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UniStar
NUCLEAR ENERGY

10 CFR 50.4
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June 3, 2009

UN#09-255

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

Subject: UniStar Nuclear Energy, NRC Docket No. 52-016
Response to Request for Additional Information for the Calvert Cliffs Nuclear Power Plant, Unit 3,
RAI No. 99, Probable Maximum Tsunami Flooding

Reference:

1) John Rycyna (NRC) to Robert Poche (UniStar Nuclear Energy), "RAI No 99 RHEB 2090.doc (PUBLIC)" email dated April 16, 2009

2) UniStar Nuclear Energy Letter UN#09-272, from Greg Gibson to Document Control Desk, U.S. NRC, Response Schedule to Request for Additional Information for RAI No. 99, Probable Maximum Tsunami Flooding; RAI No.101, Groundwater; RAI No. 103, Probable Maximum Surge and Seiche Flooding, dated June 2, 2009

The purpose of this letter is to respond to a request for additional information (RAI) identified in the NRC e-mail correspondence to UniStar Nuclear Energy, dated April 16, 2009 (Reference 1). This RAI addresses Probable Maximum Tsunami Flooding, as discussed in Section 2.4.6 of the Final Safety Analysis Report (FSAR), as submitted in Part 2 of the Combined License Application (COLA), Revision 4.

Reference 1 requested UniStar Nuclear Energy to respond to the RAI within 30 days. Reference 2 stated that a schedule of delivery dates for Questions 02.04.06-2, -4 and -5 would be provided June 3, 2009.

The enclosure provides our responses to RAI No. 99, Questions 02.04.06-2, -4 and -5 and includes revised COLA content. A Licensing Basis Document Change Request has been initiated to incorporate these changes into a future revision of the COLA.

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NRO

Our responses to RAI No. 99, Questions 02.04.06-2, -4 and -5 do not include any new regulatory commitments.

If there are any questions regarding this transmittal, please contact me at (410) 470-4205, or Mr. Michael J. Yox at (410) 495-2436.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on June 3, 2009

Greg Gibson

Enclosure: Response for Request for Additional Information RAI No. 99, Questions 02.04.06-2, 02.04.06-4, 02.04.06-5, Probable Maximum Tsunami Flooding, Calvert Cliffs Nuclear Power Plant Unit 3

cc: John Rycyna, NRC Project Manager, U.S. EPR COL Application
Laura Quinn, NRC Project Manager, Environmental Projects Branch 2
Getachew Tesfaye, NRC Project Manager, U.S. EPR DC Application (w/o enclosure)
Loren Plisco, Deputy Regional Administrator, NRC Region II (w/o enclosure)
Silas Kennedy, U.S. NRC Resident Inspector, CCNPP, Units 1 and 2
U.S. NRC Region I Office

GTG/SFW/KAT

Enclosure

Response for Request for Additional Information RAI No. 99, Questions 02.04.06-2, 02.04.06-4, 02.04.06-5, Probable Maximum Tsunami Flooding, Calvert Cliffs Nuclear Power Plant Unit 3

RAI No. 99

Question 02.04.06-2

Section C.I.2.4.6.1 of Regulatory Guide 1.206 (RG 1.206) provides specific guidance with respect to determination of Probable Maximum Tsunami Flooding. This includes a discussion of the generation of tsunami-like waves from hill-slope failures and the stability of the coastal area. Provide a discussion in the updated FSAR of the cliff-side stability near the CCNPP site with reference to the findings in Section 2.5.2.1 and 2.4.9 of the FSAR.

Response

FSAR Section 2.4.6.1 summarizes the mechanism of cliff erosion near the CCNPP Unit 3 site. This mechanism is described in detail in FSAR Section 2.4.9. Additional discussions on the stability of natural cliffs near the site are provided in FSAR Section 2.5.5.2.2. Section 2.5.2.1, provides information on regional seismic hazard analysis in relation to vibratory ground motion.

