



Crystal River Nuclear Plant  
15760 W. Power Line Street  
Crystal River, FL 34428

Docket 50-302  
Operating License No. DPR-72

10 CFR 50.54(f)

September 6, 2013  
3F0913-01

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

Subject: Crystal River Unit 3 – Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding the Seismic Aspects of Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident – 1.5 Year Response for CEUS Sites

References:

1. NRC letter dated March 12, 2012, "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," (ADAMS Accession Number ML12053A340)
2. NRC letter dated February 15, 2013, "Endorsement of Electric Power Research Institute Final Draft Report 1025287, Seismic Evaluation Guidance" (ADAMS Accession Number ML12319A074)
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," dated November 2012 (ADAMS Accession Number ML12333A170)
4. NEI to NRC letter dated April 9, 2013, "Proposed Path Forward for NTTF Recommendation 2.1: Seismic Reevaluations" (ADAMS Accession Number ML13101A379)
5. NRC letter dated May 7, 2013, "Electric Power Research Institute Final Draft Report XXXXXX, "Seismic Evaluation Guidance: Augmented Approach for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic," as an Acceptable Alternative to the March 12, 2012, Information Request for Seismic Reevaluations," (ADAMS Accession Number ML13106A331)

Dear Sir:

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, the NRC issued Reference 2, endorsing the Reference 3 industry guidance for responding to Reference 1. Section 4 of

A001  
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Reference 3 identifies the detailed information to be included in the seismic hazard evaluation submittals.

On April 9, 2013, the Nuclear Energy Institute (NEI) submitted Reference 4 to 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 profiles and nonlinear material properties" (Items 3.a and 3.b in Section 4 of Reference 3) be submitted to NRC by September 12, 2013, with the remaining seismic hazard and screening information submitted to NRC by March 31, 2014. In Reference 5, the NRC agreed with this recommendation.

In accordance with 10 CFR 50.54(f), Duke Energy Florida, Inc., formerly known as Florida Power Corporation, hereby submits the requested descriptions of "subsurface materials and properties" and "base case profiles and nonlinear material properties" for Crystal River Unit 3 (CR-3) in the Enclosure to this letter. The information provided in the Enclosure to this letter is considered an interim product of seismic hazard development efforts being performed for the industry by EPRI. The complete and final seismic hazard reports for Duke Energy will be provided to the NRC in our seismic hazard submittals by March 31, 2014 in accordance with Reference 5.

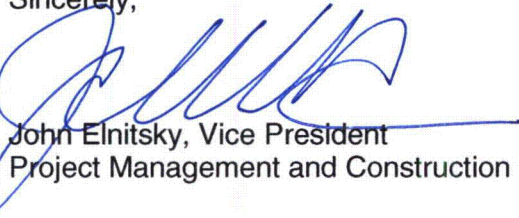
The Enclosure to this letter contains information provided by Lettis Consultants International, Inc., (LCI) for use by CR-3. LCI used data from URS Study/Report CR3-13-05-100-001, "Soil Report for Crystal River Unit 3 Nuclear Power Plant, Revision 1," Appendices E – H, to develop Table 1 of this Enclosure.

This document contains no new regulatory commitments.

If you have any questions regarding this submittal, please contact Mr. Dan Westcott, Licensing Supervisor, at (352) 563-4796.

I declare under penalty of perjury that the foregoing is true and correct. Executed on September 6, 2013.

Sincerely,



John Elnitsky, Vice President  
Project Management and Construction

JE/dwh

Enclosure: Descriptions of "Subsurface Materials and Properties" and "Base Case Profiles and Nonlinear Material Properties" for Crystal River Unit 3 (CR-3)

xc: NRR Project Manager  
Regional Administrator, Region II

**DUKE ENERGY FLORIDA, INC.**

**DOCKET NUMBER 50 - 302 / LICENSE NUMBER DPR - 72**

**ENCLOSURE**

**DESCRIPTIONS OF "SUBSURFACE MATERIALS AND  
PROPERTIES" AND "BASE CASE PROFILES AND  
NONLINEAR MATERIAL PROPERTIES" FOR CRYSTAL  
RIVER UNIT 3 (CR-3)**

