VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

May 11, 2015

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Serial No. 14-273B
NL&OS/WDC R0
Docket Nos. 50-338/339
License Nos. NPF-4/7

VIRGINIA ELECTRIC AND POWER COMPANY
NORTH ANNA POWER STATION UNITS 1 AND 2
MARCH 12, 2012 INFORMATION REQUEST
SUPPLEMENT TO RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION REGARDING FLOODING HAZARD REEVALUATION REPORT

By letters dated March 11, 2013 (Serial No. 13-017) and March 31, 2014 (Serial No. 14-133), Virginia Electric and Power Company (Dominion) submitted a flooding hazard reevaluation report and seismic hazard and screening report, respectively. The seismic hazard and screening report indicates that the ground motion response spectrum (GMRS) exceeds the safe shutdown earthquake for North Anna. Based on this conclusion, in a May 14, 2014 letter the NRC requested additional information to complete the review of the flooding hazard reevaluation of the North Anna site.

As discussed in our June 16, 2014 letter (Serial No. 14-273), a new, detailed seismic evaluation of the North Anna service water reservoir (SWR) was required to provide justification for the seismic capability of the service water impoundment under the updated seismic hazard to respond to the NRC's RAI. Dominion responded to the NRC's RAI in a letter dated November 13, 2014 (Serial No. 14-273A). In a clarification call with the NRC on April 16, 2015, Dominion agreed to supplement the information provided in the RAI response.

If you have any questions regarding this information, please contact Wanda Craft at (804) 273-4687.

Sincerely,

Mark D. Sartain
Vice President – Nuclear Engineering

Vicki L. Hull
NOTARY PUBLIC
Commonwealth of Virginia
Reg. # 140542
My Commission Expires May 31, 2018

COMMONWEALTH OF VIRGINIA)
)
COUNTY OF HENRICO)

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by Mark D. Sartain, who is Vice President - Nuclear Engineering of Virginia Electric and Power Company. He has affirmed before me that he is duly authorized to execute and file the foregoing document in behalf of that company, and that the statements in the document are true to the best of his knowledge and belief.

Acknowledged before me this 11TH day of MAY, 2015.

My Commission Expires: MAY 31, 2018

Vicki L. Hull
Notary Public

A001
NRR

Commitments made in this letter: None

Attachment:
Supplement to Request for Additional Information Regarding Flooding Hazard Reevaluation Report

cc: U.S. Nuclear Regulatory Commission, Region II
Marquis One Tower
245 Peachtree Center Avenue NE, Suite 1200
Atlanta, Georgia 30303-1257

Dr. V. Sreenivas, NRC Project Manager – North Anna
U. S. Nuclear Regulatory Commission
One White Flint North
Mail Stop O8 G9A
11555 Rockville Pike
Rockville, Maryland 20852-2738

Ms. Karen Cotton-Gross, NRC Project Manager – Surry
U. S. Nuclear Regulatory Commission
One White Flint North
Mail Stop O8 G9A
11555 Rockville Pike
Rockville, Maryland 20852-2738

Mr. Brian K. Harris
Project Manager
U.S. Nuclear Regulatory Commission
One White Flint North, Mail Stop 11 F1
11555 Rockville Pike
Rockville, MD 20852-2738

Mr. Victor E. Hall
Project Manager
U.S. Nuclear Regulatory Commission
One White Flint North, Mail Stop 13 H16
11555 Rockville Pike
Rockville, MD 20852-2738

NRC Senior Resident Inspector
North Anna Power Station

ATTACHMENT

SUPPLEMENT TO REQUEST FOR ADDITIONAL INFORMATION REGARDING FLOODING HAZARD REEVALUATION REPORT

VIRGINIA ELECTRIC AND POWER COMPANY (DOMINION)
NORTH ANNA POWER STATION UNITS 1 AND 2

Supplement to Request for Additional Information Regarding Flooding Hazard Reevaluation Report North Anna Power Station Units 1 and 2

By letters dated March 11, 2013 (Serial No. 13-017) and March 31, 2014 (Serial No. 14-133), Virginia Electric and Power Company (Dominion) submitted a flooding hazard reevaluation report and seismic hazard and screening report, respectively. In a May 14, 2014 letter the NRC requested additional information to complete the review of the flooding hazard reevaluation of the North Anna site. Dominion responded to the NRC's RAI in a letter dated November 13, 2014 (Serial No. 14-273A). In a clarification call with the NRC on April 16, 2015, Dominion agreed to supplement the information provided in the RAI response. This attachment provides the supplemental information.