The cliffs near the site are steep with near-vertical slopes formed by short- and long-term erosion processes over the last several thousand years. FSAR Section 2.4.9 states that Calvert Cliffs are eroding due to failures along irregular, near-vertical surfaces as the result of shoreline erosion undercutting the cliffs at the base. Sufficient undercutting of the base causes the weight of the overlying deposits to exceed their shear strength and the undercut portion of the cliffs falls to the shoreline with a near-vertical face. The rate of shoreline erosion south of the barge jetty near the CCNPP site is estimated to be between 2 ft (0.6 m) to 4 (1.2 m) ft per year[1], as described in Section 2.4.9. Because the debris from this cliff erosion process primarily falls to the beach or intertidal area where water depth is shallow, these slope failures are not expected to generate a tsunami in the Chesapeake Bay.

In the process of evaluating regional slope stability, FSAR Section 2.5.5.2.2 describes two hypothetical scenarios of massive cliff failure at the site. These are in the form of (1) a wedge (or plane) portion of the cliffs sliding into Chesapeake Bay at an inclined angle, or (2) a portion of the cliffs separating and toppling into Chesapeake Bay. However, as noted in FSAR 2.5.5.2.2, these cliff failure hypotheses are not expected to occur, as they are not supported by geologic evidence and hydrogeologic conditions found at the site. Combined with the fact that the near shore area is in shallow water depth, it is not credible that tsunamis would be generated or would impact the safety functions of the plant as a result of these improbable slope failure mechanisms.

COLA Impact

FSAR Section 2.4.6.1 will be updated as follows in a future COLA revision:

2.4.6.1 Probable Maximum Tsunami

The potential of a subaerial landslide near the site was assessed with geological maps, topographic maps, and CCNPP site reconnaissance. Along the western shoreline of the Chesapeake Bay, slope failure has occurred and appears to be caused by erosion of the base

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[1] Maryland Department of Natural Resources, Maryland Shorelines Online, Website: http://shorelines.dnr.state.md.us/shoreMapper/standard/, Date accessed: February 7, 2007

of the cliffs that reach an Elevation of about 100 ft (30.5 m) NGVD 29 (National Geodetic Vertical Datum of 1929), as described in Section 2.4.9. Two additional cliff failure scenarios, sliding and toppling along a failure plane, are hypothesized in Section 2.5.5.2.2. However, they are not supported by geologic and hydrogeologic evidence and are not expected to occur. Combined with the shallow water depth in the near shore area of the cliffs, it is not credible that the safety-functions of the plant would be affected as a result of tsunamis generated from these hypothetical cliff failure mechanisms. ~~This process has not resulted in the generation of tsunami-like waves in the Chesapeake Bay.~~ Across from the CCNPP site, the eastern shore of the Chesapeake Bay consists of nearly flat terrain. The topographic data indicate that cliffs along the eastern shore of the Chesapeake Bay, opposite the CCNPP site, are not subject to slope failure. Hence, it was concluded that the subaerial landslide near the site will not trigger local tsunami like waves in the Chesapeake Bay.

Question 02.04.06-4

Section C.I.2.4.6.1 of Regulatory Guide 1.206 (RG 1.206) provides specific guidance with respect to determination of Probable Maximum Tsunami Flooding. This includes a discussion of the potential of earthquake-induced waves in large bodies of water. Provide a discussion in the updated FSAR of the historical and geologic record, or lack thereof, for seismically-generated seiches in Chesapeake Bay. If possible, also provide an analysis of resonant frequencies of the Bay.

Response

A literature search reveals no historical or geologic evidence of seismically-generated seiches in Chesapeake Bay.