## Crystal River site description

The basic information used to create the site geologic profile at the Crystal River Nuclear Power Plant is shown in Table 1. This profile was developed using information documented in Ref. 1. As indicated in Ref. 1, the SSE Control Point is defined at elevation 93 ft, and the profile was modeled up to this elevation. For dynamic properties of rock layers, modulus and damping curves were represented with 2 models. The first model used rock curves taken from Ref. 2, the second model assumed linear behavior. These dynamic property models were weighted equally. For dynamic properties of fill and compacted sand layers, modulus and damping curves were also represented with 2 models. The first model used soil curves taken from Ref. 2, the second model used soil curves taken from Ref. 3 and Ref. 4. These dynamic property models were weighted equally. To model the profile, rock modulus and damping curves from Ref. 2 were paired with soil modulus and damping curves from Ref. 2, and linear rock modulus and damping curves were paired with soil modulus and damping curves from Ref. 3 and Ref. 4.

The 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 ( $V_s$ ) corresponding to each profile are shown in Table 2.

## References

1. URS (2012). *Site Geologic Conditions for Crystal River Unit 3 Nuclear Power Plant—Revision 1*, Informal report transmitted by letter PE-CR3-A07-12268 from B. Alumbaugh to C. Albers on September 25, 2012.
2. EPRI (1993). *Guidelines for Determining Design Basis Ground Motions*, Elec. Power Res. Inst., Palo Alto, CA, Rept. TR-102293, Vol. 1-5.
3. 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.
4. 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.

Table 1

Summary of Geotechnical Profile Data for Crystal River Nuclear Power Plant

Elevation of Top of Stratum	Shear Wave Velocity (fps)	Source
121.5	900	Appendix E
96	650	
91.5	650	
88	1200	
84	2630	
72	2100	
0.7	3740	
-8	2300	Appendix F
-23	2300	
-49	2850	
-95	2700	
-157	3450	
-175	3400	
-199	3300	
-223	3300	
-263	3550	
-306	3350	
-344	4200	
-404	3350	
-464	3800	Appendix G
-704	4600	
-1064	5900	
-1314	7400	
-1564	5100	
-1714	7200	
-1814	6150	
-2014	7250	
-2614	5400	
-2764	5900	
-2964	6200	
-3614	5200	
-4214	5600	
-4314	4800	
-4882	4800	Appendix H
-5882	9200	

Note: Elevations sourced from Levy COLA are reported at elevations shown in Appendix F and G. Elevations from the October 2011 Seismic Hazard Report (Appendix H) are inferred based upon a plant grade elevation of 118.5 ft.

