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September 12, 2013

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

Serial No. 13-242C
NL&OS/WDC R0
Docket Nos. 50-336/423
License Nos. DPR-65
NPF-49

DOMINION NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION UNITS 2 AND 3
RESPONSE TO MARCH 12, 2012 INFORMATION REQUEST
REGARDING SEISMIC ASPECTS OF RECOMMENDATION 2.1 – 1.5 YEAR
RESPONSE FOR CEUS SITES

References:

1. NRC Letter, "Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," dated March 12, 2012
2. NRC Letter, Endorsement of EPRI Final Draft Report 1025287, "Seismic Evaluation Guidance," dated February 15, 2013
3. EPRI Report 1025287, Seismic Evaluation Guidance: Screening, Prioritization and Implementation Details (SPID) for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic
4. NEI letter to NRC, Proposed Path Forward for NTTF Recommendation 2.1: Seismic Reevaluations, dated April 9, 2013
5. NRC Letter, EPRI Final Draft Report 3002000704, "Seismic Evaluation Guidance: Augmented Approach for the Resolution of Near-Term Task Force Recommendation 2.1: Seismic," as an Acceptable Alternative to the March 12, 2012, Information Request for Seismic Reevaluations, dated May 7, 2013

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued Reference 1 to all power reactor licensees and holders of construction permits in active or deferred status. Enclosure 1 of Reference 1 requested each addressee in the Central and Eastern United States (CEUS) to submit a written response consistent with the requested seismic hazard evaluation information (items 1 through 7) by September 12, 2013. On February 15, 2013, NRC issued Reference 2, endorsing the Reference 3 industry guidance for responding to Reference 1. Section 4 of Reference 3 identifies the detailed information to be included in the seismic hazard evaluation submittals.

On April 9, 2013, NEI submitted Reference 4 to the NRC, requesting NRC agreement to delay submittal of some of the CEUS seismic hazard evaluation information so that an update to the EPRI (2004, 2006) ground motion attenuation model could be completed and used to develop that information. NEI proposed that descriptions of subsurface materials and properties and base case velocity profiles (items 3a and 3b in Section 4 of Reference 3) be submitted to NRC by September 12, 2013 as an interim product of seismic hazard development efforts being performed in accordance with Reference 3.

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NRR

The final seismic hazard and screening information will be submitted to NRC by March 31, 2014. In Reference 5, NRC agreed with this recommendation.

The attachment to this letter contains the requested descriptions of subsurface materials and properties and base case velocity profiles for Millstone Power Station.

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

Sincerely,

Eugene S. Grecheck
Vice President - Nuclear Engineering and Development

COMMONWEALTH OF VIRGINIA)
)
COUNTY OF HENRICO)

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by Eugene S. Grecheck, who is Vice President - Nuclear Engineering and Development of Dominion Nuclear Connecticut, Inc. 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 12TH day of September, 2013.

My Commission Expires: May 31, 2014

Vicki L. Hull
Notary Public

VICKI L. HULL
Notary Public
Commonwealth of Virginia
140542
My Commission Expires May 31, 2014

Commitments made in this letter: No new regulatory commitments

Attachment: Subsurface Materials and Properties and Base Case Velocity Profiles (SPID Section 4, Items 3a and 3b)

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NRC Senior Resident Inspector
Millstone Power Station

ATTACHMENT

SUBSURFACE MATERIALS AND PROPERTIES AND BASE CASE VELOCITY PROFILES (SPID SECTION 4, ITEMS 3A AND 3B)

MILLSTONE POWER STATION UNITS 2 AND 3
DOMINION NUCLEAR CONNECTICUT, INC.

Millstone Units 2 and 3

Subsurface Materials and Properties and Base Case Velocity Profiles

1 Introduction

This document provides the rationale for developing three profiles to be used in computing the ground motion response spectrum (GMRS) consistent with the methodology outlined in the Electric Power Research Institute's (EPRI) Screening Prioritization and Implementation Details (SPID) document (Reference 1).

The following are considered in this report:

- geologic setting,
- stratigraphy,
- safety-related structures,
- shear wave velocity,
- layer thickness,
- unit weight and Poisson's ratio,
- shear modulus and material damping versus cyclic shear strain,
- groundwater level, and
- profiles selected for use.

2 Geologic Setting

As described in Reference 3, the Millstone Power Station (MPS) site is located at the southern tip of Millstone Point in Waterford, Connecticut. It is on a low-lying peninsula within the Seaboard Lowland section of the New England physiographic province, a geologically complex region characterized by metamorphosed and folded rocks of Ordovician-Silurian age. The Millstone site is underlain by the Ordovician Monson Gneiss of pre-Silurian age and the Westerly Granite of Pennsylvanian or younger age. The Monson Gneiss is part of a series of lower Paleozoic metavolcanic and metasedimentary rocks and granitic gneisses that underlie most of eastern Connecticut. The Monson Gneiss at the site area is light gray and medium grained. The Westerly Granite at the site is a dike or molten rock intrusion described as fine-grained, gray (surficially altered to pink) rock. The Monson Gneiss is underlain by Cambrian age rock.

