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10 CFR 50.54(f)

CNS-15-053
June 23, 2015

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

Duke Energy Carolina, LLC (Duke Energy)
Catawba Nuclear Station, Units 1 and 2
Docket Numbers 50-413 and 50-414
Renewed License Numbers NPF-35 and NPF-52

Subject: Duke Energy Carolina, LLC (Duke Energy)
Catawba Nuclear Station (CNS), Units 1 and 2
Docket Nos. 50-413 and 50-414
Renewed License Nos. NPF-35 and NPF-52

Catawba Nuclear Station, Units 1 and 2, Request for Additional Information Regarding Expedited Seismic Evaluation Process Report

References:

1. Duke Letter, *Catawba Nuclear Station Expedited Seismic Evaluation Process Report (CEUS Sites), Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident* , dated December 31, 2014.

A010
NRR

Ladies and Gentlemen:

Catawba Nuclear Station (CNS) submitted its Expedited Seismic Evaluation Process (ESEP) Report (Reference 1) to the NRC on December 31, 2014.

On May 13, 2015, a conference call was held between Duke Energy and the NRC. During this call several questions seeking clarification in support of the NRC's review of Catawba's ESEP report were discussed. These questions had been submitted via email and were discussed with Nick DiFrancesco, NRC Project Manager. As the response to these questions will be placed on the docket, it is being processed as a 10 CFR 50.54(f) Request for Additional Information (RAI).

The response to the RAI is contained in an enclosure to this letter.

There are no regulatory commitments associated with this submittal.

Should you have any questions concerning this letter or require additional information, please contact Cecil Fletcher at (803) 701-3622.

I declare under penalty of perjury that the foregoing is true and correct. Executed on June 23, 2015.

Sincerely,

Kelvin Henderson
Vice President, Catawba Nuclear Station

Enclosure 1- Catawba Nuclear Station Response to the NRC Request for Additional Information (RAI) Regarding Expedited Seismic Evaluation Process Report

xc:

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Enclosure 1

Duke Energy Response to Questions
Related to the Catawba
Expedited Seismic Evaluation Process (ESEP) Report

Catawba Nuclear Station, Units 1and 2
Docket Numbers 50-413 and 50-414
Renewed License Numbers NPF-35 and NPF-52

Question 1

Please clarify the reason for the omission of the containment monitoring system in the ESEL, and provide more information on how the pressure inside containment will be monitored.

Response to Question 1

Pressure inside containment is monitored by the containment pressure monitors 1NSPT5370 in Unit 1 and 2NSPT5370 in Unit 2. 1NSPT5370 was inadvertently left off the Unit 1 Expedited Seismic Equipment List (ESEL) included in the submittal. However, it had been evaluated and met the Review Level Ground Motion (RLGM) requirement. This omission will be corrected in the updated submittal.

Question 2

Section 6.4 of the ESEP report, "Functional Capacity Screening Using EPRI NP-6041-SL," states:

> "The components were screened against EPRI NP-6041-SL [7], Table 2-4. ISRS were used for all components for the screening; therefore, the screening levels of EPRI NP-6041-SL [7] were increased by a factor of 1.5 (EPRI 1019200 [2], Seismic Fragility Applications Guide Update)."

The ESEP report notes the elevations for the ESEL items, but it does not explicitly provide their mounting heights above grade level. Electric Power Research Institute (EPRI) NP-6041-SL also states that care shall be exercised when using this guidance for elements mounted at elevations greater than 40-feet above grade level. Please provide the mounting heights of all ESEL items above grade level. Also, clarify (1) what is the reference level to establish the elevation of components (e.g., basemat), and (2) how these ESEL items were evaluated based on the 40-feet rule and whether the 1.5 factor was applied throughout.

Response to Question 2

In-Structure Response Spectra (ISRS) were utilized for all components located above the basemat. Section 5 of the Augmented Approach Guidance (EPRI Technical Report 3002000704, *Seismic Evaluation Guidance: Augmented Approach for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic*) 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, *Seismic Fragility Applications Guide Update*, 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 Catawba Expedited Seismic Evaluation Process (ESEP) evaluation.