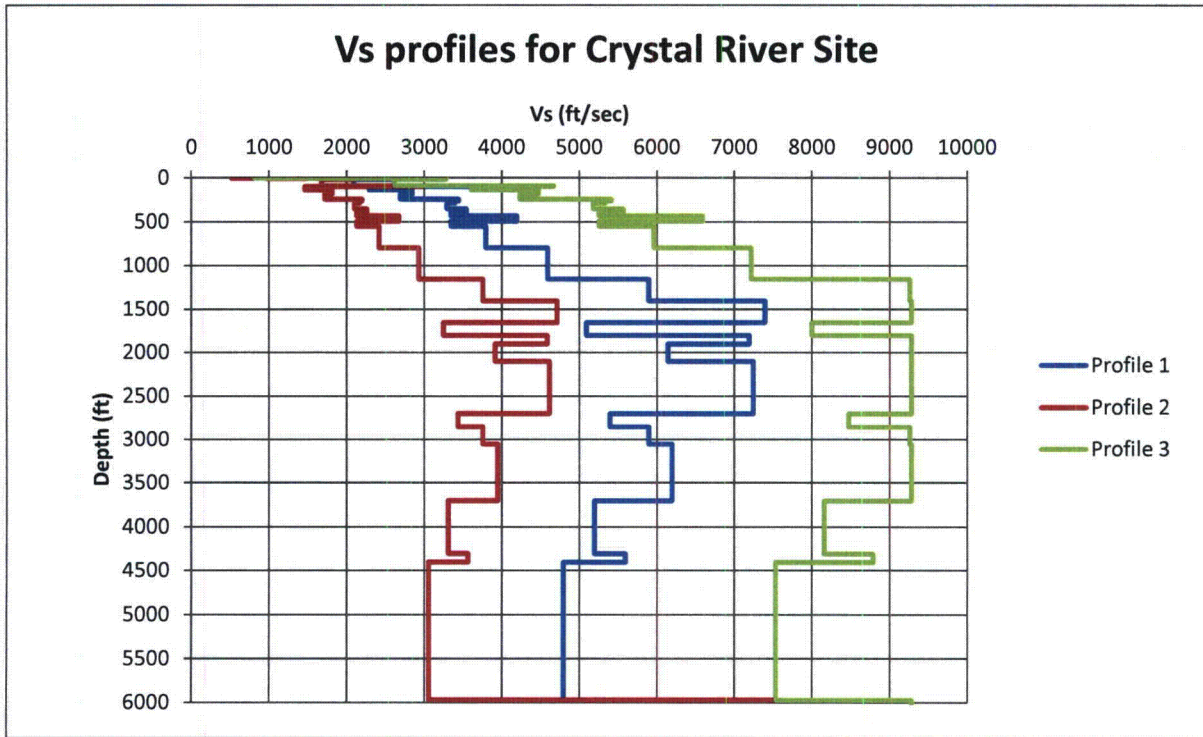


Figure 1. Vs profiles for Crystal River site

Table 2

Layer thicknesses, depths, and Vs for 3 profiles, Crystal River 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	650		0	520		0	812
1.5	1.5	650	1.5	1.5	520	1.5	1.5	812
3.5	5.0	650	3.5	5.0	520	3.5	5.0	812
4.0	9.0	1200	4.0	9.0	960	4.0	9.0	1500
5.5	14.5	2630	5.5	14.5	2104	5.5	14.5	3287
5.5	20.0	2630	5.5	20.0	2104	5.5	20.0	3287
1.0	21.0	2630	1.0	21.0	2104	1.0	21.0	3287
5.8	26.8	2100	5.8	26.8	1680	5.8	26.8	2625
5.8	32.6	2100	5.8	32.6	1680	5.8	32.6	2625
5.8	38.4	2100	5.8	38.4	1680	5.8	38.4	2625
5.8	44.2	2100	5.8	44.2	1680	5.8	44.2	2625
5.8	50.0	2100	5.8	50.0	1680	5.8	50.0	2625
6.0	56.0	2100	6.0	56.0	1680	6.0	56.0	2625
6.0	62.1	2100	6.0	62.1	1680	6.0	62.1	2625
6.0	68.1	2100	6.0	68.1	1680	6.0	68.1	2625
6.0	74.2	2100	6.0	74.2	1680	6.0	74.2	2625
6.0	80.2	2100	6.0	80.2	1680	6.0	80.2	2625
6.0	86.3	2100	6.0	86.3	1680	6.0	86.3	2625
6.0	92.3	2100	6.0	92.3	1680	6.0	92.3	2625
8.7	101.0	3740	8.7	101.0	2992	8.7	101.0	4675
6.3	107.3	2300	6.3	107.3	1465	6.3	107.3	3611
6.3	113.7	2300	6.3	113.7	1465	6.3	113.7	3611
6.3	120.0	2300	6.3	120.0	1465	6.3	120.0	3611
7.3	127.3	2300	7.3	127.3	1465	7.3	127.3	3611
7.3	134.7	2300	7.3	134.7	1465	7.3	134.7	3611
7.3	142.0	2300	7.3	142.0	1465	7.3	142.0	3611
7.7	149.7	2850	7.7	149.7	1815	7.7	149.7	4474
7.7	157.3	2850	7.7	157.3	1815	7.7	157.3	4474
7.7	165.0	2850	7.7	165.0	1815	7.7	165.0	4474
7.7	172.7	2850	7.7	172.7	1815	7.7	172.7	4474
7.7	180.3	2850	7.7	180.3	1815	7.7	180.3	4474
7.7	188.0	2850	7.7	188.0	1815	7.7	188.0	4474
6.9	194.9	2700	6.9	194.9	1720	6.9	194.9	4239
6.9	201.8	2700	6.9	201.8	1720	6.9	201.8	4239
6.9	208.7	2700	6.9	208.7	1720	6.9	208.7	4239
6.9	215.6	2700	6.9	215.6	1720	6.9	215.6	4239
6.9	222.5	2700	6.9	222.5	1720	6.9	222.5	4239
6.9	229.3	2700	6.9	229.3	1720	6.9	229.3	4239