The Millstone area was covered with glacial ice until approximately 15,000 years ago. These glaciers deposited drift materials including glacial till, moraine deposits, and stream deposits and, as they receded, outwash deposits. This includes a layer of very dense basal till and overlying ablation till blanketing the Millstone site. Both the basal and overlying ablation tills are relatively impermeable.

3 Stratigraphy

From Reference 3, depth to bedrock at the MPS Unit 3 (MPS3) site below final grade (El. 24 ft) ranges from approximately zero at the Auxiliary Building location to over 40 ft at the Turbine Building location. Very dense basal till overlies the bedrock, and consists of a widely-graded mixture of cobble and boulder-size rock, gravel-size material, sand and some silt binder. Between the till and final grade is a thin layer of ablation till, a medium dense silty sand with typically 20 to 40 percent passing the No. 200 sieve. The characteristics of the till material at MPS Unit 2 (MPS2) are similar. Note that around the foundations, the till materials have generally been removed and replaced with structural fill.

The thickness of the till varies between MPS2 and MPS3. At MPS2, the till is present from grade at El. 14 ft down to bedrock at El. -2 ft, which corresponds to a thickness of 16 ft. At MPS3, the till is present from grade at El. 24 ft down to bedrock at El. 15 ft (location of Refueling Water Storage Tank foundation), which corresponds to a thickness of 9 ft.

Beneath the till, the dominant bedrock at the site is the Monson Gneiss which is approximately 3,700 ft thick (Reference 3, Table 2.5.1-3) underlain by Cambrian age rock. As noted in Reference 3, at the site area the Monson Gneiss is thinly layered with light feldspathic and dark biotitic and hornblendic layers. The foliation is well defined and exhibits a consistent northwest trend. The other rock at the site is Westerly Granite which is a dike (or molten intrusion) into the Monson Gneiss with properties that are expected to be similar to the Monson Gneiss. For the soil/rock column, the properties of the more prevalent Monson Gneiss will be used.

4 Safety-Related Structures

Reference 1 provides very specific guidelines on how a nuclear power facility is to identify the Safe Shutdown Earthquake (SSE) Control Point elevation for a plant or unit if this control point was not identified in the Updated Final Safety Analysis Report (UFSAR). In the case of a plant designated as a rock site, the SSE control point is defined as the foundation bearing elevation of the highest rock-supported, safety-related structure. According to Reference 2, at MPS2, the Turbine Building has various columns bearing on the bedrock formation as high as El. -2 ft (plant grade is El. +14 ft). For MPS3, the Refueling Water Storage Tank is founded on bedrock at El. +15 ft (plant grade is El. +24 ft) and is the highest rock-founded, safety-related structure for this unit. Thus, the SSE Control Point for GMRS screening for MPS2 is at El. -2 ft and for MPS3 is at El. +15 ft.

The GMRS will be calculated as a geologic outcrop on the top of the Monson Gneiss using a truncated soil column. Since the gneiss is a hard rock with linear stress-strain behavior, the presence of the till will not influence the material properties below the GMRS elevations. Therefore, in calculation of the GMRS, the presence of the till at the top of the site profile is insignificant and it is thus not included in the profile for analysis.

5 Shear Wave Velocity

As previously described, the considered site profile consists solely of Monson Gneiss, underlain by Cambrian age rock. The shear-wave velocity (V_S) of the Monson Gneiss was measured using seismic cross-hole tests from El. +10 ft to El. -50 ft beneath MPS3 (Reference 3). Additionally, down-hole tests measured V_S from El. +5 ft to El. -99 ft (approximate to El. -100 ft).

The V_S average values were consistently at 6,500 ft/sec for both cross-hole and down-hole tests. Reference 3 notes some slight scattering, and assigns a variation of ± 300 ft/sec. This variation is small (COV = 5%) and suggests that either very few tests were taken or else the material is very uniform. In the approximately 100 ft depth of the gneiss sampled, the average unconfined compression strength of 9 cores tested was 10,000 psi (range of 4,000 psi to 14,000 psi) with an average unit weight of 165 pcf. This range in strength suggests that the rock strength (and hence V_S) is not uniform.