The answers to the specific questions are as follows:

(1) For the ESEP evaluations, the effective grade was considered to be at the base of the building, not site grade, since the design-basis Safe Shutdown Earthquake (SSE) was specified at the building foundation rather than the site surface.

(2) 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 unclipped RLGM spectrum was compared to 1.0 times the screening level. Note that this was for the functional capacity screening only, not anchorage evaluation.

Review of the results shows that all of the components located within 40 feet of the base of the building would screen out as high confidence of a low probability of failure (HCLPF) greater than the RLGM if the RLGM to screening level comparison was used instead of ISRS to 1.5 times the screening level.

Question 3

Provide more information on the qualification of the personnel that performed the plant seismic walkdowns.

Response to Question 3

Walkdown teams were composed of two Seismic Qualification Utility Group (SQUG)-trained Seismic Capability Engineers (SCEs). The Seismic Review Team (SRT) members had B.S. Degrees in Mechanical or Civil Engineering, and most were licensed Professional Engineers (P.E.s). Each SRT had at least one licensed P.E. All SRT members had at least seven years of engineering experience including designing and evaluating new and existing structures, systems, and components for nuclear facilities. The following table provides the qualifications of the ESEP SRT members.

	Title	Degree	Years of Experience	SQUG SCE
Charles M. (Chip) Conselman, P.E.	Project Manager	BS/Civil Engineering	25+	•
Paul Dorsh, P.E.	Technical Lead	BS/Mechanical Engineering	15+	•
Mike White	Manager	BS/Mechanical Engineering	20+	•
Jeff Martin, P.E.	Senior Engineer	BS/Mechanical Engineering	7+	•

Question 4

Please provide information that describes if and how the material degradation conditions were considered and evaluated for the ESEP.

Response to Question 4

The walkdown teams inspected each component for material degradation. Two material degradation conditions were found at Catawba Nuclear Station (CNS). They were for two similar electrical terminal boxes mounted to short, structural racks which had some rust. For both components, work orders were already in place to correct the problem. For these components, the existing structural capacity of the component/anchorage was evaluated based on the existing condition, and the reported HCLPF reflected the existing condition.

Question 5

A number of components were identified in Tables 6-2 and 6-3 as requiring further evaluation and/or modification; however, in Appendices A and B, those same components are listed with HCLPF values of ">RLGM." Please explain why these components, which appear to have been screened out due to the HCLPF values, were identified as requiring further evaluation and/or modification. Furthermore, an inconsistent number of components are listed as requiring further evaluation and/or modification in the report, and as listed in Appendices A and B. Please clarify and explain these apparent inconsistencies.

Response to Question 5

Components which did not meet the RLGM demand were identified as requiring further investigation and/or modification. These components were identified in Tables 6-2 and 6-3, and were reported as having a Key Failure Mode of "Modification / Investigation" in Appendices A and B. For these cases, the HCLPF reported in Appendices A and B is conditional on completion of the modification / investigation, as stated on Pages 42 and 52. Explanation is also provided in Section 6.5.3. The updated submittal will no longer use the term "investigation" since all further investigations have now been completed.

The inconsistency in the number of components was related to the investigation for the NMHX heat exchangers. The investigation had been completed, and the report body was changed to reflect this but the Appendices were not. The Appendices will be corrected in the updated submittal.

Question 6

Using the new spectra generated for equipment located in the Auxiliary Building, please clarify and explain the procedures or justification for clipping and averaging used in the ESEP analyses as follows:

(1) Section 5.2 states "The new ISRS for the ESEP were derived by scaling the CNS design-basis SSE by the RLGM scale factor of 1.91." Clarify whether the ISRS SSE or the design basis SSE was used. Also, per EPRI NP-6041-SRL1, broadened in-structure spectra may be scaled; however, these spectra are wide-band and already broadened, and the resulting ISRS will also be

wide-band and with no equipment resonant peaks to clip. Please clarify if raw, narrow-band ISRS were generated for the ESEP, and if so, provide the technical basis for the scaling process that was followed.

