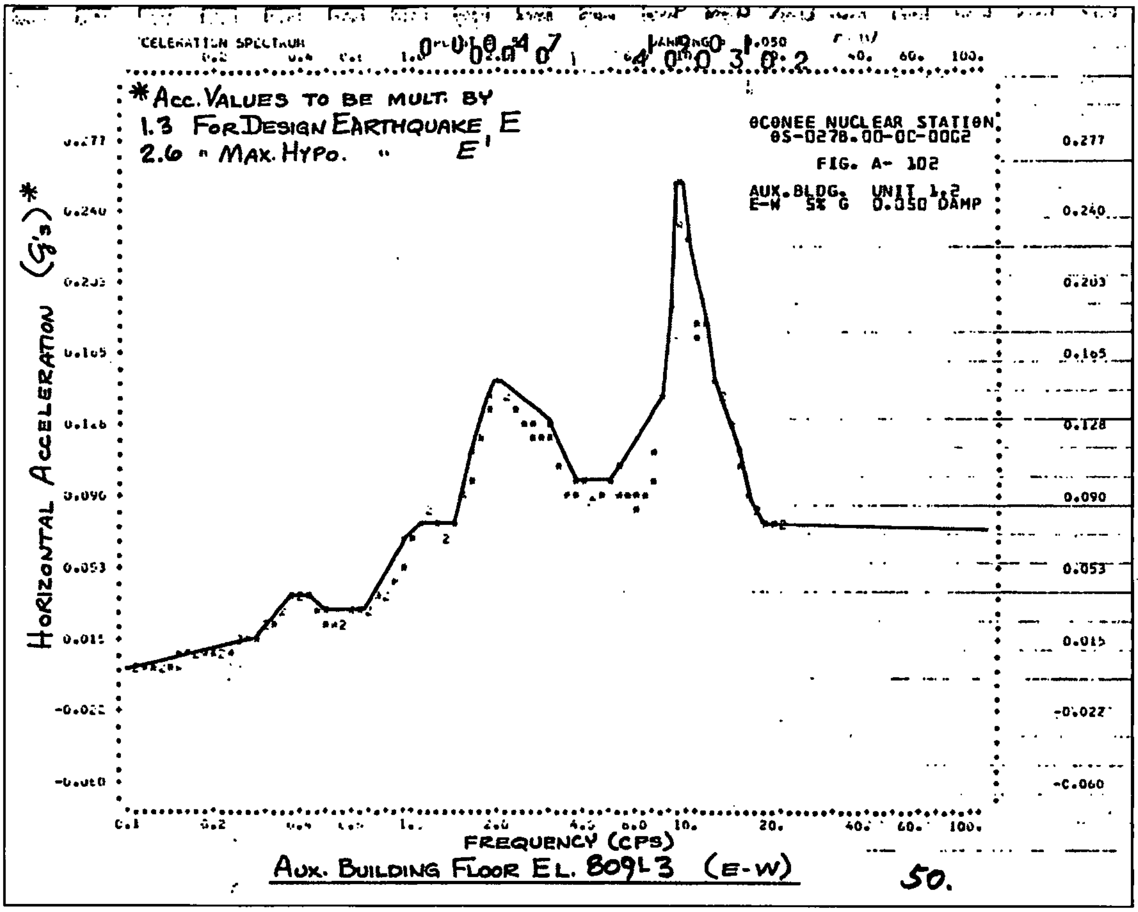
Response to Question 1

ONS design-basis ISRS are given in OSS-027B.00-00-0002, Revision 8, "Specification for the Seismic Displacements and Response Spectra for the Turbine, Auxiliary, Reactor and Standby Shutdown Facility Buildings." An example spectrum, typical of each building other than the SSF, is given below. The spectrum is not a typical broadened ISRS, which is peak-broadened by +/-15%. The ISRS were considered to be raw, unbroadened spectra for the ESEP evaluation. The exception to this was ISRS in the SSF. The SSF ISRS were developed later than the original design-basis spectra. The SSF has both raw, unbroadened spectra and peak-broadened ISRS available. The ESEP evaluation used the raw, unbroadened spectra as per EPRI NP-6041-SL.

