VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

September 12, 2013

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

Serial No. 13-244C
NL&OS/WDC R0
Docket Nos. 50-280/281
License Nos. DPR-32/37

VIRGINIA ELECTRIC AND POWER COMPANY
SURRY POWER STATION UNITS 1 AND 2
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. The final seismic hazard and screening information will be submitted to NRC by March 31, 2014. In Reference 5, NRC agreed with this recommendation.

A001
NRR

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

If you have any questions regarding this information, please contact Gary D. Miller at (804) 273-2771.

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 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 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)

cc: U.S. Nuclear Regulatory Commission, Region II
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NRC Senior Resident Inspector
Surry Power Station

ATTACHMENT

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

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

Surry Power Station Units 1 and 2

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 properties are considered in this report:

- geologic setting,
- safety related structures,
- stratigraphy / layer thickness,
- shear modulus and material damping, and
- shear wave velocity profiles selected for use.

2 Geologic Setting

As described in Reference 3, the Surry Power Station (SPS) site is located adjacent to the James River on Gravel Neck in Surry County, Virginia, within the Atlantic Coastal Plain physiographic province, approximately half way between the Atlantic Ocean and the Fall Line forming the boundary between the Piedmont and Atlantic Coastal Plain. In Virginia, the Atlantic Coastal Plain has a stair-step character composed of a series of plains successfully decreasing in elevation from west to east. These plains are separated from one another by scarps. In the site vicinity, four plains are recognized. From highest to lowest they are the elevation 120-foot plain, the elevation 90-foot plain, the elevation 70-foot plain, and the elevation 45-foot plain. The scarps separating these plains are known as the Surry scarp, the Peary scarp, and the Chippokes scarp.

The site consists of Pleistocene Epoch Norfolk Estuarine Formation deposits to depths ranging from 50 to 80 feet. Layers of brown to mottled brown sand, silty sand, organic and inorganic silts and clays, interlayered with iron-oxide cemented sands comprise the upper 20 to 35 feet of this formation, while layers of gray sand, silty sand, and organic to inorganic clays and silts with decayed vegetation and shell fragments comprise the lower portion of this formation.

The Norfolk Formation deposits lie above Miocene Epoch Chesapeake Group sediments comprising very stiff, green to dark gray clays containing shell fragments with occasional compact sand and silt layers. This Miocene deposit is estimated to be about 240 feet thick at the site. Underlying the Miocene sediments are Eocene, Paleocene,

and Cretaceous deposits estimated to be about 45 feet, 55 feet, and at least 800 feet, respectively, in thickness, based upon wells drilled in the general area. Metamorphic and igneous crystalline bedrock is estimated to be roughly 1300 feet deep at the site based upon seismic investigations conducted about 2 miles southeast of the site (Reference 3, Section 2.4.2.1). Information available in an unrelated study (Reference 4) suggests however, that the basement bedrock is somewhat deeper, on the order of 1600 feet below Hog Island, the peninsula where the plant is located.

Upper portions of the Pleistocene deposits were excavated and replaced with compacted granular fill to support shallow foundations at the plant, while the lower Miocene deposits support deep mat foundations, driven piles and sheet pile cutoffs (Reference 3, Section 2.4.7 and Table 2.4-12). The pertinent soil profile varies from the top of Miocene clay to the top of the granular fill replacement material.

3 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 accordance with Reference 1, Surry has been designated as a soil supported site. In the case of a plant designated as a soil site, the SSE control point is defined as the foundation bearing elevation of the highest soil supported, safety related structure. The safety related structure at Surry Power Station bearing at the highest elevation is the Emergency Condensate Storage Tank which bears at elevation 26.5 feet on compacted fill placed after the critical power block area was excavated to approximately elevation 7 feet during construction (Reference 3, Section 2.4.7.1 and 2.4.9). Thus, the SSE Control Point for GMRS screening for Surry Power Station is at El. 26.5 ft.