(2) The CNS ESEP submittal also states that for equipment in the Auxiliary Building, new floor response spectra were generated for the RLE per EPRI NP-6359 and that the SSE ISRS were amplified by a factor of 1.91 (RLGM scale factor) throughout the frequency range and were then clipped (per EPRI 1019200), using the methodology in EPRI NP-6041-SL. Clarify and provide the technical basis to determine whether raw, narrow-band ISRS for the Auxiliary Building were generated, followed by clipping and averaging, and whether any shifting was introduced as recommended in EPRI NP-6041-SLR1. 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.

(3) The dynamic characteristics of the structure along the N-S and E-W directions may be significantly different, causing the ISRS to also vary in shape and spectral amplification. Clarify the approach and technical basis followed for averaging the clipped peaks of the N-S and E-W ISRS. Also, further explain how the averaging was performed, including a sample calculation using representative N-S and E-W clipped ISRS.

Response to Question 6

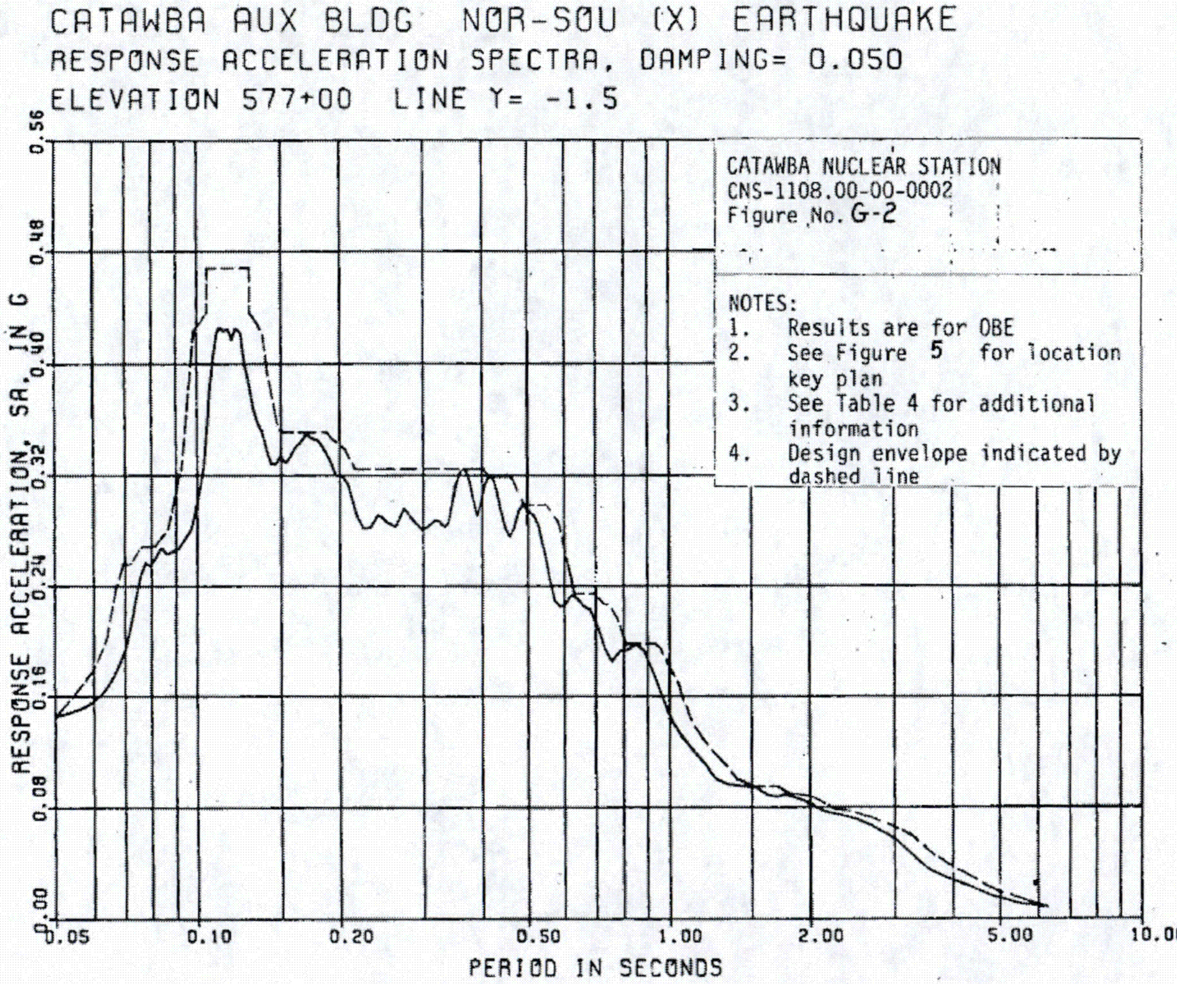
(1) Raw, unbroadened SSE ISRS were available and were scaled to obtain the "new ISRS." The scaling was done in accordance with EPRI 3002000704. The spectral acceleration values for the 5%-damped SSE ISRS were multiplied by the RLGM/SSE scale factor of 1.91.