Peak clipping was performed only for use in screening against EPRI NP-6041-SL Table 2-4 or for comparison to test response spectra. Clipped-peak spectra were not used for anchorage evaluations. The technical basis for using clipped-peak spectra, for comparison to wide-band earthquake experience or test response spectra, is given in EPRI 1019200, Seismic Fragility Applications Guide Update. The ESEP peak clipping followed the methodology in Appendix Q of EPRI NP-6041-SL. The calculated clipping factors ranged between 0.55 and 1.0. If the calculated clipping factor would reduce the primary peak to less than an adjacent peak, the reduction was limited to the value of the second peak. None of the clipping factors were less than 0.55.

The following example shows the peak clipping for the ISRS for Elevation 809'-3" of the Unit 1-2 Auxiliary Building. The design-basis ISRS are from Figures A-102 and A-93 of OSS-027B.00-00-0002 for the East-West and North-South directions, respectively. The example also shows the averaging of the peak spectral accelerations, which is discussed in Question 2.

The East-West SSE floor response spectrum is Figure A-102 of OSS-027B.00-00-0002, shown below:



The RLGM spectral accelerations are 2.0 times the SSE (MHE), which are 2.6 times the spectral accelerations in the figure. Thus, the RLGM peak spectral acceleration is 5.2 times the peak spectral acceleration from the figure, or 1.33g. The clipping factor is computed using Equations O-2 and O-6 of EPRI NP-6041-SL. The calculations and resulting peak-clipped spectrum are shown below. Note that RLE refers to the RLGM.

$Peak_{RLE} := max(acc_{RLE}) g = 1.33 \cdot g$	Peak RLE acceleration.
$Sa_{peak\_80\%} := \dfrac{0.8 \cdot Peak_{RLE}}{g} = 1.06$	80% of peak acceleration.
$f_a := 8.15 \quad f_b := 10.1 \qquad \Delta f_{0.8} := f_b - f_a = 2.0$	Frequencies differential at 80% of peak frequency. See figure below.
$f_c := mean(f_a, f_b) = 9.1$	Central frequency.
$B := \dfrac{\Delta f_{0.8}}{f_c} = 0.21$	Bandwidth to central frequency ratio. (EPRI NP-6041, Eq Q-2)

$$C_c := \begin{cases} 0.55 \text{ if } B \le 0.2 \\ (0.40 + 0.75B) \text{ if } 0.2 \le B \le 0.8 \\ 1.0 \text{ otherwise} \end{cases} = 0.56$$

HCLPF Clipping Factor. (EPRI NP-6041, Eq Q-6)

$Peak\_RRS_c := Peak_{RLE} \cdot C_c = 0.744 \cdot g$

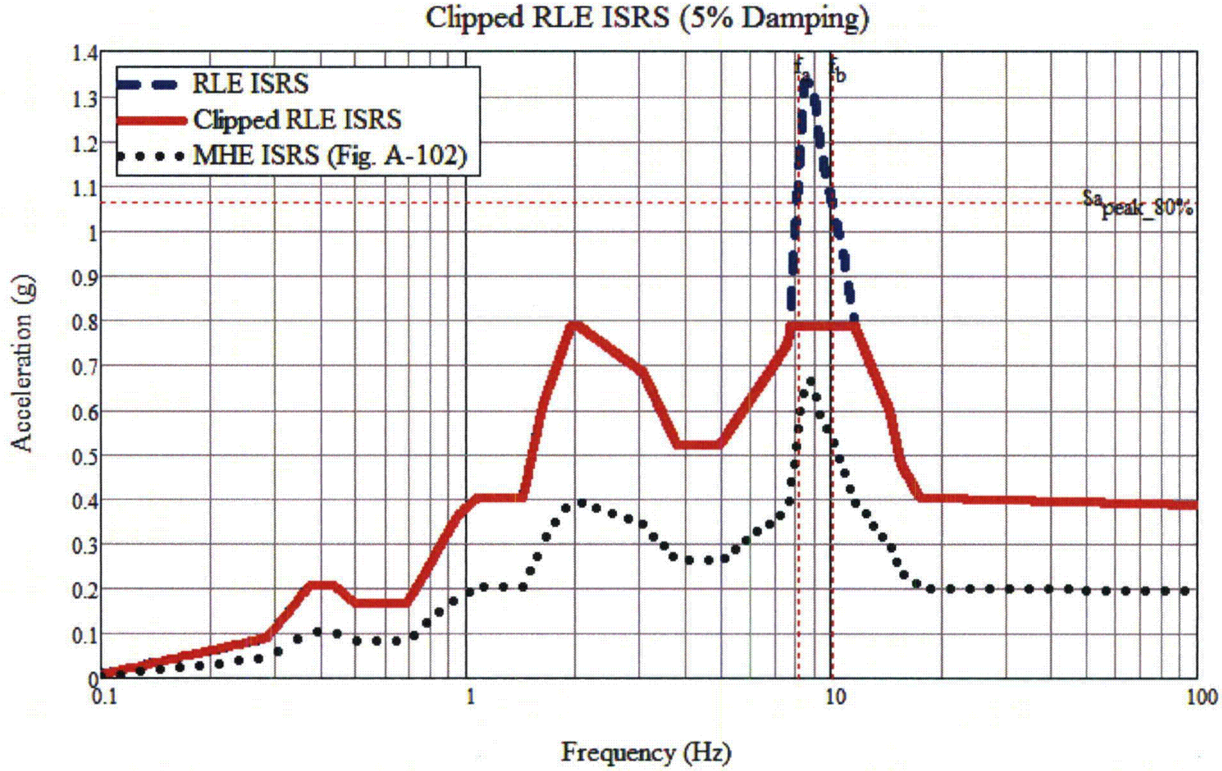
Clipped required response spectra. (EPRI NP-6041, Eq Q-4)