4 Stratigraphy / Layer Thickness

The GMRS elevation is at the top of approximately 1600 feet of unconsolidated sedimentary deposits, terminating in either upper Miocene Epoch clays and silts or lower Pleistocene Epoch clay, sand or silty sand materials. The top 140 to 200 vertical feet of the 1600 feet was selectively explored, sampled and tested with laboratory or geophysical methods. The properties of these and the underlying materials are summarized in Table 1. As indicated in Table 1, the SSE Control Point is assumed to be at the surface, and the profile was modeled up to the surface.

Information provided in Table 1 is based primarily on Reference 3. Where specific data were not readily available, reasonable approximations and supporting data are provided and documented in Reference 2.

5 Shear Modulus and Material Damping

For dynamic properties of soft rock layers, modulus and damping curves were represented with two (2) models. The first model used rock curves taken from Reference 5, the second model assumed linear behavior. These dynamic property models were weighted equally. For dynamic properties of clay and sand layers, modulus and damping curves were also represented with 2 models. The first model used soil curves taken from Reference 5, the second model used soil curves taken from References 6 and 7. These dynamic property models were weighted equally. To model the profile, soft rock modulus and damping curves from Reference 5 were paired with soil modulus and damping curves from Reference 5, and linear rock modulus and damping curves were paired with soil modulus and damping curves from References 6 and 7.

6 Shear Wave Velocity

The three (3) base-case shear-wave velocity profiles used to model amplification at the site are shown in Figure 1. Profiles 1, 2, and 3 are weighted 0.4, 0.3, and 0.3, respectively. Thicknesses, depths, and shear-wave velocities (Vs) corresponding to each profile are shown in Table 2.

7 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 Profile for Surry Power Station," ETE-CCE-2013-0002, Revision 0.
3. Surry Power Station, UFSAR, Revision 44.07.
4. United States Geological Survey (USGS) Professional Paper No. 1612, "The Effects of the Chesapeake Bay Impact Crater on the Geological Framework and Correlation of Hydrogeologic Units of the Lower York-James Peninsula, Virginia", published February 22nd, 2000.
5. EPRI (1993). *Guidelines for Determining Design Basis Ground Motions*, Elec. Power Res. Inst., Palo Alto, CA, Rept. TR-102293, Vol. 1—5.
6. Silva, W.J., N. A. Abrahamson, G.R. Toro, and C. Costantino (1996). *Description and Validation of the Stochastic Ground Motion Model,* Rept. submitted to Brookhaven Natl. Lab., Assoc. Universities Inc., Upton NY 11973, Contract No. 770573.

7. Walling, M.A., W.J., Silva and N.A. Abrahamson (2008). "Nonlinear Site Amplification Factors for Constraining the NGA Models," *Earthquake Spectra,* 24 (1) 243-255.
8. EPRI Letter, R.P. Kassawara, EPRI to D. Bhargava, Dominion, *Transmittal of Site Description Report for the Surry Plant*, August 30, 2013.
9. Regulatory Guide 1.208, "A Performance Based Approach to Define the Site Specific Earthquake Ground Motion," March 2007.

Table 1: Surry Power Station Site Geotechnical Profile Data

Depth Range (feet)	Soil Description	Density (pcf)	Shear Wave Velocity, V_s (fps)
0 (El. 26.5)	**Emergency Condensate Storage Tank**	---	---
0 (El. 26.5)	**SSE Control Point Elevation**	---	---
0 -16	Compacted Granular Fill	130	1000 [1]
16 - 27	Pleistocene Upper Clay	94	790
27- 40	Pleistocene Sand A	99	950
40 - 52	Pleistocene Lower Medium Clay	84	710
52 – 67	Pleistocene Sand B	102	830
67 (El. -41)	**Containment Foundation**	---	---
67-96	Miocene Chesapeake dark blue to gray Clay, shell Marl	87	940
96 (El. -70)	**Pile tips below Spent Fuel Pool, Main Steam Valve House, and Refueling Water Storage Tank**	---	---
67-307	Miocene Chesapeake dark blue to gray Clay, shell Marl	87	940
307-362	Eocene gray Marl, Glauconitic and Quart Sand, Pyritic Marl, Limestone beds	120 [2]	1200 [2]
362-407	Paleocene Mattaponi mottled Clay, Glauconitic Sand and Marl, Quartz Sand	130 [2]	1000 [2]
407-1600	Cretaceous Potomac Group Sand and Clay beds	140 [2]	2000 [2
1600 – 1700	Crystalline Igneous and Metamorphic Rock	160 [2]	7000 [2]
1700+ [2]	"Hard Rock" - Crystalline Igneous and Metamorphic Rock	170 [2]	9200 [2] [3]

