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OCAN091301

September 12, 2013

U.S. Nuclear Regulatory Commission  
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11555 Rockville Pike  
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SUBJECT: Response to NRC Request for Information (RFI) Pursuant to  
10 CFR 50.54(f) Regarding the Seismic Aspects of Recommendation 2.1  
of the Near-Term Task Force (NTTF) Review of Insights from the  
Fukushima Dai-ichi Accident – 1.5-Year Response for Central and  
Eastern United States (CEUS) Sites  
Arkansas Nuclear One – Units 1 and 2  
Docket Nos. 50-313 and 50-368  
License Nos. DPR-51 and NPF-6

- REFERENCES:
1. NRC Letter to Entergy, *RFI Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3 of the NTTF Review of Insights from the Fukushima Dai-ichi Accident*, dated March 12, 2012 (OCNA031208) (ML12053A340)
  2. NRC Letter, *Endorsement of Electric Power Research Institute (EPRI) Final Draft Report 1025287, Seismic Evaluation Guidance*, dated February 15, 2013 (ML12319A074)
  3. EPRI Report 1025287, *Seismic Evaluation Guidance: Screening, Prioritization and Implementation Details for the Resolution of Fukushima NTTF Recommendation 2.1: Seismic* (ML12333A170)
  4. Nuclear Energy Institute (NEI) Letter to NRC, *Proposed Path Forward for NTTF Recommendation 2.1: Seismic Reevaluations*, dated April 9, 2013 (ML13101A345)
  5. NRC Letter, EPRI Final Draft Report XXXXXX, *Seismic Evaluation Guidance: Augmented Approach for the Resolution of Fukushima NTTF Recommendation 2.1: Seismic, as an Acceptable Alternative to the March 12, 2012, Information Request for Seismic Reevaluations*, dated May 7, 2013 (ML13106A331)

6. Entergy letter to NRC, *Response to NRC RFI 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*, dated April 29, 2013 (OCAN041306)

Dear Sir or Madam:

On March 12, 2012, the NRC issued Reference 1 to all power reactor licensees. Enclosure 1 of Reference 1 requested each addressee in the 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 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, with the remaining seismic hazard and screening information submitted to NRC by March 31, 2014. In Reference 5, NRC agreed with this recommendation. Reference 6 contained Entergy's commitment to follow the approach described in Reference 4.

The attachment to this letter contains the requested descriptions of subsurface materials and properties and base case velocity profiles for Arkansas Nuclear One (ANO). The information provided in the attachment 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 ANO will be provided to the NRC in the seismic hazard submittal by March 31, 2014, in accordance with Reference 5.

This letter contains no new regulatory commitments. Should you have any questions regarding this submittal, please contact Stephenie Pyle at 479.858.4704.

I declare under penalty of perjury that the foregoing is true and correct; executed on September 12, 2013.

Sincerely,

***Original signed by Jeremy G. Browning***

JGB/nbm

Attachment: ANO Descriptions of Subsurface Materials and Properties and Base Case Velocity Profiles

cc: Mr. Steven A. Reynolds  
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**Attachment to**

**0CAN091301**

**Arkansas Nuclear One (ANO) Descriptions of Subsurface Materials and Properties  
and Base Case Velocity Profiles**

## **ANO Descriptions of Subsurface Materials and Properties and Base Case Velocity Profiles**

The basic information used to create the site geologic profile at the Arkansas Nuclear One was taken from Reference 1, with the following description:

*"The reactor containment building is founded on shale of the McAlester Formation with embedment depth of around 26 ft. with tendon galleries of about 36 ft. below grade. Basement rock is estimated to be at a depth of 5,000 ft...(The) site shear-wave (S-wave) velocity of 5,350 fps (was) calculated using a Poisson's ratio of 0.30 and the range of values of the compressional-wave (P-wave) velocity from 10,000 to 14,500 fps for McAlester shale. The Unit 1 SAR indicates the site seismic P-wave varies from 11,000 to 14,500 fps (ref. U1 SAR Fig. 2-21 & 2-30), and per Tables 2-2 & 2-5 Poisson's ratio of 0.18 for 'rock' and 0.25 for 'shale' at the site. The Unit 1 SAR does not specifically provide a S-wave velocity. The U2 SAR indicates site P-wave velocities form 10,000 to 14,500 fps, and S-wave (not measured but calculated P-wave of 10,000 fps and a Poisson's ration of 0.30) of 5,350 fps ...SAR figures 2-21 (Unit 1) & 2.5-21 (Unit 2) shows the site seismic profiles (for practical purposes, both of these SAR figures are identical)...(this description) is correct and agrees with the soil profile data in the ANO Units 1 & 2 Safety Analysis Report (SAR) Amendment 24."*