Wang[1,2] and Wang and Elliott[3] described the subtidal water level variations in the Chesapeake Bay using observed water levels, current measurements and concurrent wind data. These studies correlated the subtidal variations with local and non-local forcings from various meteorological and coastal processes using spectral and coherence analyses. They found that the shortest of the response time periods was on the order of 2-3 days, corresponding to a resonant seiche motion in the bay, and was associated with local longitudinal wind forcing. Zhong et al.[4] simulated, using a numerical model, water level variations in the Chesapeake Bay in response to various forcing factors that govern tide and flux in the bay. The resonance period of about 2 days, as obtained by Zhong et al., is consistent with the seiche period identified in Wang[1] and Wang and Elliott. Zhong et al. also estimated the resonance period (T) using the classic quarter wavelength theory for semi-enclosed bays:

$$T = 4L(gh)^{-0.5}$$

Where L is the length of a semi-enclosed bay, g is acceleration due to gravity and h is the water depth. The resonance period was estimated to be 1.38 days based on a bay length of 270 km and an average water depth of 8.4 m used in Wang[1]. If the bay length of 280 km and average water depths of 8.0 m from Wang[2] were used, the resonance period would be 1.46 days.

The period of wind-induced seiche oscillations is presented in FSAR 2.4.5.4, Rev. 4. Additional discussions are provided in response to NRC RAI No. 103, Question 02.04.05-5.

COLA Impact

FSAR Section 2.4.6.2 will be supplemented as shown in Question 02.04.06-5 in a future COLA revision.

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[1] Wind Driven Circulation in the Chesapeake Bay, Winter 1975, Journal of Physical Oceanography, Volume 9, pages 564 through 572, D.-P. Wang, May 1979.

[2] Subtidal Sea Level Variation in the Chesapeake Bay and Relations to Atmospheric Forcing, Journal of Physical Oceanography, Volume 9, pages 413 through 421, D.-P. Wang, March 1979.

[3] Non-Tidal Variability in the Chesapeake Bay and Potomac River: Evidence for Non-Local Forcing, Journal of Physical Oceanography, Volume 8, pages 225 through 232, D.-P. Wang and A.J. Elliott, March 1978.

[4] Resonance and Sea Level Variability in Chesapeake Bay, Continental Shelf Research, Vol. 28, pages 2565-2573, L. Zhong, M. Li, and M.G.G Foreman, 2008.

Question 02.04.06-5

Section C.I.2.4.6.2 of Regulatory Guide 1.206 (RG 1.206) provides specific guidance with respect to the historical tsunami record, including paleo-tsunami evidence. Provide a discussion in the updated FSAR of the literature search conducted that was used to conclude the absence of tsunami deposits preserved in the vicinity of the CCNPP site.

Response

No evidence of tsunami deposits was found in the CCNPP Unit 3 site vicinity (25-mile radius) during the geologic site reconnaissance. Details of the geologic reconnaissance (office and field investigations) are provided in response to NRC RAI No. 71, Question 02.05.01-31. A literature search, aerial photo and Lidar data interpretations combined with field reconnaissance did not reveal any information on paleo-tsunami deposits in the CCNPP Unit 3 site vicinity.

COLA Impact

FSAR Section 2.4.6.2 will be updated as follows in a future COLA revision:

2.4.6.2 Historical Tsunami Record

~~Evidence of a paleo-tsunami due to the impact of an extraterrestrial body was found in an exploration of the Chesapeake Bay area by the USGS. No estimate is available as to the size of the generated tsunami wave. Also, no evidence of a paleo-tsunami due to geo-seismic events is found in the CCNPP site region.~~

The Chesapeake Bay bolide impact that was found in an exploration of the Chesapeake Bay area by the USGS (USGS, 1998) likely generated a paleo-tsunami about 35 million years ago. No estimate is available as to the size of the generated tsunami wave and no tsunami deposits attributable to this tsunami have been found. Also, information gathered during a literature search and geologic reconnaissance indicates that there is no evidence of a paleo-tsunami or paleo-tsunami deposits due to geo-seismic events in the CCNPP site region. A literature search reveals no historical or geologic evidence of seismically-generated seiches in Chesapeake Bay. Resonance frequencies of wind-induced seiches are described in Section 2.4.5.4.

FSAR Section 2.4.6.12 will be supplemented as follows in a future COLA revision:

2.4.6.12 References

USGS, 1998. The Chesapeake Bay Bolide Impact: A New View of Coastal Plain Evolution, United States Geological Survey Fact Sheet 49-98, USGS, 1998, Website: http://marine.usgs.gov/fact-sheets/fs49-98/, Date accessed: May 7, 2009.