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June 5, 2012

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

Subject: Duke Energy Carolinas, LLC
William States Lee III Nuclear Station – Docket Nos. 52-018 and 52-019
AP1000 Combined License Application for the
William States Lee III Nuclear Station Units 1 and 2
Supplemental Response to Request for Additional Information
(RAI No. 6182)
Ltr# WLG2012.06-05

References: Letter from Brian Hughes (NRC) to James Thornton (Duke Energy), Request for Additional Information Letter No. 100 Related to SRP 03.07.02 – Seismic System Analysis for the William States Lee III Units 1 and 2 Combined License Application, dated November 9, 2011 (ML11313A170)

Letter from Ronald A. Jones (Duke Energy) to Document Control Desk (NRC), Partial Response to Request for Additional Information (RAI No. 6182), Ltr# WLG2011.12-03, dated December 8, 2011 (ML11343A567)

Letter from John W. Pitesa (Duke Energy) to Document Control Desk (NRC), Supplemental Partial Response to Request for Additional Information (RAI No. 6182), Ltr# WLG2012.03-04, dated March 19, 2012 (ML12080A112)

This letter supplements Duke Energy's response to the Nuclear Regulatory Commission's request for additional information (RAI) included in the referenced letters, based on interactions with NRC staff during the April 9-11, 2012 technical audit.

The supplemental information is addressed in a separate enclosure, which also identifies associated changes that will be made in a future revision of the Final Safety Analysis Report for the Lee Nuclear Station.

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If you have any questions or need any additional information, please contact James R. Thornton, Nuclear Plant Development Licensing Manager (Acting), at (704) 382-2612.

Sincerely,

Christopher M. Fallon

Christopher M. Fallon
Vice President
Nuclear Development (Acting)

Enclosure:

1) Lee Nuclear Station Supplemental Response to Request for Additional Information (RAI), Letter No. 100, RAI 03.07.02-001

xc (w/out enclosure):
Frederick Brown, Deputy Regional Administrator, Region II

xc (w/ enclosure):
Brian Hughes, Senior Project Manager, DNRL

AFFIDAVIT OF CHRISTOPHER M. FALLON

Christopher M. Fallon, being duly sworn, states that he is Vice President, Nuclear Development (Acting), Duke Energy Carolinas, LLC, that he is authorized on the part of said Company to sign and file with the U. S. Nuclear Regulatory Commission this combined license application for the William States Lee III Nuclear Station, and that all the matter and facts set forth herein are true and correct to the best of his knowledge.

Christopher M. Fallon

Christopher M. Fallon, Vice President
Nuclear Development (Acting)

Subscribed and sworn to me on June 5, 2012

Freda K. Crump
Notary Public

My commission expires: August 17, 2016

SEAL FREDA K CRUMP NOTARY PUBLIC LINCOLN COUNTY, NC

Lee Nuclear Station Supplemental Partial Response to Request for Additional Information (RAI)

RAI Letter No. 100

NRC Technical Review Branch: **Structural Engineering Branch 1 (AP1000/EPR Projects) (SEB1)**

Reference NRC RAI Number(s): **RAI 03.07.02-001**

NRC RAI:

The staff performed a review of WLG-1000-S2R-802, Revision 1, and finds that additional information is required to assess the adequacy of the applicant's seismic analysis for satisfying NRC regulations (Appendix A to 10 CFR Part 50):

(a) WLG-1000-S2R-802 contains a site-specific analysis to demonstrate acceptability of the AP1000 standard design. Staff review of this report finds that there is insufficient detail to assess adequacy of the seismic analysis method used by the applicant. In particular, it is not clear if the applicant's method of seismic analysis is consistent with that of AP1000 DCD Sections 3.7.1 and 3.7.2, which provide acceptable methods for performing seismic analysis. To address this issue, the staff requests the applicant to identify any DCD departures pertaining to these DCD sections, particularly as they relate to critical damping values (3.7.1.3), development of design time-histories (3.7.1.2), three components of earthquake motion (3.7.2.6), and seismic modeling and analysis of Seismic Category II building structures (3.7.2.8.4).

Staff notes that NRC regulation, 10 CFR Part 52.79, "Contents of Applications; Technical Information in Final Safety Analysis Report," requires that the COL applicant's FSAR contain a description and safety assessment of the structures, systems, and components as well as the evaluations required to show that the safety functions will be accomplished. Based on this requirement, staff requests the applicant to include a description of the site-specific seismic analysis (including methods, significant assumptions, and results) in FSAR Section 3.7.

(b) WLG-1000-S2R-802, Section 5.0, describes a parametric study performed to assess the impact of the reduced shear wave velocity below the NW corner of Unit 1. Based on these results (Figures 6-1 though 6-6), the applicant asserts that (a) the effect of the "softer" NW corner on the design is minimal, and that (b) the SSI results from Unit 2 bound the Unit 1 results, thereby constituting a conservative seismic input assumption for the 3-D SSI analysis of Unit 1.