(2) The new floor response spectra for the Review Level Earthquake (RLE) referred to in Section 5.2 were for the Individual Plant Examination of External Events Seismic Margin Assessment (SMA). In the SMA, a new analysis of the Auxiliary Building was done using the RLE as input as opposed to scaling the SSE floor response spectra as was done for the other structures. The ESEP used floor response spectra obtained by scaling the SSE ISRS by the RLGM/SSE scale factor. The design-basis floor response spectra contained plots of both raw and peak-broadened floor response spectra. The raw, unbroadened SSE ISRS were used for development of the RLGM ISRS as noted in (1) above.

Peak shifting was not performed for the CNS evaluations since for all cases the evaluations utilized either the peak spectral acceleration or zero period acceleration.

The ESEP peak clipping followed the methodology in Appendix Q of EPRI NP-6041-SL (specifically Equations Q-2, Q-4, and Q-6). 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.

An example of clipping is shown below. It should be noted that peak-clipped ISRS were not used for anchorage evaluations.



The RLGM spectral accelerations are 1.91 times the SSE, which are 1.875 times the Operating Basis Earthquake (OBE) spectral accelerations in the figure. Thus, the RLGM peak spectral acceleration is 3.58 times the peak spectral acceleration from the figure, or 1.52g. The clipping factor is computed using Equations Q-2 and Q-6 of EPRI NP-6041-SL. The calculations and resulting peak-clipped spectrum are shown below. Note that "RLE" as used in the calculation refers to the RLGM.

$Peak_{RLE} := max(acc_{RLE})\ g = 1.52 \cdot g$ — Peak RLE acceleration.

$Sa_{peak\_80\%} := \frac{0.8 \cdot Peak_{RLE}}{g} = 1.22$ — 80% of peak acceleration.

$f_a := 7.1 \quad f_b := 9.9 \quad \Delta f_{0.8} := f_b - f_a = 2.8$ — Frequencies differential at 80% of peak frequency. See figure below.

$f_c := mean(f_a, f_b) = 8.5$ — Central frequency.

$B := \frac{\Delta f_{0.8}}{f_c} = 0.33$ — Bandwidth to central frequency ratio. (EPRI NP-6041, Eq Q-2)

$$C_c := \begin{cases} 0.55 & \text{if } B \le 0.2 \\ (0.40 + 0.75B) & \text{if } 0.2 \le B \le 0.8 \\ 1.0 & \text{otherwise} \end{cases} = 0.65$$