$Peak\_RRS_c := 2.6 \cdot F_{RLE} \cdot 0.151138g = 0.786 \cdot g$

Clipped required response spectra, determined manually since secondary peak may be too wide to clip.

$$a(f) := \begin{cases} (accRLE(f)) \text{ if } accRLE(f) \le \dfrac{Peak\_RRS_c}{g} \\ \dfrac{Peak\_RRS_c}{g} \text{ otherwise} \end{cases}$$

Equation for the clipped peak graph.



Note that RLE ISRS is not visible when overlapped by Clipped RLE ISRS.

Note that manual clipping was performed in order to prevent the clipped peak from falling below the secondary peak, which is relatively wide at 80% of the respective peak.

$Peak_{clip\_A102} := Peak\_RRS_c = 0.79 \cdot g$

Peak clipped RLE acceleration.

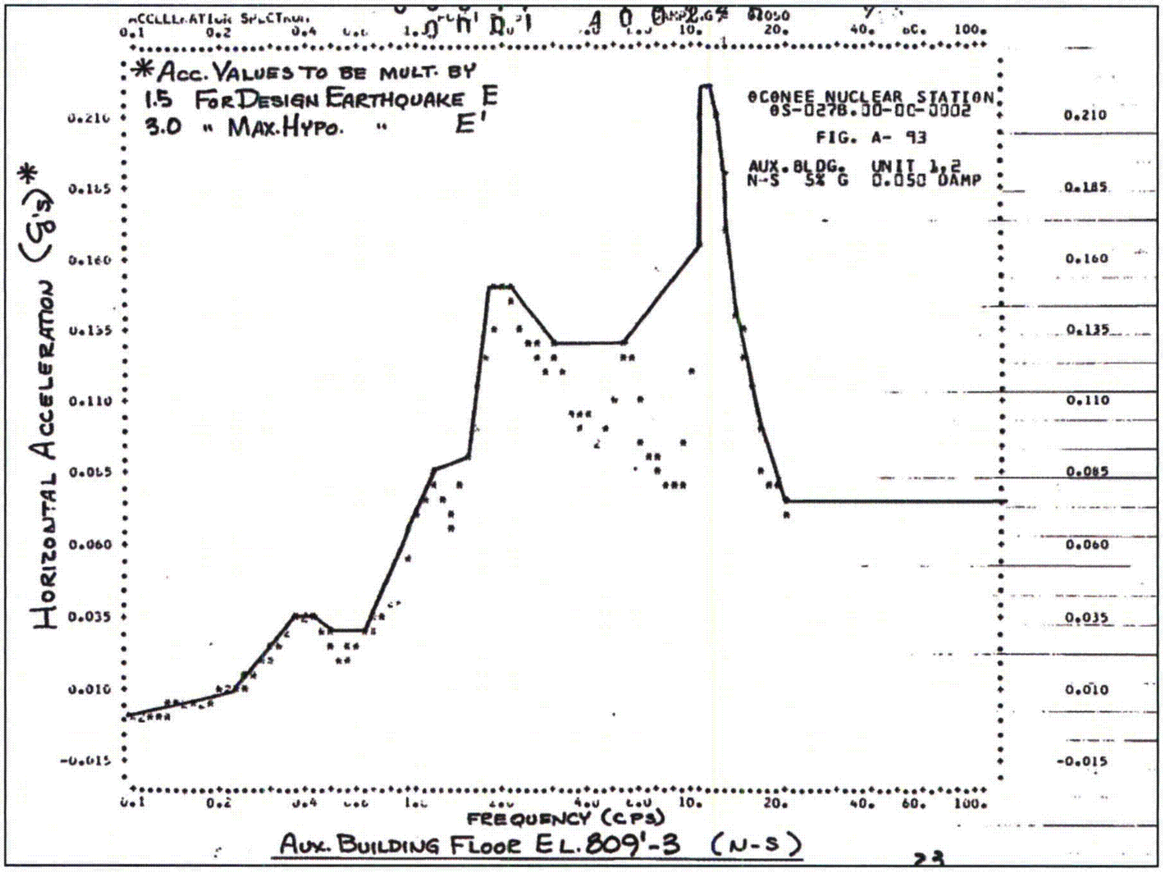
$Peak_{RLE\_A102} := Peak_{RLE} = 1.33 \cdot g$

