From: Michael Scott
To: Joseph_Hegner@dom.com
Date: Thu, Feb 26, 2004 8:04 AM
Subject: PRELIMINARY QUESTIONS - PACKAGE #3

Please find attached the NRC staff's third package of preliminary questions for the site safety analysis report in the North Anna ESP application, in the form of draft requests for additional information (RAIs).

The RAIs in this package address the seismology area. Additional RAIs will likely be developed in this area and will be forwarded to you on or before 6/3/04 in accordance with the planned North Anna review schedule. We are providing these RAIs at this time to facilitate the review and to support meeting the review schedule. Your timely response to them will also support meeting the review schedule milestones. Partial submittals would be welcome to minimize delays.

Please contact me if you have questions.

Sincerely,

Michael L (Mike) Scott
Senior Project Manager
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Phone (301) 415-1421

CC: Clifford Munson; Goutam Bagchi; Kamal Manoly; Laura Dudes; Nanette Gilles; Robert Weisman; Stephen Koenick

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Subject: PRELIMINARY QUESTIONS - PACKAGE #3
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DRAFT

North Anna Early Site Permit Application
Site Safety Analysis Report (SSAR)
Requests for Additional Information (RAI)
RAI LETTER NO. 3

Section 2.5.1 - Basic Geologic and Seismic Information

RAI 2.5.1-1
Section 2.5.2 of the site safety analysis report (SSAR) concludes that the Central Virginia seismic zone (CVSZ) is the largest contributor to the seismic hazard for the ESP site. SSAR Section 2.5.1.1.4 (pg 2-2-194 and 195) summarizes the findings of Obermeier and McNulty (Reference 71), who conducted reconnaissance studies in search of paleoliquefaction features associated with the CVSZ.

1. The Obermeier and McNulty study (Reference 71) regarding paleoliquefaction was limited in time interval (mid- to late-Holocene) and geographic coverage. Therefore, please provide additional justification for the SSAR statement:

   "The near-total lack of widespread paleoliquefaction features in the 300 km of stream exposures searched within the Piedmont, has led some researchers (Reference 71) to conclude that it is unlikely that any earthquakes have occurred in central Virginia in excess of M~7."

1. The findings of Obermeier and McNulty (Reference 71) indicate the presence of two Holocene paleoliquefaction features in the CVSZ. According to SSAR Section 2.5.1.1.4, these two paleoliquefaction features are located along the James and Rivanna Rivers, about 25-30 miles from the ESP site. Please provide justification for concluding that, in spite of the occurrence of recent earthquake(s) that produced paleoliquefaction features in the CVSZ, such earthquakes are not abundant in the seismic zone, and for concluding that the earthquakes that produced these liquefaction features are "local shallow moderate magnitude earthquakes of M 5 to 6." In addition, please describe the impact of these liquefaction-producing earthquake events on the recurrence model used for the CVSZ.

   Considering that the CVSZ is the major contributor to the hazard at the ESP site, please provide the following additional information:

   a. a map showing the locations of the paleoliquefaction features relative to the ESP site,

   a. evidence that supports the stated ages of the liquefied sediments,

   a. specific locations, dimensions, and characteristics of the liquefaction features, and

b. extent of the CVSZ covered by the study.

RAI 2.5.1-2
In SSAR Section 2.5.1.1.4, Dominion concludes on the basis of several lines of evidence, including aerial reconnaissance, that the northern segment of the East Coast Fault System (ECFS) "probably does not exist or has a very low probability of activity if it does exist." Please provide additional information on the nature of the aerial reconnaissance for the ECFS, including the area covered and the type of evidence used to conclude that the northern segment of the ECFS does not exist or has low probability of activity. Please explain how information gathered during the aerial reconnaissance and from other sources supports conclusions in the SSAR that appear to be inconsistent with those made in the detailed geomorphic analysis of Marple and Talwani (Reference 74).

RAI 2.5.1-3
In SSAR Section 2.5.1.1.4, Dominion concludes that the seven fall lines defined by Weems (Reference 70) do not "represent a capable tectonic source." Weems (Reference 70) favors a neotectonic origin for the seven fall lines. Please provide additional justification to confirm or disprove the seven fall lines defined by Weems (Reference 70) as a capable tectonic source. Also, please explain how the absence of these features in the compilation of Crone and Wheeler (Reference 59) demonstrates that the fall lines are not capable tectonic sources.

RAI 2.5.1-4
In SSAR Section 2.5.1.1.4, Dominion concludes, citing Crone and Wheeler (Reference 59), that neither the Hylas shear zone nor the Lake of the Woods thrust fault are capable tectonic sources stating, "there is no geomorphic expression, historical seismicity, or Quaternary deformation along either the Hylas shear zone or Lake of the Woods thrust fault (Reference 59)." Please provide an explanation of how the information in Crone and Wheeler (Reference 59) forms a basis for this conclusion.

Section 2.5.2 - Vibratory Ground Motion

RAI 2.5.2-2
SSAR Section 2.5.2.6.6 states that new ground motion models were used to characterize the seismic hazard and determine the Safe Shutdown Earthquake (SSE) spectrum for the ESP site. According to the SAR, the new ground motions are based on the 2003 EPRI-sponsored study (Reference 116), which considers 13 different ground motion relations. As stated in SSAR Section 2.5.2.6.6, differences between the ground motions from the 2003 EPRI study and the 1989 EPRI report are substantial, with the new ground motions as much as 55% higher for spectral accelerations at 10 Hz. To allow the NRC staff to fully assess the new ground motion modeling presented in the 2003 EPRI study, the following information is needed.