[1] Estimated; considered typical for compacted granular fill material.
[2] Rough estimates / Approximation for analysis purposes; no data readily available.
[3] Definition of Hard Rock Position C, Section 4 in Reference 9.

Figure 1: Vs Profiles for Surry Site

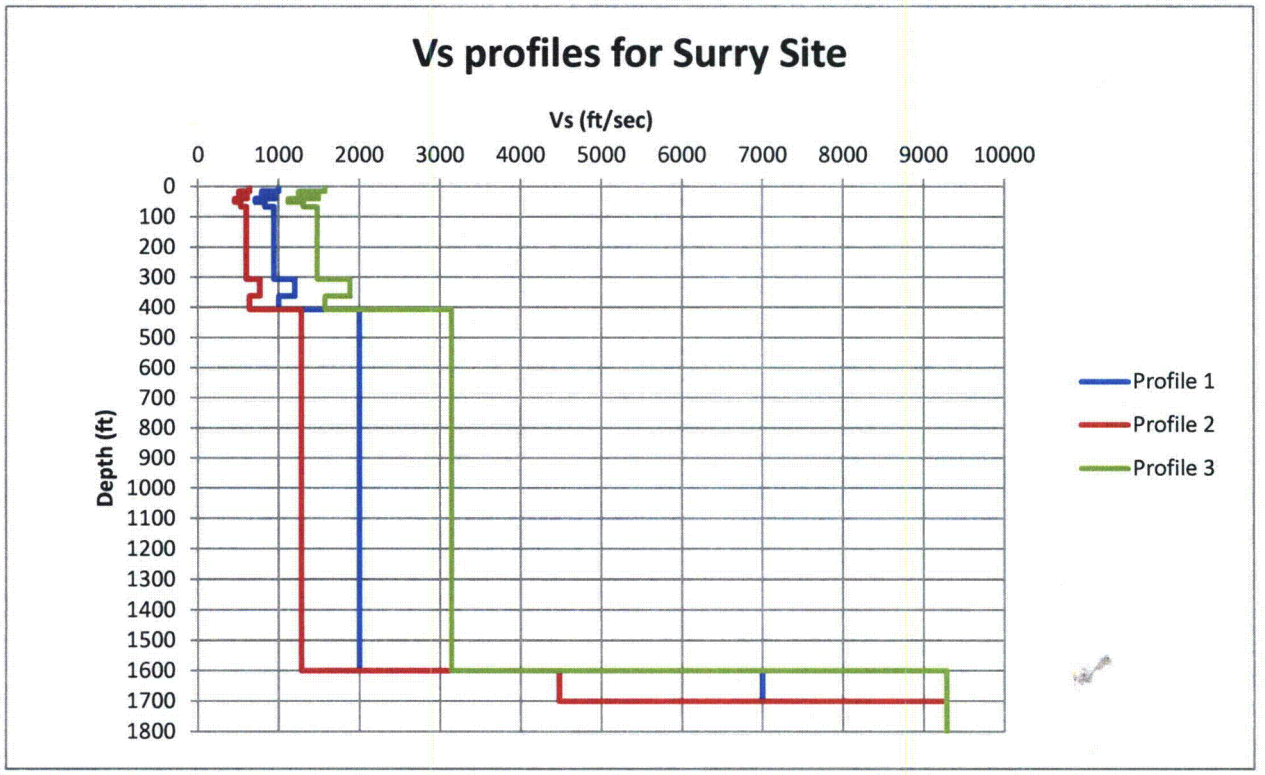

Table 2: Layer Thicknesses, Depths, and Vs for 3 Profiles, Surry Site

Profile 1			Profile 2			Profile 3		
Thickness(ft)	Depth (ft)	Vs(ft/s)	Thickness(ft)	Depth (ft)	Vs(ft/s)	Thickness(ft)	Depth (ft)	Vs(ft/s)
	0	1000		0	640		0	1570
8.0	8.0	1000	8.0	8.0	640	8.0	8.0	1570
8.0	16.0	1000	8.0	16.0	640	8.0	16.0	1570
4.0	20.0	790	4.0	20.0	506	4.0	20.0	1240
7.0	27.0	790	7.0	27.0	506	7.0	27.0	1240
6.5	33.5	950	6.5	33.5	608	6.5	33.5	1492
6.5	40.0	950	6.5	40.0	608	6.5	40.0	1492
6.0	46.0	710	6.0	46.0	454	6.0	46.0	1115
6.0	52.0	710	6.0	52.0	454	6.0	52.0	1115
7.5	59.5	830	7.5	59.5	531	7.5	59.5	1303
7.5	67.0	830	7.5	67.0	531	7.5	67.0	1303
5.0	72.0	940	5.0	72.0	602	5.0	72.0	1476
5.0	77.0	940	5.0	77.0	602	5.0	77.0	1476