The safe-shutdown earthquake Control Point is defined at the surface, and the profile was modeled up to the surface. For dynamic properties of rock layers, modulus and damping curves were represented with 2 models. The first model used rock curves taken from Reference 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 Reference 2; the second model used soil curves taken from Reference 3 and Reference 4. These dynamic property models were weighted equally. To model the profile, rock modulus and damping curves from Reference 2 were paired with soil modulus and damping curves from Reference 2, and linear rock modulus and damping curves were paired with soil modulus and damping curves from Reference 3 and Reference 4.

The three 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 1.

References

1. Entergy (2012), *Electric Power Research Institute (EPRI) Data Request for Site Amplification Calculations, Arkansas Nuclear One-Units 1 & 2*, Informal report transmitted from Entergy to EPRI in July, 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 (ML042310562)
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

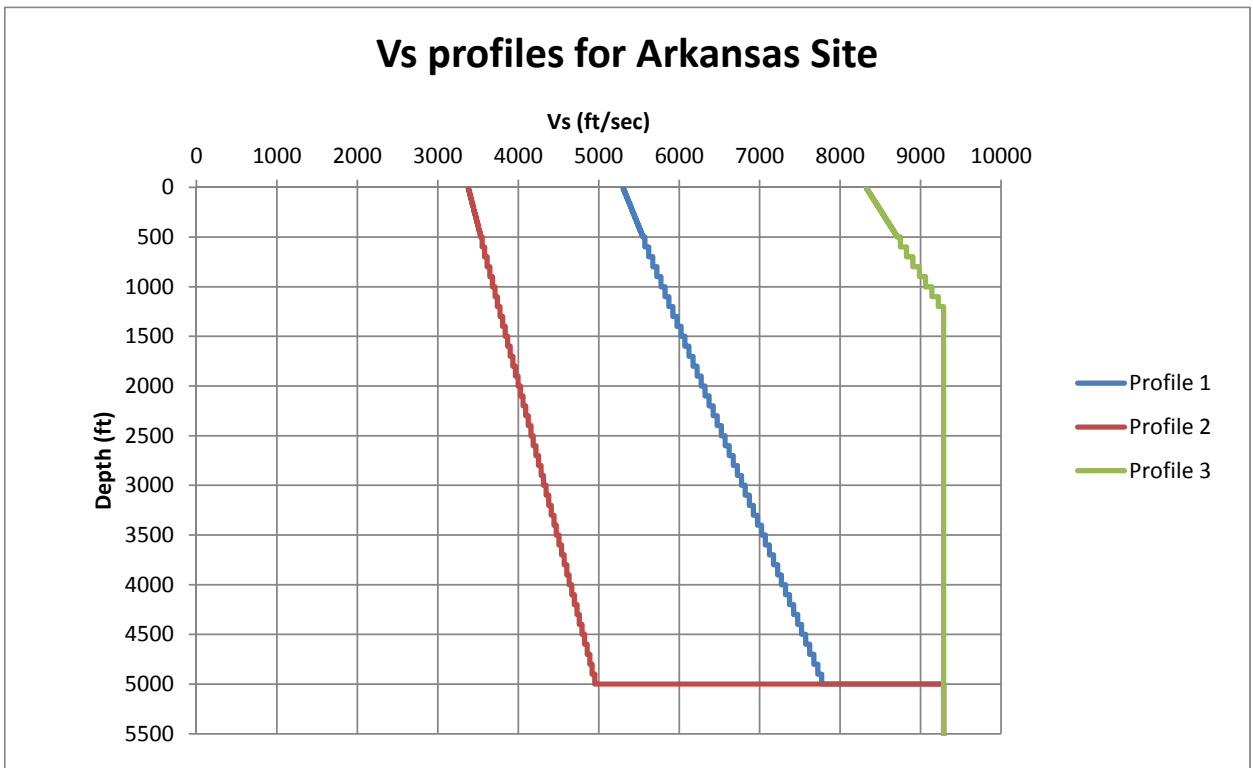


Figure 1. Vs profiles for Arkansas site

Table 1  
 Layer thicknesses, depths, and Vs for 3 profiles, Arkansas 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	5302		0	3378		0	8325
10.0	10.0	5302	10.0	10.0	3378	10.0	10.0	8325
10.0	20.0	5307	10.0	20.0	3381	10.0	20.0	8332
10.0	30.0	5312	10.0	30.0	3384	10.0	30.0	8340
10.0	40.0	5317	10.0	40.0	3387	10.0	40.0	8348
