CCNPP3COLA PEmails

From: John Rycyna
Sent: Tuesday, February 17, 2009 4:11 PM
To: Poche, Robert; McQueeney, Jennifer
Cc: CCNPP3COL Resource; Alice Stieve; Sarah Gonzalez; Clifford Munson; Rebecca Karas; Joseph Colaccino; James Biggins; Adam Gendelman
Subject: Draft RAI No 72 RGS 2070.doc (PUBLIC)
Attachments: Draft RAI No 72 RGS 2070.doc

Rob,

Attached is DRAFT RAI No. 72. You have until March 5, 2009 to review it and to decide whether you need a conference call to discuss it. After the call or after March 5, 2009 the RAI will be finalized and sent to you. You then have 30 days to respond.

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Request for Additional Information No. 72
DRAFT
2/17/2009

Calvert Cliffs Unit 3
UniStar
Docket No. 52-016
SRP Section: 02.05.02 - Vibratory Ground Motion
Application Section: 2.5.2

QUESTIONS for Geosciences and Geotechnical Engineering Branch 2 (RGS2)

02.05.02-1

The applicant's FSAR Section 2.5.2.1.2 describes the applicant's update of the EPRI seismicity catalog for the period 1985 to present. FSAR Table 2.5-2 lists the parameters (including latitude, longitude, time, and magnitude) of the updated portion of the seismicity catalog. Please clarify whether or not the values for s^2_{mb} (in FSAR Equation 2.5.2-3) were derived from the EPRI seismicity catalog or the updated seismicity catalog. Please also provide electronic versions of both the EPRI seismicity catalog and the updated seismicity catalog.

02.05.02-2

Page 2.5-98 of the FSAR states that the magnitudes given in the catalogs were converted to EPRI best or expected estimate values of m_b based on FSAR Equations 2.5.2-1 and 2.5.2-2. Please justify the use of these formulas, which are based on magnitude data acquired more than 20 years ago.

Also, in FSAR Equation 2.5.2-3, the applicant assumes b=1.0. Explain whether or not this b-value is supported by the regional seismicity data.

02.05.02-3

FSAR Tables 2.5-4 through 2.5-9 summarize each of the six EPRI team's seismic source models. The tables list probability of activity (Pa) for each source.

(a) Please explain the meaning "probability of activity" in these tables and also discuss the impacts on the seismic hazard.

(b) For the Central Virginia seismic zone (CVSZ), Tables 2.5-4 through 2.5-9 list the following values probability values specified by each team: Bechtel (0.35), Dames and Moore (1.0), Rondout (1.0), Law (0.43). Given the seismogenic nature of the CVSZ (i.e. continued seismic activity in the CVSZ since the EPRI 1986 study and the occurrence of the 9 December 2003 M4.3 central Virginia earthquake (Kim and Chapman, 2005, BSSA), please explain why the CVSZ probability of activity values have not been adjusted to 1.0.

(c) In FSAR Table 2.5-5, the Dames and Moore source characterization parameters are presented for Zones 41 (Southern Cratonic Margin) 53 (Southern Appalachian Mobile

Belt), 47 (Connecticut Basin), and 4 (Appalachian Fold Belts). Relatively low probabilities of activity were assigned to these zones by the Dames and Moore team. Please justify the source characterization parameters used by the Dames and Moore team for Zones 41, 53, 47, and 4 to assess seismic hazard of the region surrounding the Calvert Cliffs site. Considering the low probability values selected by the Dames and Moore team, please also justify the conclusion that the source characterization for Zones 41, 53, 47, and 4 still falls within the range for seismic hazard in the Central and Eastern U.S (CEUS) that is accepted by the scientific peer community.

02.05.02-4

In FSAR Sections 2.5.2.2.1.7 (page 2.5-113) and 2.5.1.1.4.5.1. (page 2.5-66) the applicant stated that Chapman and Krimgold (1994) used an Mmax of m_b 7.25 for the Central Virginia seismic zone (CVSZ). The applicant also noted that Chapman and Krimgold's estimate is "similar to" those of the EPRI teams. However, FSAR Tables 2.5-3 through 2.5.9 show that the weighted mean of the Mmax (m_b) values of the EPRI teams for the source zones is m_b 6.2. Please explain how the Mmax values summarized by these weighted means are "similar to" the value provided by Chapman and Krimgold.