6.9	236.2	2700	6.9	236.2	1720	6.9	236.2	4239
6.9	243.1	2700	6.9	243.1	1720	6.9	243.1	4239
6.9	250.0	2700	6.9	250.0	1720	6.9	250.0	4239
9.0	259.0	3450	9.0	259.0	2198	9.0	259.0	5416
9.0	268.0	3450	9.0	268.0	2198	9.0	268.0	5416
8.0	276.0	3400	8.0	276.0	2166	8.0	276.0	5338
8.0	284.0	3400	8.0	284.0	2166	8.0	284.0	5338
8.0	292.0	3400	8.0	292.0	2166	8.0	292.0	5338
8.0	300.0	3300	8.0	300.0	2102	8.0	300.0	5181
8.0	308.0	3300	8.0	308.0	2102	8.0	308.0	5181
8.0	316.0	3300	8.0	316.0	2102	8.0	316.0	5181
8.0	324.0	3300	8.0	324.0	2102	8.0	324.0	5181
8.0	332.0	3300	8.0	332.0	2102	8.0	332.0	5181
8.0	340.0	3300	8.0	340.0	2102	8.0	340.0	5181
8.0	348.0	3300	8.0	348.0	2102	8.0	348.0	5181
8.0	356.0	3300	8.0	356.0	2102	8.0	356.0	5181
8.6	364.6	3550	8.6	364.6	2261	8.6	364.6	5573
8.6	373.2	3550	8.6	373.2	2261	8.6	373.2	5573
8.6	381.8	3550	8.6	381.8	2261	8.6	381.8	5573
8.6	390.4	3550	8.6	390.4	2261	8.6	390.4	5573
8.6	399.0	3550	8.6	399.0	2261	8.6	399.0	5573
7.6	406.6	3350	7.6	406.6	2134	7.6	406.6	5259
7.6	414.2	3350	7.6	414.2	2134	7.6	414.2	5259
7.6	421.8	3350	7.6	421.8	2134	7.6	421.8	5259
7.6	429.4	3350	7.6	429.4	2134	7.6	429.4	5259
7.6	437.0	3350	7.6	437.0	2134	7.6	437.0	5259
10.0	447.0	4200	10.0	447.0	2675	10.0	447.0	6594
10.0	457.0	4200	10.0	457.0	2675	10.0	457.0	6594
10.0	467.0	4200	10.0	467.0	2675	10.0	467.0	6594
10.0	477.0	4200	10.0	477.0	2675	10.0	477.0	6594
10.0	487.0	4200	10.0	487.0	2675	10.0	487.0	6594
10.0	497.0	4200	10.0	497.0	2675	10.0	497.0	6594
3.0	500.0	3350	3.0	500.0	2134	3.0	500.0	5259
28.5	528.5	3350	28.5	528.5	2134	28.5	528.5	5259
28.5	557.0	3350	28.5	557.0	2134	28.5	557.0	5259
80.0	637.0	3800	80.0	637.0	2420	80.0	637.0	5966
80.0	717.0	3800	80.0	717.0	2420	80.0	717.0	5966
80.0	797.0	3800	80.0	797.0	2420	80.0	797.0	5966
90.0	887.0	4600	90.0	887.0	2930	90.0	887.0	7222
90.0	977.0	4600	90.0	977.0	2930	90.0	977.0	7222
90.0	1067.0	4600	90.0	1067.0	2930	90.0	1067.0	7222
90.0	1156.9	4600	90.0	1156.9	2930	90.0	1156.9	7222
62.5	1219.4	5900	62.5	1219.4	3758	62.5	1219.4	9263

