LeeRAIsPEm Resource

From: Brian Hughes
Sent: Tuesday, December 23, 2008 9:23 AM
To: LeeRAIsPEm Resource
Subject: LEE-RAI-LTR-050 RELATED TO SRP 02.05.02 FOR THE LEE UNITS 1 AND 2 COL
Attachments: LEE-RAI-LTR-050.doc

Hearing Identifier: Lee_COL_RAI
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From: Brian Hughes

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Recipients:
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December 23, 2008

Mr. Peter S. Hastings, P.E.
Licensing Manager, Nuclear Plant Development
Duke Energy
526 South Church Street
Charlotte, NC 28201-1006

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 050 RELATED TO SRP 02.05.02 FOR THE WILLIAM STATES LEE III UNITS 1 AND 2 COMBINED LICENSE APPLICATION

Dear Mr. Hastings:

By letter dated December 12, 2007, as supplemented by letters dated January 28, 2008, February 6, 2008 and February 8, 2008, Duke Energy submitted its application to the U. S. Nuclear Regulatory Commission (NRC) for a combined license (COL) for two AP1000 advance passive pressurized water reactors pursuant to 10 CFR Part 52. The NRC staff is performing a detailed review of this application to enable the staff to reach a conclusion on the safety of the proposed application.

The NRC staff has identified that additional information is needed to continue portions of the review. The staff's request for additional information (RAI) is contained in the enclosure to this letter.

To support the review schedule, you are requested to respond within 30 days of the date of this letter. If changes are needed to the final safety analysis report, the staff requests that the RAI response include the proposed wording changes.

If you have any questions or comments concerning this matter, you may contact me at 301-415-6582.

Sincerely,

/**RA**/

Brian Hughes, Senior Project Manager
AP1000 Projects Branch 1
Division of New Reactor Licensing
Office of New Reactors

Docket Nos. 52-018
52-019

Enclosure:
Request for Additional Information

CC: see next page

P.Hastings

If you have any questions or comments concerning this matter, you may contact me at 301-415-6582.

Sincerely,

/**RA**/

Brian Hughes, Senior Project Manager
AP1000 Projects Branch 1
Division of New Reactor Licensing
Office of New Reactors

Docket Nos. 52-018
52-019

eRAI Tracking No. 1487

Enclosure:
Request for Additional Information

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DATE	11/07/08	11/06/08	11/18/08	12/23/08

*Approval captured electronically in the electronic RAI system.

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Request for Additional Information No. 1487

12/23/2008

William States Lee III, Units 1 and 2
Duke Energy Carolinas, LLC
Docket No. 52-018 and 52-019
SRP Section: 02.05.02 - Vibratory Ground Motion
Application Section: 2.5.2

QUESTIONS for Geosciences and Geotechnical Engineering Branch 2 (RGS2)

02.05.02-35

FSAR Section 2.5.2.1 (pg 2.5-83 through 2.5-85) describes how the seismicity catalog was updated for the post-EPRI/SOG time period from 1985 to 2005.

(a) Please explain why the rectangular region for the seismicity catalog update, shown in Figure 2.5.2-201, is not symmetrical about the Lee site, but, rather, extends farther southward into areas of lower seismicity.

(b) FSAR Section 2.5.2.1.1 (pg 2.5-83) describes the goal of creating a homogeneous catalog of CEUS earthquakes with consistent estimates of body-wave magnitude (mb). Currently the most commonly cataloged magnitude for moderate-size earthquakes in the CEUS is a short-period surface-wave magnitude like mbLg. Please explain the relationship between these two magnitude measures.

(c) FSAR Section 2.5.2.1.2 (pgs 2.5-84 and 2.5-85) describes how values of duration magnitude and local magnitude are converted to E[mb] and mb* using equation 4-2 from EPRI/SOG (Reference 204). The USGS/NEIC on-line PDE catalog (http://neic.usgs.gov/neis/epic/epic_rect.html) for the update region for 1985-2005 lists mbLg magnitudes for most of the earthquakes (~75%) with magnitude equal to or greater than 2.5. Reference 204 seems to recommend equation 4-3, not equation 4-2, for determining mb* when E[mb] is determined directly from instrumental data. Please clarify the method used to create an updated catalog with uniform magnitudes, and explain why mbLg and equation 4-3 are not used directly.