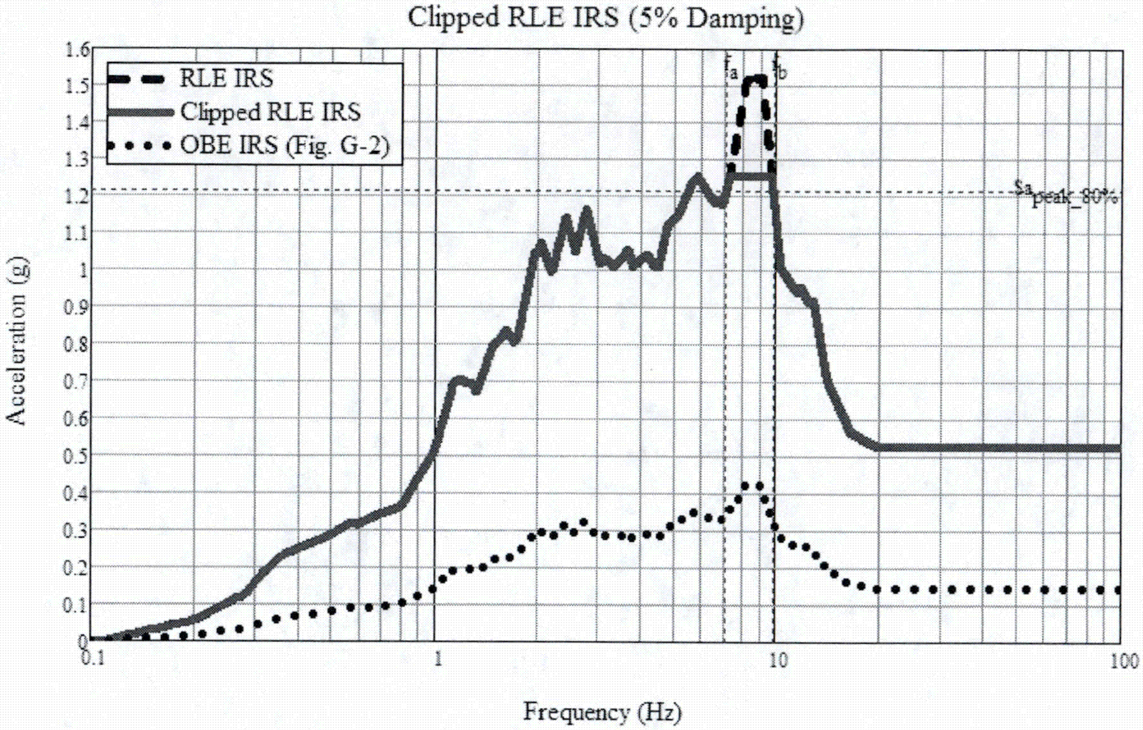
HCLPF Clipping Factor. (EPRI NP-6041, Eq Q-6)

$Peak\_RRS_c := Peak_{RLE} \cdot C_c = 0.985 \cdot g$ — Clipped required response spectra. (EPRI NP-6041, Eq Q-4)

$Peak\_RRS_c := F_{RLE} \cdot F_{OBE\_SSE} \cdot 0.34964g = 1.253 \cdot g$ — Clipped required response spectra, determined manually since secondary peak may be too wide to clip.

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

Equation for the clipped peak graph.