62.5	1281.9	5900	62.5	1281.9	3758	62.5	1281.9	9263
62.5	1344.4	5900	62.5	1344.4	3758	62.5	1344.4	9263
62.5	1406.9	5900	62.5	1406.9	3758	62.5	1406.9	9263
62.5	1469.4	7400	62.5	1469.4	4714	62.5	1469.4	9285
62.5	1531.9	7400	62.5	1531.9	4714	62.5	1531.9	9285
62.5	1594.4	7400	62.5	1594.4	4714	62.5	1594.4	9285
62.5	1656.9	7400	62.5	1656.9	4714	62.5	1656.9	9285
75.0	1731.9	5100	75.0	1731.9	3249	75.0	1731.9	8007
75.0	1806.9	5100	75.0	1806.9	3249	75.0	1806.9	8007
100.0	1906.9	7200	100.0	1906.9	4586	100.0	1906.9	9285
100.0	2006.9	6150	100.0	2006.9	3917	100.0	2006.9	9285
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100.0	2506.9	7250	100.0	2506.9	4618	100.0	2506.9	9285
100.0	2606.9	7250	100.0	2606.9	4618	100.0	2606.9	9285
100.0	2706.9	7250	100.0	2706.9	4618	100.0	2706.9	9285
75.0	2781.9	5400	75.0	2781.9	3440	75.0	2781.9	8478
75.0	2856.9	5400	75.0	2856.9	3440	75.0	2856.9	8478
100.0	2956.9	5900	100.0	2956.9	3758	100.0	2956.9	9263
100.0	3056.9	5900	100.0	3056.9	3758	100.0	3056.9	9263
108.3	3165.2	6200	108.3	3165.2	3949	108.3	3165.2	9285
108.3	3273.5	6200	108.3	3273.5	3949	108.3	3273.5	9285
108.3	3381.9	6200	108.3	3381.9	3949	108.3	3381.9	9285
108.3	3490.2	6200	108.3	3490.2	3949	108.3	3490.2	9285
108.3	3598.5	6200	108.3	3598.5	3949	108.3	3598.5	9285
108.3	3706.8	6200	108.3	3706.8	3949	108.3	3706.8	9285
100.0	3806.8	5200	100.0	3806.8	3312	100.0	3806.8	8164
100.0	3906.8	5200	100.0	3906.8	3312	100.0	3906.8	8164
100.0	4006.8	5200	100.0	4006.8	3312	100.0	4006.8	8164
100.0	4106.8	5200	100.0	4106.8	3312	100.0	4106.8	8164
100.0	4206.8	5200	100.0	4206.8	3312	100.0	4206.8	8164
100.0	4306.8	5200	100.0	4306.8	3312	100.0	4306.8	8164
100.0	4406.8	5600	100.0	4406.8	3567	100.0	4406.8	8792
109.7	4516.5	4800	109.7	4516.5	3057	109.7	4516.5	7536
109.7	4626.2	4800	109.7	4626.2	3057	109.7	4626.2	7536
109.7	4735.9	4800	109.7	4735.9	3057	109.7	4735.9	7536
109.7	4845.6	4800	109.7	4845.6	3057	109.7	4845.6	7536
109.7	4955.3	4800	109.7	4955.3	3057	109.7	4955.3	7536
109.7	5065.1	4800	109.7	5065.1	3057	109.7	5065.1	7536
109.7	5174.8	4800	109.7	5174.8	3057	109.7	5174.8	7536
100.0	5274.8	4800	100.0	5274.8	3057	100.0	5274.8	7536

100.0	5374.8	4800	100.0	5374.8	3057	100.0	5374.8	7536
100.0	5474.7	4800	100.0	5474.7	3057	100.0	5474.7	7536
100.0	5574.7	4800	100.0	5574.7	3057	100.0	5574.7	7536
100.0	5674.7	4800	100.0	5674.7	3057	100.0	5674.7	7536
100.0	5774.7	4800	100.0	5774.7	3057	100.0	5774.7	7536
100.0	5874.7	4800	100.0	5874.7	3057	100.0	5874.7	7536
100.0	5974.7	4800	100.0	5974.7	3057	100.0	5974.7	7536
3280.8	9255.6	9285	3280.8	9255.6	9285	3280.8	9255.6	9285



SOIL REPORT FOR CRYSTAL RIVER UNIT 3  
NUCLEAR POWER PLANT – APPENDIX E

Project No.: 30958-129  
Report No.: CR3-13-05-100-001  
Revision No.: 1

## APPENDIX E

Recommended Best Estimate Dynamic Soil Properties  
(Pg. 20 of GZA GeoEnvironmental ISFSI Calculation No. S08-0041)



SOIL REPORT FOR CRYSTAL RIVER UNIT 3  
NUCLEAR POWER PLANT – APPENDIX E

Project No.: 30958-129  
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*Table 12 – Recommended Best Estimate Values for Low Strain Shear and Elastic Modulus*