1. Please provide hazard curves for 2.5 and 5 Hz spectral acceleration similar to those provided in the SSAR for 1 Hz (Figure 2.5-45) and 10 Hz (Figure 2.5-44).

ATTACHMENT

1. Please provide a copy of the following two documents: Silva et al. (1997) "Description and validation of the stochastic ground motion model", submitted to Brookhaven National Laboratory (BNL) and Silva et al. (2002) "Development of regional hard rock attenuation relations for Central and Eastern North America."

1. Chapter 2, "Ground Motion Model Development," of the 2003 EPRI study (Reference 116) describes the development of the ground motion models, and Table 2-2 in Chapter 2 shows the placement of each of the 13 ground motion relationships into 4 groups. Page 2-6 of the 2003 EPRI study states that "the model weight was based on the variance between a model's predictions and the available ground motion database." Please describe the data (i.e., earthquake dates, magnitudes, source-receiver distances, frequencies, site conditions) used to determine the weighting of the models within each group or cluster. Also, please provide the weight assigned to each of the 13 ground-motion relationships within their respective group or cluster.

1. Table 2-7 in Chapter 2 shows the relative weights for each of the 4 groupings of ground motion models. Please describe the seismological principles used to determine the importance weights given for each of the model clusters.

1. Chapter 3, "Ground Motion Model Results," of the 2003 EPRI study (Reference 116) describes the ground motion attenuation model for sites located in the Central and Eastern U.S. Table 3-2 in Chapter 3 provides the ground motion attenuation model functional forms for 5 groups or clusters. Please explain why some of the attenuation relationships in cluster 1 contain terms accounting for Moho reflections or losses from the effective Q in the crust, whereas the functional form for cluster 1 does not contain either of these two terms.

RAI 2.5.2-3

Regarding new seismic source characterizations, SSAR Section 2.5.2.6.3 states that, for the Charleston seismic source, the USGS source parameters (Reference 127) were adopted. SSAR Section 2.5.2.2.9 states that "the most significant impact of the 2002 USGS model (Reference 127) on seismic hazard for the ESP site is the updated Charleston sources parameters." Figures 2.5-40 and 2.5-41 show 1 Hz spectral acceleration seismic hazard curves (median and mean, respectively) at the ESP site for the northern and southern segments of the East Coast Fault System (ECFS). As shown in both of these figures, the southern segment of the ECFS (ECFS-S), which includes the Charleston seismic source, makes a significant contribution to the overall hazard at 1 Hz spectral acceleration. In spite of the significant contribution of the ECFS-S for low frequency ground motion, the controlling earthquake for the 1 and 2.5 Hz frequency range is a magnitude 5.5 earthquake at a distance of 30 km from the ESP site (Table 2.5-26). Neither this magnitude or distance correspond to an event occurring in the ECFS-S (i.e, Charleston source zone). Please explain this result in view of the statement quoted above and Figures 2.5-40 and 41 in the application.

RAI 2.5.2-4

SSAR Tables 2.5-5 through 2.5-11 summarize the parameters developed by the six Earth Science Teams (ESTs) as part of the 1989 EPRI Project (Reference 115) for the seismic source zones surrounding the ESP site. The source parameters shown in Tables 2.5-5 through 2.5-11

are maximum magnitudes, distances from the ESP site, activity probabilities, and smoothing options. In addition, Tables 2.5-5 through 2.5-10 provide information on whether the source parameters have been updated for the probabilistic seismic hazard analysis (PSHA) presented in the ESP application.

1. Please provide the actual *a* and *b* values for the recurrence model used for each of the seismic source zones and the weights assigned to these values. In addition, please provide the recurrence intervals and their weights associated with the M_{max} values for each seismic source zone.

1. With regard to the seismic source zones surrounding the ESP site, in particular the Central Virginia Seismic Zone (CVSZ), and considering the 1994 EPRI study of Arch Johnston, "Seismotectonic Interpretations and Conclusions from the Stable Continental Region Seismicity Database," please provide updated information on the following or explain why updated information is not needed: 1) maximum magnitudes and weights, 2) probabilities of activity, 3) recurrence model values and weights, and 4) source zone geometries for the PSHA recently completed for the ESP site.

Section 2.5.3 -Surface Faulting

RAI 2.5.3-1

SSAR Section 2.5.3 states that, in addition to compiling and reviewing existing data, Dominion interpreted aerial photography and conducted field and aerial reconnaissance of all faults within a five-mile radius of the site to assess the potential for surface fault rupture. Dominion focused on seven bedrock faults, as listed in Section 2.5.3.2, and concluded that "the Chopawamsic and Spotsylvania thrust faults are not associated with seismicity and do not exhibit geomorphic evidence of potential Quaternary activity." The SSAR indicates that Dominion conducted similar aerial photographic and reconnaissance studies for the other faults within five miles of the site, and draws similar conclusions. Please provide the following details about each of the reconnaissance studies:

1. A general description of the flight conditions (i.e., weather, lighting conditions and the time of year).

1. The extent of the coverage for each fault and the criteria for the locations chosen along the fault.

1. The geomorphic setting (i.e., valleys, hills, bedrock exposures, ...) for each of the sites visited along the faults.

1. A description of the criteria used for concluding that there is no evidence of Quaternary activity on the fault.

1. The vintage and scale of the photographs used for the aerial photographic study.