5.0	82.0	940	5.0	82.0	602	5.0	82.0	1476
5.0	87.0	940	5.0	87.0	602	5.0	87.0	1476
5.0	92.0	940	5.0	92.0	602	5.0	92.0	1476
5.0	97.0	940	5.0	97.0	602	5.0	97.0	1476
5.0	102.0	940	5.0	102.0	602	5.0	102.0	1476
5.0	107.0	940	5.0	107.0	602	5.0	107.0	1476
5.0	112.0	940	5.0	112.0	602	5.0	112.0	1476
5.0	117.0	940	5.0	117.0	602	5.0	117.0	1476
3.0	120.0	940	3.0	120.0	602	3.0	120.0	1476
7.0	127.0	940	7.0	127.0	602	7.0	127.0	1476
5.0	132.0	940	5.0	132.0	602	5.0	132.0	1476
5.0	137.0	940	5.0	137.0	602	5.0	137.0	1476
5.0	142.0	940	5.0	142.0	602	5.0	142.0	1476
5.0	147.0	940	5.0	147.0	602	5.0	147.0	1476
5.0	152.0	940	5.0	152.0	602	5.0	152.0	1476
5.0	157.0	940	5.0	157.0	602	5.0	157.0	1476
5.0	162.0	940	5.0	162.0	602	5.0	162.0	1476
5.0	167.0	940	5.0	167.0	602	5.0	167.0	1476
5.0	172.0	940	5.0	172.0	602	5.0	172.0	1476
5.0	177.0	940	5.0	177.0	602	5.0	177.0	1476
5.0	182.0	940	5.0	182.0	602	5.0	182.0	1476
5.0	187.0	940	5.0	187.0	602	5.0	187.0	1476
5.0	192.0	940	5.0	192.0	602	5.0	192.0	1476