There are no V_S data below about El. -100 ft. The only information we have is that the Monson Gneiss is approximately 3,700 ft thick. Reference 1, Appendix B, indicates that for Cenozoic or Paleozoic sedimentary rocks, a constant V_S gradient of 0.5 m/sec/m (0.5 ft/sec/ft) should be used. The Monson Gneiss is Paleozoic, but is metamorphic rather than sedimentary. Nevertheless, it is reasonable to use this V_S gradient. This is equivalent to 200 ft/sec increase over 400 ft depth. Assuming this increase starts at 6,500 ft/sec at El. -100 ft (see Table 1), V_S at the base of the Monson Gneiss at about El. -3,700 ft will be 8,300 ft/sec. It can be assumed that the V_S of the Cambrian rock below the Monson Gneiss continues with the same gradient.

6 Layer Thickness

The Monson Gneiss below about El. -100 ft is assumed to be essentially monolithic with a constant shear wave velocity gradient. The effect of considering the base case, lower range and upper range profiles results in the hard rock (9,200 ft/sec) interface being reached at differing depths.

7 Unit Weight and Poisson's Ratio

Reference 3 reports the Monson Gneiss has a unit weight of 165 pcf and a Poisson's ratio of 0.33. These values are adopted for the underlying Cambrian rock.

8 Shear Modulus and Damping Ratio versus Strain

The shear modulus (G) and damping ratio (D) values of the Monson Gneiss are independent of shear strain. The damping of the gneiss is estimated to be 1%. This value is adopted for the underlying Cambrian rock.

9 Groundwater Level

Figure 2.5.4-37 of Reference 3 is a groundwater contour map that shows groundwater elevations ranging from about El. +6 ft to El. +22 ft across the MPS3 power block, with El. +18 ft to El. +20 ft under the reactor. For MPS3, a groundwater level of El. +20 ft (i.e., 4 ft below final grade) is selected for use. For MPS2, a groundwater level of El. +10 ft (i.e., 4 ft below final grade) is selected for use.

10 Selected Profiles

Due to the limited amount of data constraining the site characteristics, the methodology outlined in Reference 1 is used to develop three profiles to be considered in subsequent site response analyses. As described in Reference 1 Appendix B, the lower range (LR), base case (BC), and upper range (UR) profiles correspond to the 10^{th}, 50^{th}, and 90^{th} percentiles, respectively. Using weights of 0.3, 0.4, and 0.3 for the LR, BC, and UR, respectively, an accurate three-point approximation of the normal distribution can be achieved.

Reference 1 Appendix B recommends that the uncertainty in V_S be modeled using a log-normal distribution with a logarithmic standard deviation ($\sigma_\mu$ln) of 0.35 for sites with very limited V_S data. The 10^{th}-percentile velocity profile is computed by multiplying the BC velocity profile by $\exp(-1.28 \cdot 0.35)$, which corresponds to 0.639. Similarly, the 90^{th}-percentile profile is computed by multiplying the BC velocity profile by $\exp(1.28 \cdot 0.35)$ or 1.57. Note that, using these relationships, the increase in the V_S gradient is about 0.32 ft/sec/ft for the 10^{th} percentile, and about 0.784 ft/sec/ft for the 90^{th} percentile.

The three profiles selected for use are presented in Table 1. Note that during the site response analyses, these profiles will be truncated at the last exceedance of 9,200 ft/sec. The three profiles are plotted against elevation down to V_{BC} = 9,200 ft/sec in Figure 1.

11 References

1. Electric Power Research Institute (EPRI). "Seismic Evaluation Guidance, Screening, Prioritization and Implementation Details (SPID) for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic," Final Report No. 1025287, Electric Power Research Institute, Palo Alto, CA, 2013.

2. Dominion, "Seismic Screening GMRS Subsurface Profiles for Millstone and North Anna Power Stations," ETE-CCE-2013-0001, Revision 0.

3. Millstone Unit 3 Final Safety Analysis Report (FSAR), Revision 26.

Table 1: Base Case V_S Profile and Related Properties

Material[1]	Elevation (ft)	Thickness (ft)	V_S (ft/sec)			PR[4]	Unit Wt (lb/ft^3)
			V_{BC}	V_{LR}	V_{UR}[3]		
Monson	+15 to -100[2]	115[2]	6500	4150	10200	0.33	165
Monson	-100 to -500	400	6700	4280	10520	0.33	165
Monson	-500 to -900	400	6900	4410	10830	0.33	165
Monson	-900 to -1300	400	7100	4540	11150	0.33	165
Monson	-1300 to -1700	400	7300	4660	11460	0.33	165
Monson	-1700 to -2100	400	7500	4790	11770	0.33	165
Monson	-2100 to -2500	400	7700	4920	12090	0.33	165
Monson	-2500 to -2900	400	7900	5050	12400	0.33	165
Monson	-2900 to -3300	400	8100	5180	12720	0.33	165
Monson	-3300 to -3700	400	8300	5300	13030	0.33	165
Cambrian	-3700 t0 -4100	400	8500	5430	13340	0.33	165
Cambrian	-4100 to -4500	400	8700	5560	13660	0.33	165
Cambrian	-4500 to -4900	400	8900	5690	13970	0.33	165
Cambrian	-4900 to -5300	400	9100	5810	14290	0.33	165
Cambrian	-5300 to -5500	200	9200	5880	14440	0.33	165
Cambrian	Below -5500	-	>9200	(5)	-	0.33	165