02.05.02-5

FSAR Section 2.5.2.2.2.3 discusses post-EPRI seismic source characterization studies including the USGS (2002) model. The recurrence of New Madrid Seismic Zone (NMSZ) Mmax earthquakes is recognized as having changed (USGS, 2002) since the EPRI (1986) study. However, there is no calculation of the contribution of the NMSZ to the hazard at the CCNPP site. Intensity observations due to the Dec. 16, 1811 earthquake rank MMI IV in the site region. Shake Map MMI IV suggests a PGA between 3.9 and 9.2% g. This is close to the 0.1g PGA associated with the GMRS (refer to FSAR page 2.5-143). Please discuss the significance of the NMSZ at the CCNPP site and provide justification for not including this source zone in the seismic hazard analysis in light of the above intensity observations and recent revisions to the national seismic hazard maps (USGS, 2002, 2008).

02.05.02-6

FSAR Section 2.5.2.2.2.5 (page 2.5-116) states, "Chapman (Chapman, 2002) created probabilistic seismic hazard maps for the South Carolina Department of Transportation (SCDOT)." The FSAR continues by stating, "The SCDOT model employs a combination of line and area sources to characterize Charleston-type earthquakes in three separate geometries and uses a slightly different Mmax range (**M** 7.1 to 7.5) than the Chapman (Chapman, 2002) model (Table 2.5-14 and Figure 2.5-54)."

Clarify whether the Chapman (Chapman, 2002) reference is the SCDOT model, and if not, provide a proper reference to the SCDOT model and clarify the apparent discrepancy in the FSAR. Revise the FSAR as appropriate to clarify the relationship between these models.

02.05.02-7

In FSAR Section 2.5.2.2.2.7 (page 2.5-123), the applicant discussed the 2-sigma analysis of event ages performed for the updated Charleston seismic source model and stated the following: "Event ages have then been defined by selecting the age range common to each of the samples. For example, an event defined by overlapping 2-sigma sample ages of 100–200 cal. yr. BP (before present) and 50–150 cal. yr. BP would have an event age of 50–150 cal. yr. BP." Please clarify if the resulting event age of 50-150 cal. yr. BP is an error and instead should be 100 – 150 cal. yr. BP. Please also explain whether or not this error has been propagated through subsequent analyses.

02.05.02-8

FSAR Section 2.5.2.4.1 (page 2.5-129) states: "For amplitudes corresponding to annual exceedance frequencies in the range 10^{-4} to 10^{-6}, the 2006 calculations replicate the 1989 EPRI results (EPRI, 1989a) to an accuracy that is in the range of 3 percent to 12 percent, with the 2006 calculations indicating slightly higher hazard. This is acceptable agreement, given that independent software was used to perform these calculations."

(a) Provide the basis for concluding that a 12% disagreement just due to software is acceptable.

(b) Discuss the possible sources of this 3 to 12% difference due to the use of independent software to perform the hazard calculations.

02.05.02-9

FSAR Section 2.5.2.4.6 (page 2.5-133) states the following:

"Use of all distances in the calculation of mean magnitude and distance controlling earthquake values of M = 5.5 and R =97 for the 10^{-4} event. It is clear from the total deaggregation results (see Figure 2.5-67 of the FSAR) that this is not the distance of the earthquake controlling high frequency motions. Use of the alternative method leads to the same mean magnitude but to the closer distance, R, of 35 km, in better agreement with the deaggregation results (again, as shown in the figure)."

FSAR Figure 2.5-91 shows that the mean seismic hazard (at 10^{-4}) by source for the Rondout team at 10Hz is dominated by the Central Virginia seismic zone (CVSZ), which is denoted RND-29. This Rondout source zone is 89km from the CCNPP site.

(a) Using the procedure specified in Appendix D to RG 1.208, the applicant obtained values of M=5.5 and R=97, which fit well with a source in the CVSZ. Given that FSAR Figure 2.5-91 shows the CVSZ clearly controls high frequency motions, please justify the use of the alternative method.