10.0	50.0	5322	10.0	50.0	3390	10.0	50.0	8356
10.0	60.0	5327	10.0	60.0	3393	10.0	60.0	8364
10.0	70.0	5332	10.0	70.0	3397	10.0	70.0	8372
10.0	80.0	5337	10.0	80.0	3400	10.0	80.0	8379
10.0	90.0	5342	10.0	90.0	3403	10.0	90.0	8387
10.0	100.0	5347	10.0	100.0	3406	10.0	100.0	8395
10.0	110.0	5352	10.0	110.0	3409	10.0	110.0	8403
10.0	120.0	5357	10.0	120.0	3413	10.0	120.0	8411
10.0	130.0	5362	10.0	130.0	3416	10.0	130.0	8419
10.0	140.0	5367	10.0	140.0	3419	10.0	140.0	8427
10.0	150.0	5372	10.0	150.0	3422	10.0	150.0	8434
10.0	160.0	5377	10.0	160.0	3425	10.0	160.0	8442
10.0	170.0	5382	10.0	170.0	3428	10.0	170.0	8450
10.0	180.0	5387	10.0	180.0	3432	10.0	180.0	8458
10.0	190.0	5392	10.0	190.0	3435	10.0	190.0	8466
10.0	200.0	5397	10.0	200.0	3438	10.0	200.0	8474
10.0	210.0	5402	10.0	210.0	3441	10.0	210.0	8481
10.0	220.0	5407	10.0	220.0	3444	10.0	220.0	8489
10.0	230.0	5412	10.0	230.0	3448	10.0	230.0	8497
10.0	240.0	5417	10.0	240.0	3451	10.0	240.0	8505
10.0	250.0	5422	10.0	250.0	3454	10.0	250.0	8513
10.0	260.0	5427	10.0	260.0	3457	10.0	260.0	8521
10.0	270.0	5432	10.0	270.0	3460	10.0	270.0	8529
10.0	280.0	5437	10.0	280.0	3464	10.0	280.0	8536
10.0	290.0	5442	10.0	290.0	3467	10.0	290.0	8544
10.0	300.0	5447	10.0	300.0	3470	10.0	300.0	8552
10.0	310.0	5452	10.0	310.0	3473	10.0	310.0	8560
10.0	320.0	5457	10.0	320.0	3476	10.0	320.0	8568
10.0	330.0	5462	10.0	330.0	3479	10.0	330.0	8576
10.0	340.0	5467	10.0	340.0	3483	10.0	340.0	8584
10.0	350.0	5472	10.0	350.0	3486	10.0	350.0	8591
10.0	360.0	5477	10.0	360.0	3489	10.0	360.0	8599
10.0	370.0	5482	10.0	370.0	3492	10.0	370.0	8607