Peak RLE acceleration.

$Clip_{AB809U12} := mean(Peak_{clip\_A93}, Peak_{clip\_A102}) = 0.85 \cdot g$

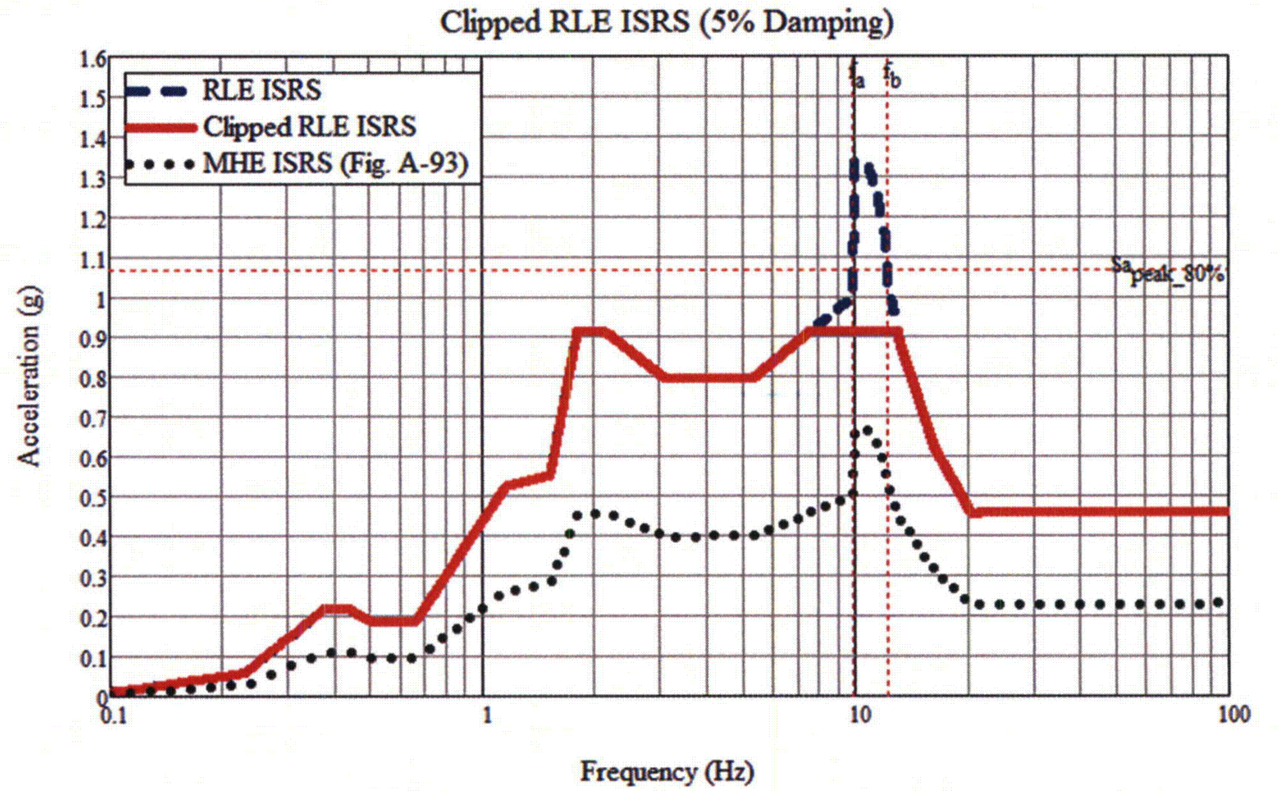
Average NS/EW clipped peak.