(d) FSAR Section 2.5.2.1.2 (pg 2.5-85) shows how magnitude uncertainty, σmb, is used to compute uniform, un-biased magnitudes, but does not describe how it is estimated. Please explain how σmb is estimated for post-EPRI/SOG earthquakes.

(e) The last sentence in FSAR Section 2.5.2.1.2 (pg 2.5-85) states that, for the purpose of recurrence analysis, the 89 earthquakes that occurred within the rectangular region are considered independent events. This statement suggests that the updated catalog is not declustered. Please explain why the updated catalog is not declustered for the purpose of recurrence analysis.

02.05.02-36

FSAR Table 2.5.2-201 does not include sources for the earthquake parameters which are presented. Please indicate sources for the earthquake parameters (hypocenter, magnitude, etc) presented in Table 2.5.2-201.

02.05.02-37

FSAR Sections 2.5.2.2.1 (pg 2.5-87) and 2.5.1.1.3.2.2 (pg 2.5-39) state that maximum magnitude (mmax) values were converted from moment-magnitude (M) to body-wave magnitude (mb) using the arithmetic average of results from three equations. Three references are cited, including Frankel et al. (1996). As described in the Frankel et al (1996) reference, however, two published equations were applied therein for the mmax conversion (i.e., Johnston, 1994, and Boore and Atkinson, 1987), with each used for a different ground-motion relation. Consequently, it is not clear what is meant by the reference to the Frankel et al (1996) equation. Please clarify the Frankel et al (1996) reference and indicate the specific conversion relations that were used.

02.05.02-38

FSAR Section 2.5.2.2.1.3 (pg 2.5-92) cites Source 108 for Law Engineering as “Brunswick, NC Background”. This source should be labeled “Brunswick, GA Background” since its location includes Brunswick, GA, not NC. The source coincides approximately with the location of the South Georgia Rift Basin. Please correct the label for Source 108.

02.05.02-39

During the latter stages of the EPRI/SOG effort, data were compiled and analyzed from earthquakes in stable continental regions worldwide which were considered to be geologic and tectonic analogs of the CEUS. The current USGS Mmax specification for the CEUS extended-margin zone, M 7.5 +0.2/-0.4, is based on an analysis by A. Johnston of the global SCR dataset. The EPRI/SOG teams saw an early version of his work, but not the final compilation of magnitudes and tectonic settings that was published in 1994. The 2001, M 7.6-7.7 Bhuj (Gujarat, India) earthquake is considered a CEUS analog event by many earth scientists because it occurred in an intraplate tectonic setting. Please justify why the M 7.6-7.7 Bhuj earthquake in India does not constitute new information that requires updating of the EPRI/SOG Mmax model.

02.05.02-40

FSAR Section 2.5.2.2.2.4.3 (pg 2.5-109) describes how Charleston-type paleoearthquake ages for the UCSS model are based on overlapping 2-sigma ages of paleoliquefaction features, where the dated paleoliquefaction features are reported in Reference 222 (Talwani and Schaeffer, 2001). Furthermore, the UCSS model considers these "trimmed" ages to represent the approximately 95 percent confidence interval, with a "best estimate" event age as the midpoint of the approximately 95 percent age range.

(a) Please provide a table or figure that summarizes the probability distribution functions (PDFs) for calibrated ages of layers bounding paleoliquefaction features from Talwani

and Schaefer (2001) that are used to define "Event Age (YBP)" and "Event Age (YBP)" in the second and last columns of Table 2.5.2-215.

(b) Please discuss event ages at each paleoliquefaction site in the context of minimum and maximum limiting ages as reported in Talwani and Schaefer (2001).

(c) In the context of the observations in a and b above, please derive 95% confidence intervals (2-sigma) for event ages at each site as derived from layer dates in Talwani and Schaefer (2001). Please consider papers such as Biasi and others (BSSA, 2002) for an overview on how event ages and confidence intervals are calculated from multiple bounding PDFs.