Notes:

1. Monson refers to the Monson Gneiss and includes the Westerly Granite, where present.
2. Values are for MPS3. For MPS2, elevation range is -2 ft to -100 ft, and thickness is 98 ft.
3. During the site response analyses, these profiles will be truncated at 9,200 ft/sec.
4. PR = Poisson's ratio
5. For V_{LR}, values continue to increase at same gradient of 0.32 ft/sec per ft to V_{LR} = 9,200 ft/sec, at approximately El. -16,000 ft.

Groundwater assumed at El. +10 ft for MPS2 and El. +20 ft for MPS3.

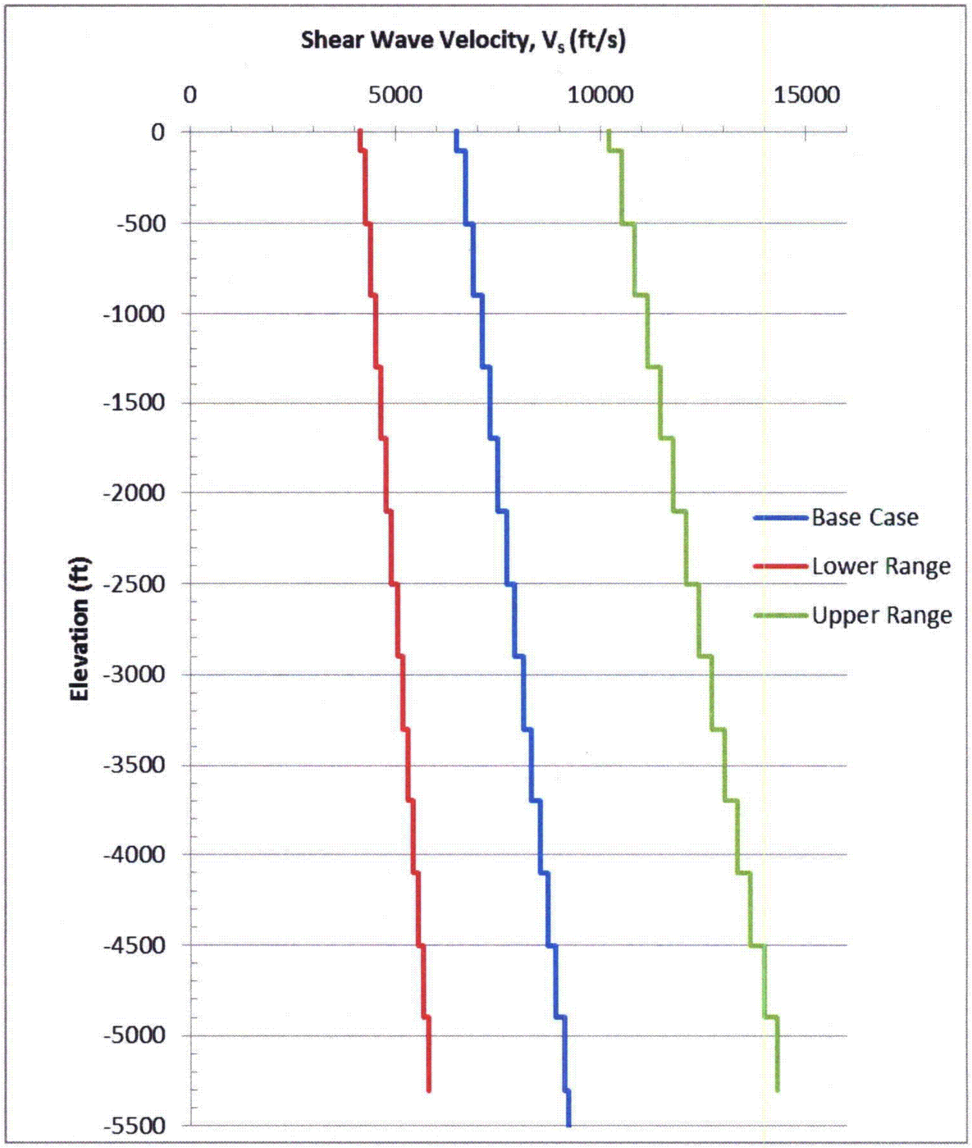

Figure 1: Base Case V_S Profiles