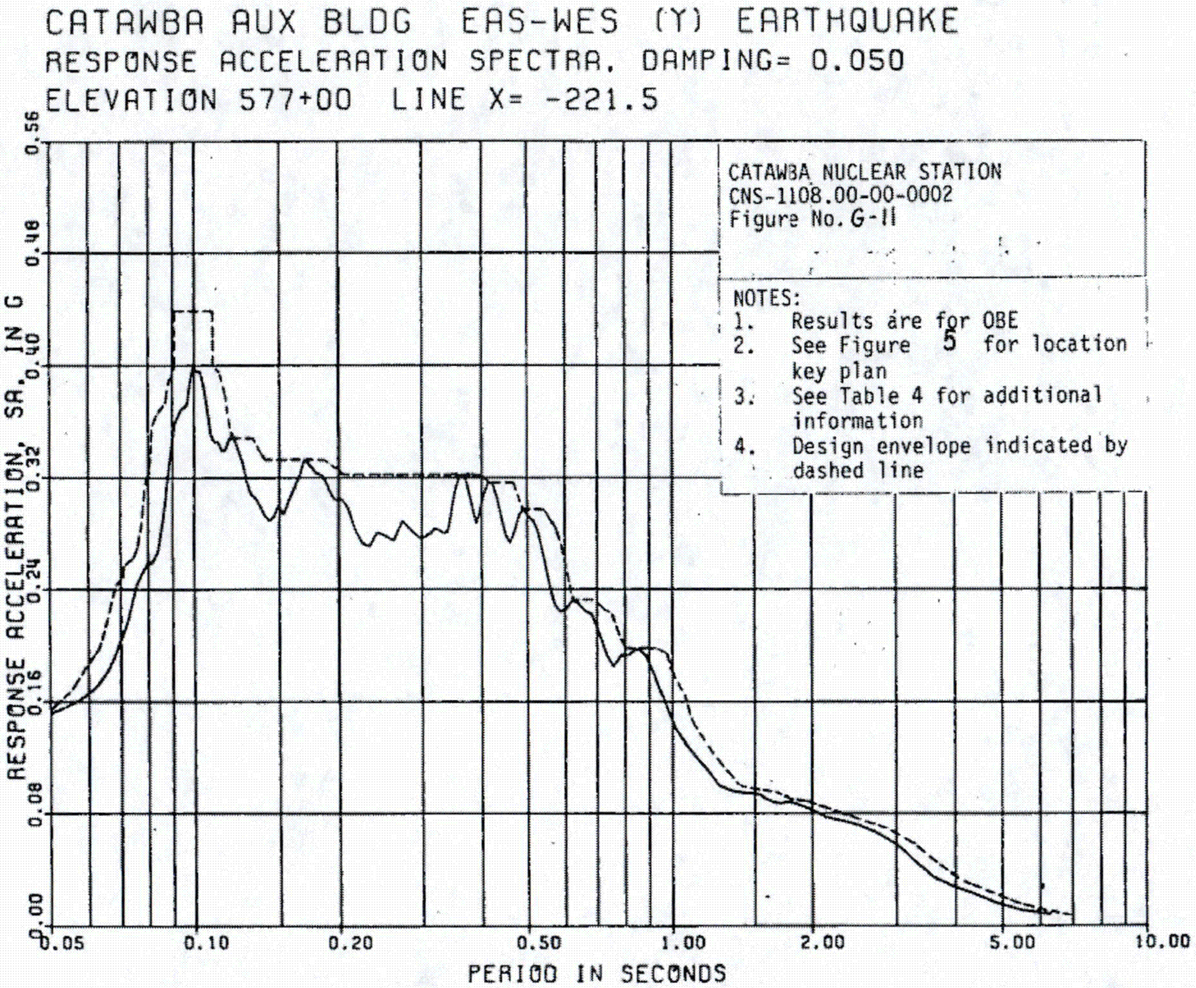


Note that RLE IRS is not visible when overlapped by Clipped RLE IRS.