(d) In the context of 95% confidence intervals (2-sigma) for event ages at each site as calculated in part c above, please derive 95% confidence intervals (2-sigma) for events that span multiple sites.

(e) Given the newly-calculated probable event ages in a through d above, please discuss the basis for assuming that the liquefaction observations reported in Talwani and Schaeffer (2001) are best interpreted as reflecting only large, Charleston-type events.

02.05.02-41

FSAR Section 2.5.2.4 (pg 2.5-115) mentions the Catawba, McGuire and Oconee sites in regard to comparing the percent difference of seismic hazard calculated for the Lee site to those other hard-rock sites in the CEUS. These comparisons are presented in FSAR Table 2.5.2-216. However, the locations of the four sites are not shown relative to each other or to regional geology and seismicity. Please provide a figure showing the relative locations of the Lee, Catawba, McGuire and Oconee sites, including generalized geology and seismicity, to accompany the information shown in Table 2.5.2-216.

02.05.02-42

FSAR Section 2.5.2.4.3.2 (pgs 2.5-118 through 2.5-220) discusses the possibility of clustered earthquakes at New Madrid. The occurrence rate of earthquake clusters is determined using both a Poisson model and a lognormal renewal model with a range of coefficients of variation. Details of the cluster model are not provided in the FSAR, however, but rather a reference is made to the Exelon application for the Clinton ESP site (Reference 293) for additional information.

(a) Please provide a comprehensive summary of the New Madrid cluster model, including a detailed description of how events are considered as a cluster.

(b) Regarding the time-dependence of earthquake probabilities, please specify the coefficients of variation considered and the resulting probabilities. Please also describe the data that are available to constrain model parameters.

02.05.02-43

In FSAR Figure 2.5.2-228 (i.e., the 1 Hz hazard curve), the mean hazard matches the 85 percentile hazard at exceedence frequencies less than ~2e-5. In Figure 2.5.2-229 (0.5 Hz hazard curve), the mean hazard exceeds the 85% percentile hazard at exceedence frequencies less than ~6e-5. This information suggests an extremely "fat-tailed" distribution of hazard at low spectral frequencies (long periods) and higher (0.1 g) ground motions.

Please elaborate on the probability distribution of exceedence frequencies at these periods and ground motion levels.

02.05.02-44

RG 1.208 states that fractile hazard curves should be reported at the 0.05, 0.16, 0.50, 0.84 and 0.95 levels. FSAR Figures 2.5.2-223 through 2.5.2-229 only show mean, median and 0.15 and 0.85 fractile hazard curves. Also, Figure 2.5.2-230 does not illustrate the rock UHRS for 10-6 annual frequencies.

Please include the suggested fractile hazard curves in Figures 2.5.2-223 through 2.5.2-229, and plot the rock UHRS for 10-6 annual frequencies in Figure 2.5.2-230.

02.05.02-45

FSAR Section 2.5.2.4.4 discusses implementation of the Cumulative Absolute Velocity (CAV) model of Abrahamson and Watson-Lamrey (2005). Please provide details on how the CAV filter was implemented and how it impacts the hazard.

02.05.02-46

The FSAR uses the EPRI (2004) ground motion equations in the updated PSHA. Since 2004, however, two new ground motion prediction models for the CEUS have been published. These published models are "Empirical-stochastic ground-motion prediction for eastern North America", Tavakoli and Pezeshk (BSSA, 2005, v.95[6], 2283-2296); and "Earthquake ground-motion prediction equations for eastern North America", Atkinson and Boore (BSSA, 2006, v.96[6], 2181-2205).

Please describe the potential impact of these two new ground motion relations on the results of the PSHA.

02.05.02-47

FSAR Section 2.5.2.4.4 (pg 2.5-121) states that ground motions for frequencies "other than 100 Hz" are assumed to be partially correlated with the ground motions at 100 Hz, so that the filtering is consistent from frequency to frequency. Please clarify what is meant by "frequencies other than 100 Hz".