Clarification Item 1:

Provide a tabulation of the results of the Vs-based correlations from Youd, et al (2001) with a best estimate Vs profile with the age factor of 2 removed (i.e., with age factor=1).

Dominion Response:

The results of the shear wave velocity (Vs) based correlations from Youd, et al (2001) with a best estimate Vs profile with the age factor of 2 removed (i.e., with age factor=1) are presented in Table 1.

Reference: Youd et al. (2001). Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils, Journal of Geotechnical and Geoenvironmental Engineering, 127(10), October 2001, pp. 817-833.

Table 1: Liquefaction Analysis Based on Best Estimate Shear Wave Velocity

Moment Magnitude: 7.10; Peak Ground Acceleration (PGA) (g): 0.28; Depth of Groundwater Table (ft): 0.0; Magnitude Scaling Factor (MSF): 1.174

MEASURED SHEAR WAVE VELOCITY			STRATIGRAPHY INFORMATION		OVERBURDEN STRESS			CORRECTED SHEAR WAVE VELOCITY			CYCLIC RESISTANCE RATIO			CYCLIC STRESS RATIO		FACTOR OF SAFETY (Age Factor = 2)	FACTOR OF SAFETY (Age Factor = 1)
Elevation	Depth	Shear Wave Velocity, V_s	Fines Content	Unit Weight	u	σ_{v0}	σ_{v0}'	V_s	V_{s1}	V_{s1}^*	$CRR_{7.5}$	K_σ (D_r=60%)	CRR	r_d	CSR		
(ft)	(ft)	(ft/sec)	(%)	(pcf)	(psf)			(m/sec)									
317.5	2.50	472.0	29	125.0	156.0	312.5	156.5	143.9	275.9	200.0	2.00	1.00	2.35	0.99	0.36	13.0	6.5
312.5	7.50	690.0	29	125.0	468.0	937.5	469.5	210.3	306.4	200.0	2.00	1.00	2.35	0.98	0.36	13.2	6.6
307.5	12.50	755.0	29	125.0	780.0	1562.5	782.5	230.1	295.1	200.0	2.00	1.00	2.35	0.97	0.35	13.3	6.7
302.5	17.50	787.0	29	125.0	1092.0	2187.5	1095.5	239.9	282.8	200.0	2.00	1.00	2.35	0.96	0.35	13.5	6.7
297.5	22.50	814.0	29	125.0	1404.0	2812.5	1408.5	248.1	274.7	200.0	2.00	1.00	2.35	0.95	0.34	13.6	6.8
292.5	27.50	838.0	29	125.0	1716.0	3437.5	1721.5	255.4	268.9	200.0	2.00	1.00	2.35	0.94	0.34	13.8	6.9
287.5	32.50	860.0	29	125.0	2028.0	4062.5	2034.5	262.1	264.7	200.0	2.00	1.00	2.35	0.91	0.33	14.2	7.1
282.5	37.50	880.0	29	125.0	2340.0	4687.5	2347.5	268.2	261.4	200.0	2.00	0.97	2.28	0.87	0.32	14.4	7.2
277.5	42.50	898.0	29	125.0	2652.0	5312.5	2660.5	273.7	258.5	200.0	2.00	0.93	2.19	0.83	0.30	14.6	7.3
272.5	47.50	915.0	29	125.0	2964.0	5937.5	2973.5	278.9	256.2	200.0	2.00	0.90	2.12	0.79	0.29	14.8	7.4
267.5	52.50	931.0	29	125.0	3276.0	6562.5	3286.5	283.8	254.2	200.0	2.00	0.88	2.06	0.75	0.27	15.2	7.6
262.5	57.50	946.0	29	125.0	3588.0	7187.5	3599.5	288.3	252.5	200.0	2.00	0.85	2.00	0.71	0.26	15.6	7.8
257.5	62.50	960.0	29	125.0	3900.0	7812.5	3912.5	292.6	250.9	200.0	2.00	0.83	1.95	0.67	0.24	16.2	8.1
252.5	67.50	973.0	29	125.0	4212.0	8437.5	4225.5	296.6	249.5	200.0	2.00	0.81	1.91	0.62	0.23	16.8	8.4
247.5	72.50	986.0	29	125.0	4524.0	9062.5	4538.5	300.5	248.3	200.0	2.00	0.80	1.87	0.58	0.21	17.6	8.8
242.5	77.50	998.0	29	125.0	4836.0	9687.5	4851.5	304.2	247.2	200.0	2.00	0.78	1.83	0.56	0.20	18.0	9.0
237.5	82.50	1009.0	29	125.0	5148.0	10312.5	5164.5	307.5	246.1	200.0	2.00	0.77	1.80	0.56	0.20	17.7	8.8

Clarification Item 2:

Provide a tabulation of shear wave velocity, shear modulus, and damping information for the saprolite material (similar to the tabulation of information submitted in conjunction with the seismic hazard and screening report).