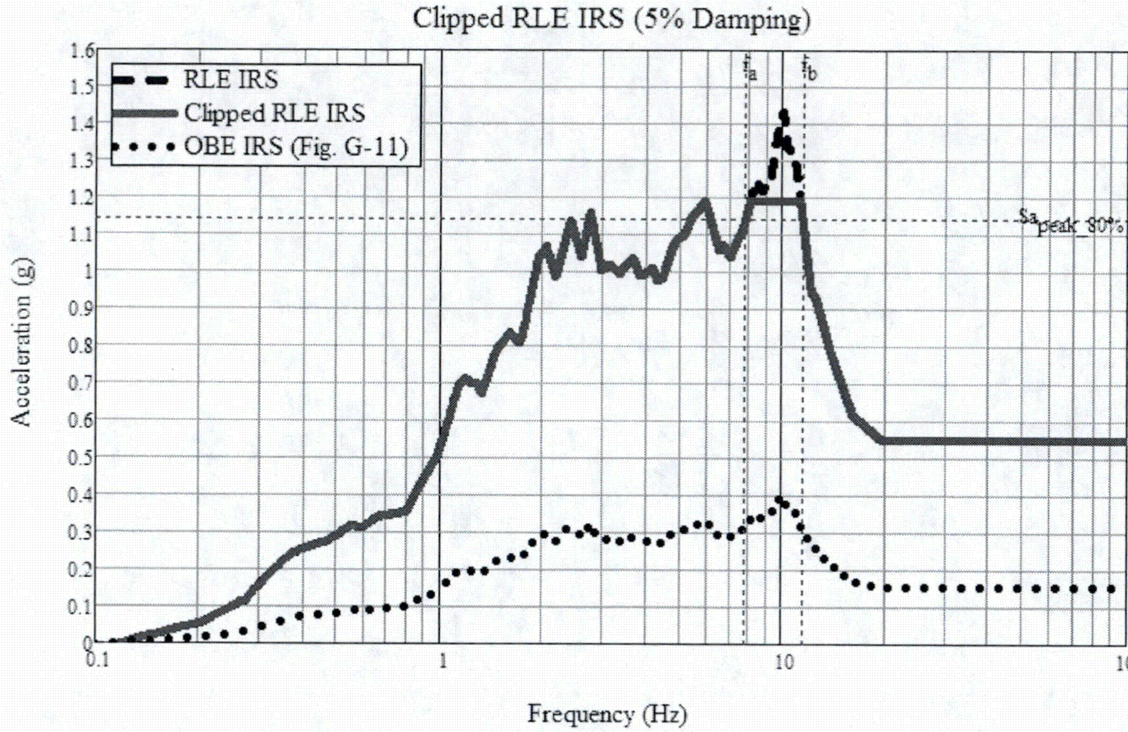
Note that manual clipping was performed in order to prevent the clipped peak from falling below the secondary peak, which is relatively wide at 80% of its peak.

$Peak_{clip\_G2} := Peak\_RRS_c = 1.25 \cdot g$ Peak clipped RLE acceleration.

$Peak_{RLE\_G2} := Peak_{RLE} = 1.52 \cdot g$ Peak RLE acceleration.


CATAWBA AUX BLDG EAS-WES (Y) EARTHQUAKE
RESPONSE ACCELERATION SPECTRA, DAMPING= 0.050
ELEVATION 577+00 LINE X= -221.5
CATAWBA NUCLEAR STATION
CNS-1108.00-00-0002
Figure No. G-11
NOTES:
1. Results are for OBE
2. See Figure 5 for location key plan
3. See Table 4 for additional information
4. Design envelope indicated by dashed line
RESPONSE ACCELERATION, SA, IN G
0.00
0.08
0.16
0.24
0.32
0.40
0.48
0.56
0.05
0.10
0.20
0.50
1.00
2.00
5.00
10.00
PERIOD IN SECONDS

$Peak_{RLE} := max(acc_{RLE})\, g = 1.43 \cdot g$	Peak RLE acceleration.
$Sa_{peak\_80\%} := \frac{0.8 \cdot Peak_{RLE}}{g} = 1.14$	80% of peak acceleration.
$f_a := 7.75 \quad f_b := 11.6 \quad \Delta f_{0.8} := f_b - f_a = 3.9$	Frequencies differential at 80% of peak frequency. See figure below.
$f_c := mean(f_a, f_b) = 9.7$	Central frequency.
$B := \frac{\Delta f_{0.8}}{f_c} = 0.40$	Bandwidth to central frequency ratio. (EPRI NP-6041, Eq Q-2)
$C_c := \begin{cases} 0.55 & \text{if } B \le 0.2 \\ (0.40 + 0.75B) & \text{if } 0.2 \le B \le 0.8 \\ 1.0 & \text{otherwise} \end{cases} = 0.70$	HCLPF Clipping Factor. (EPRI NP-6041, Eq Q-6)
$Peak\_RRS_c := Peak_{RLE} \cdot C_c = 0.999 \cdot g$	Clipped required response spectra. (EPRI NP-6041, Eq Q-4)
$Peak\_RRS_c := F_{RLE} \cdot F_{OBE\_SSE} \cdot 0.332552g = 1.191 \cdot g$	Clipped required response spectra, determined manually since secondary peak may be too wide to clip.
$a(f) := \begin{cases} accRLE(f) & \text{if } accRLE(f) \le \frac{Peak\_RRS_c}{g} \\ \frac{Peak\_RRS_c}{g} & \text{otherwise} \end{cases}$	Equation for the clipped peak graph.