The North-South SSE floor response spectrum is Figure A-93 of OSS-027B.00-00-0002, shown below:



The RLGM spectral accelerations are 2.0 times the SSE (MHE), which are 3.0 times the spectral accelerations in the figure. Thus, the RLGM peak spectral acceleration is 6.0 times the peak spectral acceleration from the figure, or 1.34g. The clipping factor is computed using Equations O-2 and O-6 of EPRI NP-6041-SL.

Repeating the calculations shown above, the clipping factor is 0.68.



Note that RLE ISRS is not visible when overlapped by Clipped RLE ISRS.

Note that manual clipping was performed in order to prevent the clipped peak from falling below the secondary peak, which is relatively wide at 80% of its peak.

$Peak_{clip\_A93} := Peak\_RRS_c = 0.91 \cdot g$ Peak clipped RLE acceleration.

$Peak_{RLE\_A93} := Peak_{RLE} = 1.34 \cdot g$ Peak RLE acceleration.

Question 2

ESEP Report Section 6.4 “Functional Capacity Screening Using EPRI NP-6041-SL,” states “..., and the North-South and East-West clipped peaks were averaged.” The technical basis for averaging the clipped peaks of N-S and E-W ISRS is not clear. The dynamic characteristics of the intervening structure between the ground and the location of the ISRS filters the ground motion. N-S and E-W ISRS may be significantly different in shape and spectral amplification. While averaging may be appropriate for the ground motions, which have amplitudes that are roughly equal in the two horizontal directions, it is not obvious that averaging is appropriate for ISRS.

Please provide the technical basis for the appropriateness of averaging, and also clarify how averaging was performed, including an example calculation using representative N-S and E-W clipped ISRS.

Response to Question 2

The 1.2g screening level in Table 2-4 of EPRI NP-6041-SL was based on the capacity spectrum derived from four site recordings at facilities experiencing real earthquakes. The free-field site spectrum for each facility was taken as the average of the spectral accelerations in the two orthogonal horizontal directions. The resulting four site spectra were then averaged and smoothed to obtain the reference spectrum for earthquake experience data. This spectrum has a peak spectral acceleration of 1.2g.

The peak spectral accelerations of the four (averaged) free-field ground response spectra had significant variation. As well, the peak spectral acceleration of the two horizontal spectra for each site had significant variation. This is because the recordings were from real earthquake motions which are different in the orthogonal horizontal directions due to various factors. Horizontal ground response spectra used for design are the same in each horizontal direction.

Since the earthquake experience data peak spectral acceleration was based on site spectra that were averages of the orthogonal horizontal spectra, it is appropriate for comparison to use a seismic demand which is the average of the peak spectral accelerations in the two horizontal directions. The screening levels in Table 2-4 of EPRI NP-6041 are for comparison to ground response spectra. Page 2-44 of EPRI NP-6041-SL calls for comparison to the average of the two horizontal directions. EPRI NP-6041-SL cautions against making the screening comparison for equipment at elevations more than about 40 feet above grade, but does not provide direction on how to do this appropriately. The common method for doing this is to use ISRS for this comparison, and this is reflected in EPRI 1019200 which directs that it is best to use ISRS if available, regardless of elevation, and to compare to 1.5 times the screening level of Table 2-4 of EPRI NP-6041-SL. For the ESEP evaluation, the average of peak spectral accelerations of the two horizontal ISRS were used, reflecting the fact that the screening level was also an average.

Review of the results shows that all of the components that screened out as HCLPF greater than the RLGM based on the Table 2-4 of EPRI NP-6041-SL would also have screened out if the maximum horizontal peak spectral acceleration were used instead of the average. Thus there would be no change to any of the reported HCLPF capacities if the maximum acceleration were used.

An example using representative N-S and E-W clipped ISRS is shown below. The peak spectral accelerations are from the example following Question 1.

North-South: $\mathrm{Peak}_{\mathrm{clip\_A93}} := \mathrm{Peak\_RRS}_c = 0.91 \cdot g$ **Peak clipped RLE acceleration.**

East-West: $\mathrm{Peak}_{\mathrm{clip\_A102}} := \mathrm{Peak\_RRS}_c = 0.79 \cdot g$ **Peak clipped RLE acceleration.**

Averaged: $\mathrm{Clip}_{\mathrm{AB809U12}} := \mathrm{mean}(\mathrm{Peak}_{\mathrm{clip\_A93}}, \mathrm{Peak}_{\mathrm{clip\_A102}}) = 0.85 \cdot g$ **Average NS/EW clipped peak.**

The averaged peak spectral acceleration, 0.85g, is 93% of the maximum of the two directions, 0.91g. For all of the ISRS, the percentages ranged from 72% to 100%.