Elevation of Top of Stratum (ft)	Stratum	Shear Wave Velocity (fps)	Unit Weight (psf)	Poisson's Ratio	Shear Modulus ( $G_{max}$ ) (ksf)	Elastic Modulus ( $E_{max}$ ) (ksf)
121.5	New Fill	900	138	0.35	3,471	9,373
96	Existing Fill	650	120	0.35	1,575	4,251
91.5	Pamlico Terrace Deposits	650	120	0.35	1,575	4,251
88	Upper Decomposed Unit	1200	130	0.33	5,814	15,464
84	Inglis Formation - Cap Rock	2630	131	0.33	28,140	74,853
72	Inglis Formation – DCL/Lower Dolomitized Unit	2100	136	0.33	18,626	49,545
0.7	Avon Park Formation	3740	151	0.33	65,594	174,480



SOIL REPORT FOR CRYSTAL RIVER UNIT 3  
NUCLEAR POWER PLANT – APPENDIX F

Project No.: 30958-129  
Report No.: CR3-13-05-100-001  
Revision No.: 1

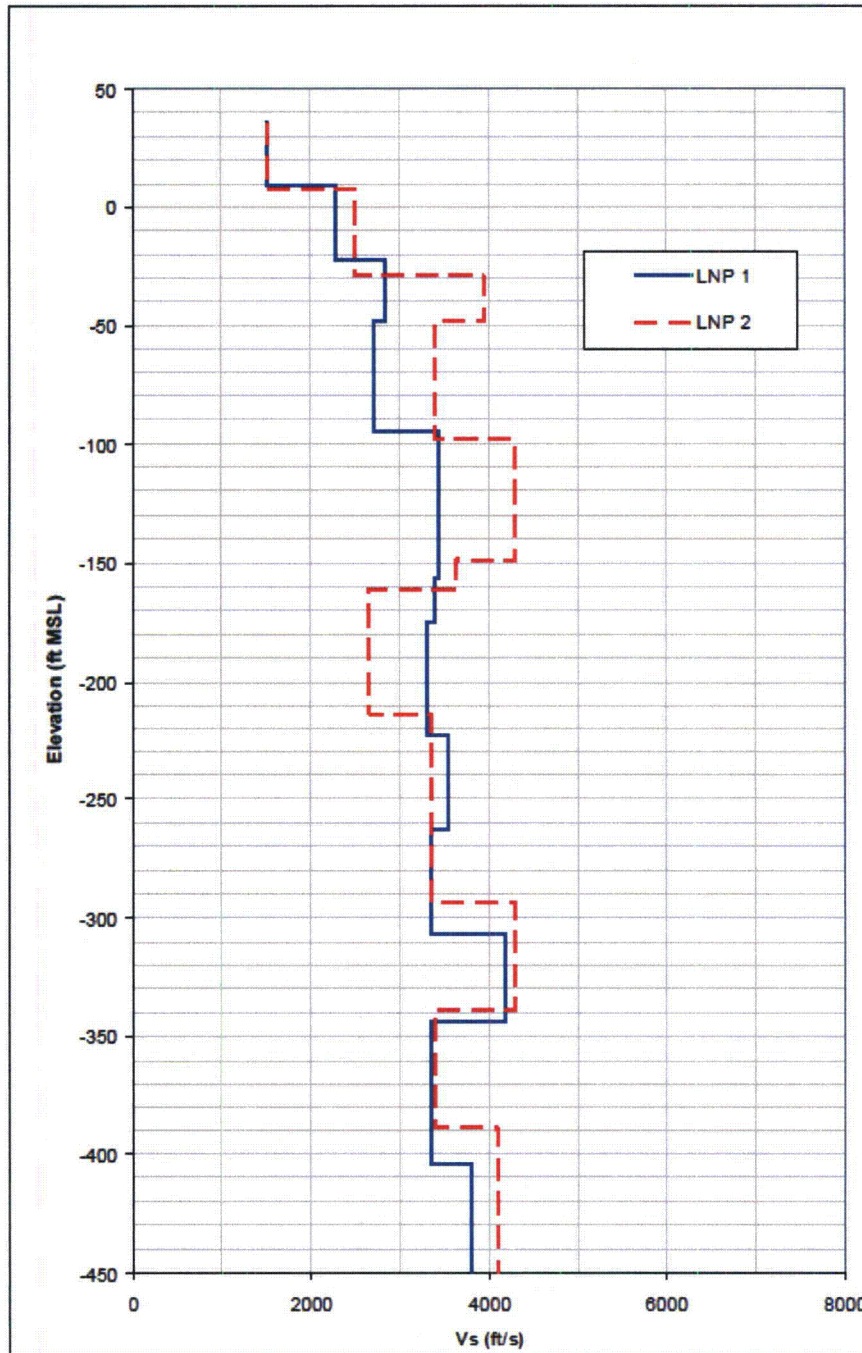
## APPENDIX F

Levy GMRS Shear Wave Velocity Profiles  
(Figure 2.5.2-254 of the Levy COLA)