Table 2: Layer Thicknesses, Depths, and Vs for 3 Profiles, Surry Site

Profile 1			Profile 2			Profile 3		
Thickness(ft)	Depth (ft)	Vs(ft/s)	Thickness(ft)	Depth (ft)	Vs(ft/s)	Thickness(ft)	Depth (ft)	Vs(ft/s)
5.0	197.0	940	5.0	197.0	602	5.0	197.0	1476
5.0	202.0	940	5.0	202.0	602	5.0	202.0	1476
5.0	207.0	940	5.0	207.0	602	5.0	207.0	1476
5.0	212.0	940	5.0	212.0	602	5.0	212.0	1476
5.0	217.0	940	5.0	217.0	602	5.0	217.0	1476
5.0	222.0	940	5.0	222.0	602	5.0	222.0	1476
5.0	227.0	940	5.0	227.0	602	5.0	227.0	1476
5.0	232.0	940	5.0	232.0	602	5.0	232.0	1476
5.0	237.0	940	5.0	237.0	602	5.0	237.0	1476
5.0	242.0	940	5.0	242.0	602	5.0	242.0	1476
5.0	247.0	940	5.0	247.0	602	5.0	247.0	1476
3.0	250.0	940	3.0	250.0	602	3.0	250.0	1476
7.0	257.0	940	7.0	257.0	602	7.0	257.0	1476
5.0	262.0	940	5.0	262.0	602	5.0	262.0	1476
5.0	267.0	940	5.0	267.0	602	5.0	267.0	1476
5.0	272.0	940	5.0	272.0	602	5.0	272.0	1476
5.0	277.0	940	5.0	277.0	602	5.0	277.0	1476
5.0	282.0	940	5.0	282.0	602	5.0	282.0	1476
5.0	287.0	940	5.0	287.0	602	5.0	287.0	1476
5.0	292.0	940	5.0	292.0	602	5.0	292.0	1476
5.0	297.0	940	5.0	297.0	602	5.0	297.0	1476
5.0	302.0	940	5.0	302.0	602	5.0	302.0	1476
5.0	307.0	940	5.0	307.0	602	5.0	307.0	1476
5.0	312.0	1200	5.0	312.0	768	5.0	312.0	1884
5.0	317.0	1200	5.0	317.0	768	5.0	317.0	1884
5.0	322.0	1200	5.0	322.0	768	5.0	322.0	1884
5.0	327.0	1200	5.0	327.0	768	5.0	327.0	1884
5.0	332.0	1200	5.0	332.0	768	5.0	332.0	1884
5.0	337.0	1200	5.0	337.0	768	5.0	337.0	1884
5.0	342.0	1200	5.0	342.0	768	5.0	342.0	1884
5.0	347.0	1200	5.0	347.0	768	5.0	347.0	1884
5.0	352.0	1200	5.0	352.0	768	5.0	352.0	1884
5.0	357.0	1200	5.0	357.0	768	5.0	357.0	1884
5.0	362.0	1200	5.0	362.0	768	5.0	362.0	1884
5.0	367.0	1000	5.0	367.0	640	5.0	367.0	1570
5.0	372.0	1000	5.0	372.0	640	5.0	372.0	1570
5.0	377.0	1000	5.0	377.0	640	5.0	377.0	1570