Dominion Response:

Tabulation of shear wave velocity for the subsurface materials, including saprolite, is provided in Table 2. Shear modulus (G) and damping (D) information for the saprolite and Zone III materials is provided in Tables 3 and 4, respectively. The unit weights for saprolite, Zone III, Zone III-IV, and Zone IV materials are 125 pcf, 150 pcf, 163 pcf, and 164 pcf, respectively.

Table 2: Shear Wave Velocity Information

Stratum	Top Elevation [ft]	Top Depth [ft]	Thickness [ft]	V_S BE [fps]	V_S Log-SD	Thickness Range [ft]
Saprolite-1	315	0	5	472	0.35	60-100
Saprolite-2	310	5	5	690	0.35	
Saprolite-3	305	10	5	755	0.35	
Saprolite-4	300	15	5	787	0.35	
Saprolite-5	295	20	5	814	0.35	
Saprolite-6	290	25	5	838	0.35	
Saprolite-7	285	30	5	860	0.35	
Saprolite-8	280	35	5	880	0.35	
Saprolite-9	275	40	5	898	0.35	
Saprolite-10	270	45	5	915	0.35	
Saprolite-11	265	50	5	931	0.35	
Saprolite-12	260	55	5	946	0.35	
Saprolite-13	255	60	5	960	0.35	
Saprolite-14	250	65	5	973	0.35	
Saprolite-15	245	70	5	986	0.35	
Saprolite-16	240	75	5	998	0.35	
Saprolite-17	235	80	5	1009	0.35	
ZoneIII	230	85	6	4251	0.31	3-9
ZoneIII_IV-1	224	91	19	5449	0.2	12-26
ZoneIII_IV-2	205	110	35	5177	0.41	23-47
ZoneIV	170	145	35	8800	0.1	23-47
Bedrock-1*	135	180	10	9200	0	NA
Bedrock-2	125	190	0	9200	0	NA

*Stratum Bedrock-1 (10 ft thick) is added with the bedrock properties for bedrock depth variation analysis.

Table 3: Saprolite Shear Modulus and Damping Information

Strain [%]	G/Go	Sigma	D [%]	Sigma
0.0001	1	0.004	1.3	0.187
0.0003	1	0.008	1.3	0.196
0.001	0.99	0.018	1.6	0.219
0.003	0.94	0.038	2.4	0.250
0.01	0.79	0.079	4.4	0.255
0.03	0.57	0.133	8.2	0.202
0.1	0.32	0.195	14.3	0.117
0.3	0.15	0.234	20.6	0.060
1	0.05	0.255	27.9	0.022

Note that the damping ratio is limited to 15% for the site response analysis.

Table 4: Zone III Shear Modulus and Damping Information

Strain [%]	G/Go	Sigma	D [%]	Sigma
0.0001	1	0.010	0.6	0.600
0.0003	1	0.011	0.6	0.600
0.001	1	0.013	0.6	0.600
0.003	1	0.045	0.6	0.600
0.01	1	0.072	0.6	0.600
0.03	0.98	0.108	0.6	0.600
0.1	0.87	0.140	2.7	0.400
0.3	0.63	0.150	8.2	0.300
1	0.33	0.150	17	0.300

Note that the damping ratio is limited to 15% for the site response analysis.

Clarification Item 3:

Provide a summary of the results of the slope stability calculation for the Seed method.

Dominion Response:

The summary of the results of the slope stability calculation for the Seed method are provided in Table 5 below.

Table 5: Factor of Safety Determined for Seismic Slope Stability Using Seed Method

Approach	k_h	k_v	Factor of Safety		
			Undrained		
			Downstream	Upstream	Acceptable
Seed	0.15	-0.08	1.528	1.323	1.1
	0.15	+0.08	1.569	1.515	1.1