10.0	380.0	5487	10.0	380.0	3495	10.0	380.0	8615
10.0	390.0	5492	10.0	390.0	3499	10.0	390.0	8623
10.0	400.0	5497	10.0	400.0	3502	10.0	400.0	8631
10.0	410.0	5502	10.0	410.0	3505	10.0	410.0	8638
10.0	420.0	5507	10.0	420.0	3508	10.0	420.0	8646
10.0	430.0	5512	10.0	430.0	3511	10.0	430.0	8654
10.0	440.0	5517	10.0	440.0	3514	10.0	440.0	8662
10.0	450.0	5522	10.0	450.0	3518	10.0	450.0	8670
10.0	460.0	5527	10.0	460.0	3521	10.0	460.0	8678
10.0	470.0	5532	10.0	470.0	3524	10.0	470.0	8686
10.0	480.0	5537	10.0	480.0	3527	10.0	480.0	8693
10.0	490.0	5542	10.0	490.0	3530	10.0	490.0	8701
10.0	500.0	5547	10.0	500.0	3534	10.0	500.0	8709
100.0	600.0	5572	100.0	600.0	3550	100.0	600.0	8748
100.0	700.0	5622	100.0	700.0	3581	100.0	700.0	8827
100.0	800.0	5672	100.0	800.0	3613	100.0	800.0	8905
100.0	899.9	5722	100.0	899.9	3645	100.0	899.9	8984
100.0	999.9	5772	100.0	999.9	3677	100.0	999.9	9062
100.0	1099.9	5822	100.0	1099.9	3709	100.0	1099.9	9141
100.0	1199.9	5872	100.0	1199.9	3741	100.0	1199.9	9219
100.0	1299.9	5922	100.0	1299.9	3772	100.0	1299.9	9285
100.0	1399.9	5972	100.0	1399.9	3804	100.0	1399.9	9285
100.0	1499.9	6022	100.0	1499.9	3836	100.0	1499.9	9285
100.0	1599.9	6072	100.0	1599.9	3868	100.0	1599.9	9285
100.0	1699.9	6122	100.0	1699.9	3900	100.0	1699.9	9285
100.0	1799.9	6172	100.0	1799.9	3932	100.0	1799.9	9285
100.0	1899.9	6222	100.0	1899.9	3964	100.0	1899.9	9285
100.0	1999.9	6272	100.0	1999.9	3995	100.0	1999.9	9285
100.0	2099.9	6322	100.0	2099.9	4027	100.0	2099.9	9285
100.0	2199.9	6372	100.0	2199.9	4059	100.0	2199.9	9285
100.0	2299.9	6422	100.0	2299.9	4091	100.0	2299.9	9285
100.0	2399.9	6472	100.0	2399.9	4123	100.0	2399.9	9285
100.0	2499.9	6522	100.0	2499.9	4155	100.0	2499.9	9285
100.0	2599.9	6572	100.0	2599.9	4186	100.0	2599.9	9285
100.0	2699.9	6622	100.0	2699.9	4218	100.0	2699.9	9285
100.0	2799.8	6672	100.0	2799.8	4250	100.0	2799.8	9285
100.0	2899.8	6722	100.0	2899.8	4282	100.0	2899.8	9285
100.0	2999.8	6772	100.0	2999.8	4314	100.0	2999.8	9285
100.0	3099.8	6822	100.0	3099.8	4346	100.0	3099.8	9285
100.0	3199.8	6872	100.0	3199.8	4378	100.0	3199.8	9285
100.0	3299.8	6922	100.0	3299.8	4409	100.0	3299.8	9285
100.0	3399.8	6972	100.0	3399.8	4441	100.0	3399.8	9285

100.0	3499.8	7022	100.0	3499.8	4473	100.0	3499.8	9285
100.0	3599.8	7072	100.0	3599.8	4505	100.0	3599.8	9285
100.0	3699.8	7122	100.0	3699.8	4537	100.0	3699.8	9285
100.0	3799.8	7172	100.0	3799.8	4569	100.0	3799.8	9285
100.0	3899.8	7222	100.0	3899.8	4600	100.0	3899.8	9285
100.0	3999.8	7272	100.0	3999.8	4632	100.0	3999.8	9285
100.0	4099.8	7322	100.0	4099.8	4664	100.0	4099.8	9285
100.0	4199.8	7372	100.0	4199.8	4696	100.0	4199.8	9285
100.0	4299.8	7422	100.0	4299.8	4728	100.0	4299.8	9285
100.0	4399.8	7472	100.0	4399.8	4760	100.0	4399.8	9285
100.0	4499.8	7522	100.0	4499.8	4792	100.0	4499.8	9285
100.0	4599.8	7572	100.0	4599.8	4823	100.0	4599.8	9285
100.0	4699.8	7622	100.0	4699.8	4855	100.0	4699.8	9285
100.0	4799.7	7672	100.0	4799.7	4887	100.0	4799.7	9285
100.0	4899.7	7722	100.0	4899.7	4919	100.0	4899.7	9285
100.0	4999.7	7772	100.0	4999.7	4951	100.0	4999.7	9285
3280.8	8280.6	9285	3280.8	8280.6	9285	3280.8	8280.6	9285