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

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.

$Peak_{clip\_G11} := Peak\_RRS_c = 1.19 \cdot g$ Peak clipped RLE acceleration.

$Peak_{RLE\_G11} := Peak_{RLE} = 1.43 \cdot g$ Peak RLE acceleration.

(3) 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-SL 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 6, Item (2).

North-South:

$Peak_{clip\_G2} := Peak\_RRS_c = 1.25 \cdot g$ Peak clipped RLE acceleration.

East-West:

$Peak_{clip\_G11} := Peak\_RRS_c = 1.19 \cdot g$ Peak clipped RLE acceleration.

Averaged:

$Clip_{G\_2\_11} := mean(Peak_{clip\_G2}, Peak_{clip\_G11}) = 1.22 \cdot g$ Average NS/EW clipped peak.

The averaged peak spectral acceleration is 98% of the maximum of the two directions. For all of the ISRS, the percentages ranged from 96% to 100%.

Question 7

ESEP Section 7 of the ESEP submittal details a series of items classified as inaccessible to the licensee. Please explain and justify why these items are inaccessible. Furthermore, Subsection 7.2 provides a March 2015 completion date for the walkdown and review of these inaccessible components, which is not reflected in the summary of planned actions listed in Subsection 8.4. Please correct this apparent omission or inconsistency.

Response to Question 7

Section 8.4, Table 8-1, Action #1 was intended to reflect the plan for actions described in Section 2.2. During the Unit 2 outage in March 2015, seismic walkdowns or walk-bys were completed on the items listed in Table 7-1, with the exception of two hydrogen igniters. The SRTs were able to inspect 65 hydrogen igniters of identical design and similar mounting. As of the March 2015 Unit 2 walkdowns, five hydrogen igniters remain as inaccessible (three in Unit 1 and two in Unit 2). For each one, the SRT members were prevented from viewing the igniters due to unsafe access paths. The SRT members judged that the igniters could be screened based upon similarity to the other igniters. Access to the three igniters in Unit 1 will be pursued during the November 2015 outage in hopes that access conditions may have changed. If access to these igniters is attained, the ESEP report will be updated to reflect the walkdown results. Access will not be pursued for further evaluation of the inaccessible Unit 2 igniters, based upon similarity to the accessible igniters which proved to be robust and in order to limit personnel exposure involved in acquiring access.

Question 8

The ESEP submittal presents the inconsistencies between the number of components listed in Table 7-1 for the Unit 2 walkdowns not completed at time of this report, and the components identified in the Appendix B with the note "TBD." Please clarify and explain these tables' inconsistencies.

Response to Question 8

This inconsistency was a mistake which was exclusive to Unit 2 (Items 3 through 6) and was realized prior to the Unit 2 March 2015 outage. The components in question were evaluated during the outage. The inconsistency will no longer exist in the updated submittal.

Question 9

Item 4 of subsection 8.4 does not include a regulatory commitment (date) to submit a letter to the NRC summarizing the results of all the action items listed, including the implementation of plant modifications. Please provide the expected date when these modifications will be implemented.

Response to Question 9

Currently the expected date for the Unit 1 letter would be 60 days after the Spring 2017 outage which is the second refueling outage after December 31, 2014. The expected date for Unit 2 would be no later than December 31, 2016, which is two years after the Dec 31, 2014 date.