SOIL REPORT FOR CRYSTAL RIVER UNIT 3  
NUCLEAR POWER PLANT - APPENDIX F

Project No.: 30958-129  
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SOIL REPORT FOR CRYSTAL RIVER UNIT 3  
NUCLEAR POWER PLANT – APPENDIX G

Project No.: 30958-129  
Report No.: CR3-13-05-100-001  
Revision No.: 1

## APPENDIX G

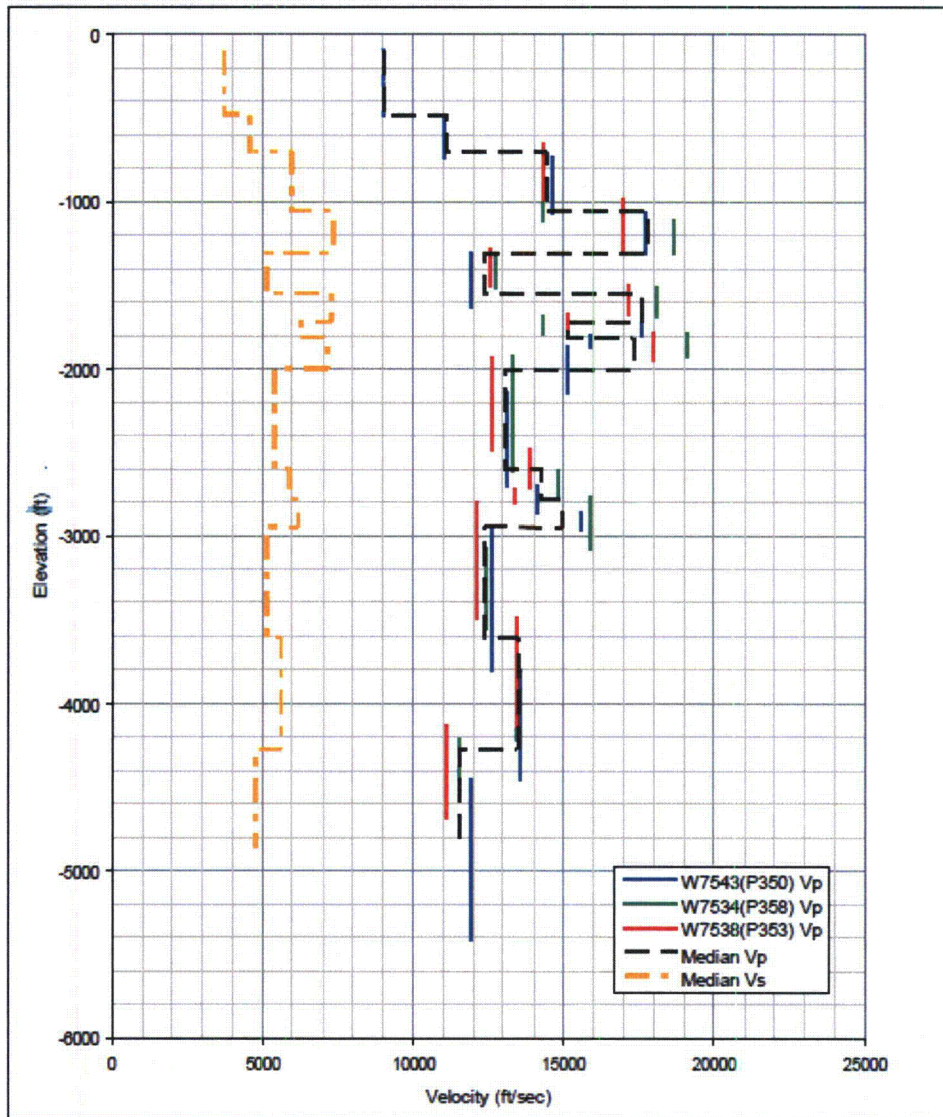
Levy Deep Boring Shear Wave Velocity Profiles  
(Figure 2.5.2-250 of the Levy COLA)



SOIL REPORT FOR CRYSTAL RIVER UNIT 3  
NUCLEAR POWER PLANT – APPENDIX G

Project No.: 30958-129  
Report No.: CR3-13-05-100-001  
Revision No.: 1

LNP COL 2.5-2



Note:

Boring Distance from LNP Site  
W7543(P350) 25 km (15 mi.)  
W7534(P358) 18 km (11 mi.)  
W7538(P353) 11 km (6.8 mi.)