(b) On page 2.5-134 of the FSAR, in reference to Figure 2.5-9, the applicant stated that "... local sources, particularly the central Virginia seismic zone, tend to dominate the hazard, particularly for high frequency ground motions (10 Hz)". However, FSAR Figure

2.5-67 does not show a dominant contribution to high frequency motions from earthquakes in the distance range of the CVSZ (i.e 76-100km). Please reconcile this apparent conflict.

(c) Which source zone (from which team) actually dominates the large contribution to the hazard at M 5.0-5.5 and R 10-20km shown in FSAR Figure 2.5-67? Please provide a figure like FSAR Figure 2.5-91, which shows the relative contribution to the hazard of the sources from that team.

02.05.02-10

FSAR Figures 2.5-78, 2.5-80, 2.5-82, and 2.5-84 show amplification functions resulting from the applicant's site response analysis. In each case, the amplification functions decrease with frequency from about 10Hz to about 20Hz, bottom out, then increase with frequency above about 50Hz.

(a) Please provide a physical mechanism to explain this increase at high frequency for the amplification function.

(b) If the increase reflects a numerical artifact rather than a physical process, state the nature of the numerical artifact and explain why or why not the artifact should be removed and results recomputed.

02.05.02-11

In FSAR Section 2.5.2.5.1.2 (page 2.5-135), the value in the statement, "The upper 400± ft (122 m) of the site soils was investigated using test borings, cone penetration testing, test pits, and geophysical methods." appears to be missing its uncertainty value. Please specify this value.

02.05.02-12

In FSAR Section 2.5.2.5.1.5 (page 2.5-139), the applicant stated that it used a stress drop of 120 bars. Please justify this choice of stress drop. For example, the current update of the USGS National Seismic Hazard Maps for sources in the central and eastern US considers equal weighting of 140 and 200 bar stress drops for the Atkinson and Boore (2006) ground motion model.

02.05.02-13

In a letter dated July 31, 2008, that applicant provided an enclosure of COLA markup pages for Revision 3 of FSAR Section 2.5.2.5.1, which provided modifications including to the GMRS location. In this edited version, the applicant noted that it evaluated two profiles for the final site amplification analysis: 1) the entire soil column, including 41 ft of fill above the foundation of the nuclear island and 2) a soil column that did not contain any soil above the base of the nuclear island foundation for the calculation of the GMRS. In Table 2.5-22, the applicant also presented revised values for the horizontal and vertical GMRS. However, this edited version describing the location of the GMRS was

not incorporated into a more recent version of Revision 3 (dated 11/25/2008). Please verify that these modifications to the GMRS are being used for the CCNPP3 site. Update the FSAR as appropriate.

In order for the staff to verify the adequacy of the GMRS, please provide electronic values for the total mean (soil) hazard curves for 1, 2.5, 5, 10, 25, and 100 Hz structural frequencies (i.e. soil hazard curves corresponding to the GMRS location or the soil column that did not contain any soil above the base of the nuclear island) for annual exceedance frequencies ranging from 10^{-3} to 10^{-6} (including a range of values between 10^{-4}, 10^{-5}, and 10^{-6}).

02.05.02-14

FSAR Section 2.5.2.6 (page 2.5-142) states, "A vertical SSE spectrum was calculated by deriving vertical-to-horizontal (V:H) ratios and applying them to the horizontal SSE." using three different methods. Please justify not considering the approach described in Appendix J of NUREG/CR-6728, which presents a methodology to estimate V/H for CEUS soil and rock sites.

In addition, recent data show that the 14 June 2008 M 6.9 Iwate-Miyagi earthquake in Japan produced a vertical ground motion of greater than 3.8 g at the surface and 0.68 g at 260 m depth (Aoi, S. and others, 2008, Trampoline effect in extreme ground motion: Science, v.322, p. 727). This vertical ground motion is much higher than its horizontal components at the surface and about equal at depth of the basement rock over a wide range of frequencies. How do these documented observations affect the modeled ground motions at the CCNPP3 site?