Table 2: Layer Thicknesses, Depths, and Vs for 3 Profiles, Surry Site

Profile 1			Profile 2			Profile 3		
Thickness(ft)	Depth (ft)	Vs(ft/s)	Thickness(ft)	Depth (ft)	Vs(ft/s)	Thickness(ft)	Depth (ft)	Vs(ft/s)
5.0	382.0	1000	5.0	382.0	640	5.0	382.0	1570
5.0	387.0	1000	5.0	387.0	640	5.0	387.0	1570
5.0	392.0	1000	5.0	392.0	640	5.0	392.0	1570
5.0	397.0	1000	5.0	397.0	640	5.0	397.0	1570
5.0	402.0	1000	5.0	402.0	640	5.0	402.0	1570
5.0	407.0	1000	5.0	407.0	640	5.0	407.0	1570
5.0	412.0	2000	5.0	412.0	1280	5.0	412.0	3140
5.0	417.0	2000	5.0	417.0	1280	5.0	417.0	3140
5.0	422.0	2000	5.0	422.0	1280	5.0	422.0	3140
5.0	427.0	2000	5.0	427.0	1280	5.0	427.0	3140
5.0	432.0	2000	5.0	432.0	1280	5.0	432.0	3140
5.0	437.0	2000	5.0	437.0	1280	5.0	437.0	3140
5.0	442.0	2000	5.0	442.0	1280	5.0	442.0	3140
5.0	447.0	2000	5.0	447.0	1280	5.0	447.0	3140
5.0	452.0	2000	5.0	452.0	1280	5.0	452.0	3140
5.0	457.0	2000	5.0	457.0	1280	5.0	457.0	3140
5.0	462.0	2000	5.0	462.0	1280	5.0	462.0	3140
5.0	467.0	2000	5.0	467.0	1280	5.0	467.0	3140
5.0	472.0	2000	5.0	472.0	1280	5.0	472.0	3140
5.0	477.0	2000	5.0	477.0	1280	5.0	477.0	3140
5.0	482.0	2000	5.0	482.0	1280	5.0	482.0	3140
5.0	487.0	2000	5.0	487.0	1280	5.0	487.0	3140
5.0	492.0	2000	5.0	492.0	1280	5.0	492.0	3140
5.0	497.0	2000	5.0	497.0	1280	5.0	497.0	3140
3.0	500.0	2000	3.0	500.0	1280	3.0	500.0	3140
7.0	507.0	2000	7.0	507.0	1280	7.0	507.0	3140
5.0	512.0	2000	5.0	512.0	1280	5.0	512.0	3140
5.0	517.0	2000	5.0	517.0	1280	5.0	517.0	3140
5.0	522.0	2000	5.0	522.0	1280	5.0	522.0	3140
5.0	527.0	2000	5.0	527.0	1280	5.0	527.0	3140
5.0	532.0	2000	5.0	532.0	1280	5.0	532.0	3140
5.0	537.0	2000	5.0	537.0	1280	5.0	537.0	3140
5.0	542.0	2000	5.0	542.0	1280	5.0	542.0	3140
5.0	547.0	2000	5.0	547.0	1280	5.0	547.0	3140
5.0	552.0	2000	5.0	552.0	1280	5.0	552.0	3140
5.0	557.0	2000	5.0	557.0	1280	5.0	557.0	3140
5.0	562.0	2000	5.0	562.0	1280	5.0	562.0	3140

Table 2: Layer Thicknesses, Depths, and Vs for 3 Profiles, Surry Site

Profile 1			Profile 2			Profile 3		
Thickness(ft)	Depth (ft)	Vs(ft/s)	Thickness(ft)	Depth (ft)	Vs(ft/s)	Thickness(ft)	Depth (ft)	Vs(ft/s)
5.0	567.0	2000	5.0	567.0	1280	5.0	567.0	3140
103.3	670.3	2000	103.3	670.3	1280	103.3	670.3	3140
103.3	773.6	2000	103.3	773.6	1280	103.3	773.6	3140
103.3	876.9	2000	103.3	876.9	1280	103.3	876.9	3140
103.3	980.2	2000	103.3	980.2	1280	103.3	980.2	3140
103.3	1083.5	2000	103.3	1083.5	1280	103.3	1083.5	3140
103.3	1186.8	2000	103.3	1186.8	1280	103.3	1186.8	3140
103.3	1290.0	2000	103.3	1290.0	1280	103.3	1290.0	3140
103.3	1393.3	2000	103.3	1393.3	1280	103.3	1393.3	3140
103.3	1496.6	2000	103.3	1496.6	1280	103.3	1496.6	3140
103.3	1599.9	2000	103.3	1599.9	1280	103.3	1599.9	3140
33.3	1633.3	7000	33.3	1633.3	4480	33.3	1633.3	9285
33.3	1666.6	7000	33.3	1666.6	4480	33.3	1666.6	9285
33.3	1699.9	7000	33.3	1699.9	4480	33.3	1699.9	9285
3280.8	4980.8	9285	3280.8	4980.8	9285	3280.8	4980.8	9285