Question 3

Section 5 of the Augmented Approach Guidance (EPRI TR 3002000704) references EPRI 1019200 specifically for screening beyond 40 feet above grade level. The Oconee ESEP Report Section 6.4, "Functional Capacity Screening Using EPRI NP-6041-SL," makes no differentiation between screening below 40 feet and screening beyond 40 feet above grade level. It appears that the licensee applied the screening guidance of EPRI 1019200 at all elevations above the basemat.

Please clarify whether, and to what extent, the screening guidance of EPRI NP-6041-SL, Table 2-4 (without the 1.5 factor) was implemented for components located less than 40 feet above grade level. Specify the lowest elevation, relative to grade level, at which screening was conducted using the 1.5 factor and the amplified, clipped SSE ISRS. If this elevation is less than 40' above grade level, please provide the technical basis for deviation from the guidance in Section 5 of EPRI TR 3002000704, also discuss differences in the reported HCLPF capacities if the Augmented Approach guidance is followed.

Response to Question 3

Section 5 of the Augmented Approach Guidance (EPRI TR 3002000704) notes that Table 2-4 of EPRI NP-6041-SL is only applicable for equipment located up to 40 feet above grade, and references EPRI 1019200 for equipment located more than 40 feet above grade. However, EPRI 1019200 recommends that ISRS, if available, should be used for comparison in place of ground response spectra regardless of elevation. This was the direction followed for the Oconee ESEP evaluation.

For the ESEP evaluations, the effective grade was considered to be the base of the building, not site grade, since the design-basis SSE (MHE) was specified at the rock surface rather than the site surface. The lowest elevation at which comparison of clipped ISRS to 1.5 times the screening level was done was the first floor above the base elevation. For the base elevations, the RLGM spectrum was compared to 1.0 times the screening level. Note that this affects the functional capacity screening only, not anchorage evaluations.

Review of the results shows that all of the components located within 40 feet of the base of the building would screen out as HCLPF greater than the RLGM regardless of which comparison was made. Thus, there would be no change to any of the reported HCLPF capacities.

Enclosure 2

Oconee Nuclear Station Units 1, 2, and 3

Errata sheet for ESEP Report

The graph in Figure 4-5 of the ESEP report is the incorrect illustration.
The figure below is the correct graph.

Figure 4-5. ONS SSE (5% Damping)(Corrected).

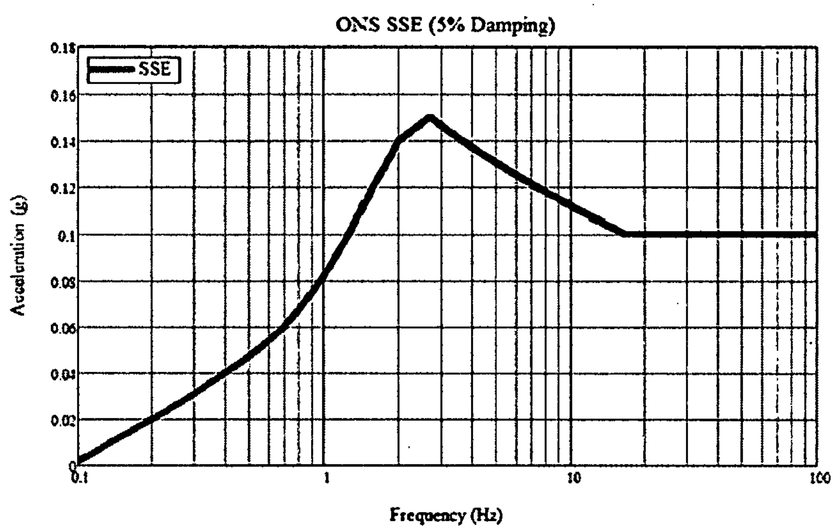


Figure 4-5. ONS SSE (5% Damping).

The purpose this graph had in the report was to illustrate a subset of data from another graph (also in the report). The figure in the original report had an incorrect graph line, which invalidated the illustration, but had no bearing on the technical validity of the report.

This graph is submitted to correct the docket.