Progress Energy Florida

Levy Nuclear Plant  
Units 1 and 2  
Part 2, Final Safety Analysis Report

Layered Velocity Profiles for Three Deep  
Borings and the Composite  
Median Profiles for  $V_p$  and  $V_s$   
FIGURE 2.5.2-250 Rev 1



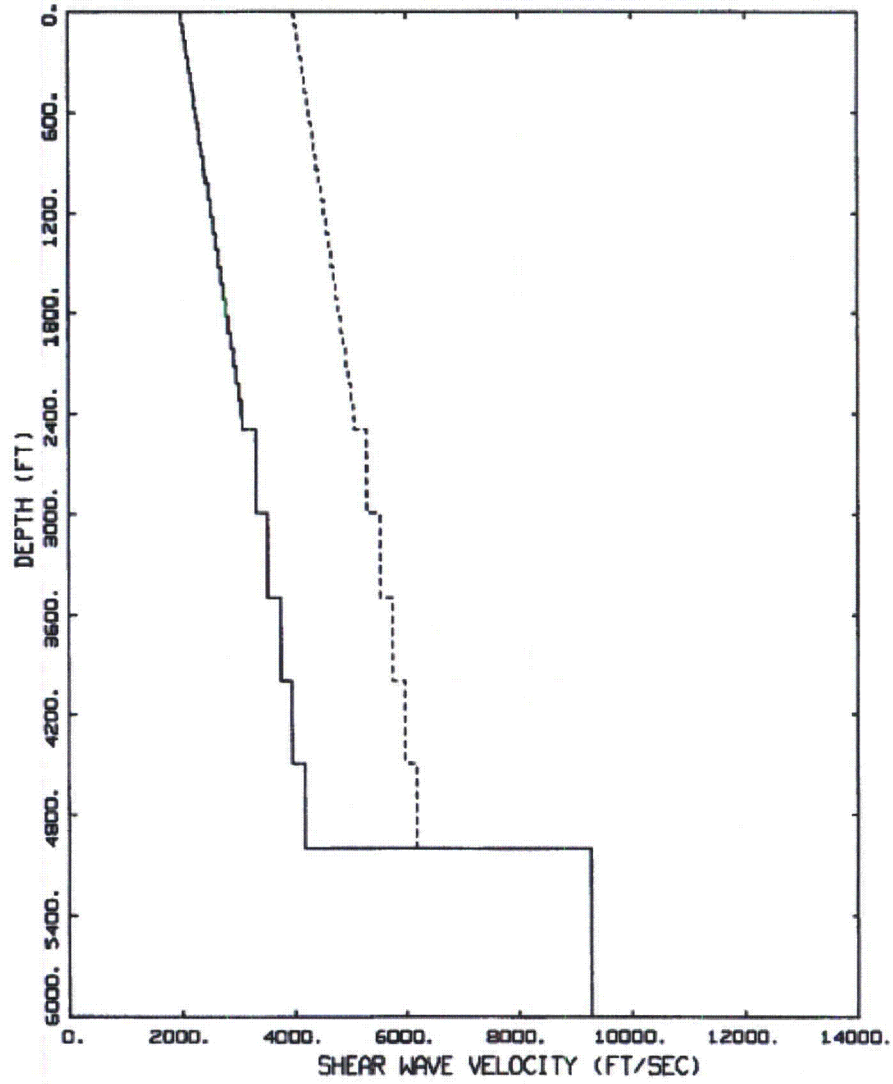
SOIL REPORT FOR CRYSTAL RIVER UNIT 3  
NUCLEAR POWER PLANT – APPENDIX H

Project No.: 30958-129  
Report No.: CR3-13-05-100-001  
Revision No.: 1

## APPENDIX H

EPRI 2008 Velocity Profile

(Figure 4-1 of the EPRI Seismic Hazard Report for Crystal River)



CRYSTAL RIVER

LEGEND  
—— PROFILE P1  
- - - PROFILE P2

Figure 4-1  
Shear-Wave Velocity Profiles for the Crystal River Site.