Staff review of the applicant's sensitivity study finds that the assessment of the NW corner effects should include a comparison of vertical responses (Figures 6-1 through 6-6), since a "soft" corner may affect the rocking response of the nuclear island. In addition, staff notes that AP1000 DCD Section 2.5.2 states that, for site-specific analysis of hard-rock sites, the COL applicant should compare in-structure response spectra (ISRS) to the AP1000 HRHF spectra at the locations given in APP-GW-GLR-115, "AP1000 Standard Combined License Technical Report Effect of High Frequency Seismic Content on SSCs." Since Appendix A does not contain such comparisons, the staff requests the applicant to provide comparisons at locations described in APP-GW-GLR-115, Section 5.2. In order to assess the significance of the

sensitivity study results on the standard design, the applicant is requested to provide comparisons of the sensitivity study results to the standard plant design spectra (HRHF and CSDRS). If the Unit 1 seismic demands (including vertical response) exceed those of Unit 2, the applicant should justify the use of the Unit 2 profile (centerline) for the 3D SSI analysis of Unit 1.

(c) WLG-1000-S2R-802, Section 3.0, describes site-specific 3-D SSI analysis, which makes use of ground-motion coherency functions (incoherency). Staff review finds that this report section does not provide sufficient detail to assess the acceptability of the incoherency approach used by the applicant. To address this issue, the applicant is requested to summarize the methodology used and describe the consistency with guidance provided in ISG-01, "Interim Staff Guidance on Seismic Issues Associated with High-Frequency Ground Motion in Design Certification and Combined License Applications."

(d) WLG-1000-S2R-802, Section 4, provides time-histories matched to the WLS FIRS. SRP Section 3.7.1 provides acceptance criteria for using a single set of synthetic time histories. Staff review finds that Section 4 does not address the SRP criteria for matching (e.g., design response spectrum enveloping and power spectral density requirements). To address this issue, the applicant is requested to provide the bases for acceptability of the assumed time histories used in SSI analysis.

Duke Energy Response:

In Reference 1 and Reference 2, Duke Energy provided a response to items (a) through (d) above. This supplemental response presents additional information requested by NRC in Action Items resulting from the April 9-11, 2012 technical audit.

Action Item 5. **<u>2-D SSI Model Boundary Conditions</u>**

a) Duke / WEC to address Unit 1 (2D) SSI model discontinuity at model boundary (sensitivity of lateral extent).
b) Duke / WEC to develop qualitative statement supported by ISRS comparisons.
c) Duke to revise letter 100 response.

Response:

Reference 3 provided Westinghouse proprietary report WLG-1000-S2R-802, Revision 2. Figures 4.2-1 and 4.2-2 of that report illustrate the 2D analytical models representing the East-West centerline configuration of Lee Unit 1 and Unit 2, respectively, and represent the variety of support configurations between Unit 1 and Unit 2. Both these detailed models extend laterally only a short distance from the nuclear island. In contrast, the 2D model of the Unit 1 northwest corner, shown in Figure 4.2-3 of WLG-1000-S2R-802, Revision 2, extends significantly farther to the west (approximately 100 ft) and to the east (approximately 60 feet). In addition, the northwest corner model also extends deeper from the plant grade to permit more detailed modeling of the variety of materials surrounding and supporting the nuclear island in that area.

Figures 5-1 through 5-12 of WLG-1000-S2R-802, Revision 2, illustrate the in-structure response spectra that result from analysis of these three configurations, and that incorporate the effects of varied embedment boundary conditions and granular fill materials placed beside the nuclear island. Inspection of these figures demonstrates that this variety of conditions resulted in only minor differences across the entire frequency spectrum in both the horizontal and vertical directions. As a result, it is concluded that any potential further changes that might result from varying the lateral extent of the Unit 1 northwest corner 2D analytical model would not be significant.

Action Item 7. **Consideration of Uncertainty in NI SSI Analyses**

a) Duke / WEC to include statement of significance of SSI calculation justification for using only best-estimate (BE) profile in NI calculation (3D).

b) Duke to revise letter 100 response.

Response:

Tables 6.3-1 and 6.3-2 of Westinghouse report WLG-1000-S2R-802, Revision 2, present the best-estimate rock profiles considered in the 3D incoherent SSI analyses of the Lee Unit 1 and Unit 2. These tables show that the best estimate shear wave velocity varies from 7500 feet per second (fps) to 8391 fps below the base mat and from 8983 fps to 9559 fps deeper in the profile, which incorporates varied rock profile conditions of approximately ±10%.

Figures 7-1 through 7-18 of report WLG-1000-S2R-802, Revision 2, present the resulting 3D in-structure response spectra for the Unit 1 and Unit 2 centerline models. Even though the two analyses include the differences in these two significantly varied rock profiles, only minor differences are noted between the Unit 1 and Unit 2 in-structure response spectra across the entire frequency spectrum in both the horizontal and vertical directions.

As a result, it is concluded that the Lee 3D incoherent SSI analyses of the nuclear island are not significantly sensitive to potential variations in the rock profiles, including upper and lower bound profiles.

References:

1. Letter from Ronald A. Jones (Duke Energy) to Document Control Desk, U.S. Nuclear Regulatory Commission, Partial Response to Request for Additional Information (RAI No. 6182), Ltr# WLG2011.12-03, dated December 8, 2011 (ML11343A567)
2. Letter from John W. Pitesa (Duke Energy) to Document Control Desk (NRC), Supplemental Partial Response to Request for Additional Information (RAI No. 6182), Ltr# WLG2012.03-04, dated March 19, 2012 (ML12080A112)
3. Letter from John W. Pitesa (Duke Energy) to Document Control Desk, U.S. Nuclear Regulatory Commission, Westinghouse Electric Company Report on William States Lee III Nuclear Station Site-Specific Seismic Analyses, Ltr# WLG2012.03-05, dated March 19, 2012

Associated Revision to the Lee Nuclear Station Final Safety Analysis Report:

None

Attachments:

None