PMFermiCOLPEm Resource

From: Norman K Peterson [petersonn@dteenergy.com]
Sent: Friday, August 09, 2013 4:32 PM
To: Eudy, Michael; Muniz, Adrian; Govan, Tekia
Cc: Michael K Brandon; barry.bryant@dom.com; Regina Borsh (Generation - 6)
Subject: DTE Response to NRC RAI Letter 87 (NRC3-13-0027)
Attachments: NRC3-13-0027.pdf

Please see attached.

Tekia: A hard copy with Attachment 3 has been overnighted to you.

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DTE Energy

10 CFR 52.79

August 9, 2013
NRC3-13-0027

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

References:
1) Fermi 3
Docket No. 52-033
2) Letter from Tekia Govan (USNRC) to Peter W. Smith (DTE Electric), "Request for Additional Information Letter No. 87 Related to Chapters 02.05.02 and 03.07.01 for the Fermi 3 Combined License Application," dated July 10, 2013

Subject: DTE Electric Company Response to NRC Request for Additional Information Letter No. 87

In Reference 2, the NRC requested additional information to support the review of certain portions of the Fermi 3 Combined License Application (COLA). The Request for Additional Information (RAI) in Reference 2 is related to the revised site-specific soil-structure interaction (SSI) seismic inputs for Fermi 3. The response to RAI 02.05.02-21 is provided in Attachment 1. Attachment 2 provides a markup of the Fermi 3 COLA resulting from the response provided in Attachment 1.

Attachment 3 contains a CD with data files requested by the NRC staff. The file format and names on the CD do not comply with the requirements for electronic submission in the NRC Guidance Document, "Guidance for Electronic Submission to the NRC," Revision 6, dated May 17, 2010; the files are not "pdf' formatted. The NRC staff requested the files be submitted in their native formats required by the software in which they are utilized in order to support NRC review of the Fermi 3 COLA.

If you have any questions, or need additional information, please contact me at (313) 235-3341.

I state under penalty of perjury that the foregoing is true and correct. Executed on the 9th day of August 2013.

Sincerely,

Peter W. Smith, Director
Nuclear Development – Licensing and Engineering
DTE Electric Company

Attachments:
1) Response to RAI Letter No. 87 (Question No. 02.05.02-21)
2) Markup of Fermi 3 COLA
3) One CD Containing Requested Electronic Files

cc: Adrian Muniz, NRC Fermi 3 Project Manager (w/o Attachment 3)
Tekia Govan, NRC Fermi 3 Project Manager
Michael Eudy, NRC Fermi 3 Project Manager (w/o Attachment 3)
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Michigan Department of Natural Resources and Environment
Radiological Protection Section (w/o attachments)
Regina A. Borsh, Dominion Energy, Inc. (w/o Attachment 3)
Barry C. Bryant, Dominion Energy, Inc. (w/o Attachment 3)

Attachment 1
NRC3-13-0027
(8 pages)

Response to RAI Letter No. 87
(eRAI Tracking No. 7170)

RAI Question No. 02.05.02-21

NRC RAI 02.05.02-21

10 CFR Part 100, Appendix A requires the determination of the static and dynamic engineering properties of the materials underlying the site, which should include properties needed to determine the behavior of the underlying material during earthquakes and the characteristics of the underlying material in transmitting earthquake-induced motions to the foundations of the plant. FSAR Section 3.7.1.1.4.1.1 (provided as markups of FSAR Section 3.7.1, April 26, 2013) describes the dynamic properties of the engineered granular backfill above the bedrock; however, in order to satisfy the requirements of 10 CFR Part 100, Appendix A, please provide the information described below.

(a) *In FSAR Section 3.7.1.1.4.1.1 you state that the shear-wave velocity values for the engineered granular backfill are based on empirical relationships for angular-grained material from Richart et al. (1970) and for sandy gravelly soils from Menq (2003). However, the FSAR only states that the lower range (LR) and upper range (UR) profiles represent the envelope of the six shear-wave velocity profiles described above for the empirical relationships of Richart et al. (1970) and Menq (2003. Please provide details regarding how the UR and LR profiles are each developed from these six individual shear-wave velocity profiles, which is not described in the FSAR.*
(b) *Please provide electronic versions of the six individual profiles shear-wave velocity profiles.*
(c) *Please provide the standard deviation [i.e. sigma ln(Vs)] for UR, IR, and LR shear-wave velocity profiles*
(d) *FSAR Figure 3.7.1-203 presents the modulus and damping relationships for the various depth ranges (i.e. between 0 ft and 36 ft) for the Menq (2003) shear modulus reduction and damping curves, which represents the LR, as well as the EPRI (1993), which represents the UR, shear modulus reduction and damping relationships. Please provide these curves electronically.*
(e) *FSAR Figure 3.7.1-210 shows the site response logic tree used to compute the mean amplification functions. According to this figure, the LR velocity profile (paired with the Menq (2003) shear modulus reduction and damping curves) is assigned a weight of 0.15, the IR velocity profile (paired with the average of the UR and LR curves) is assigned a weight of 0.50, and the UR velocity profile (paired with the EPRI (1993) curves) is assigned a weight of 0.35. Please provide a justification for this weighting scheme.*

Response

Part (a)

FSAR Subsection 3.7.1.1.4.1.1 provides the empirical relationships and material properties used to determine a total of six shear wave velocity profiles. Two of the shear wave velocity profiles use the empirical relationship of Richart et al. (FSAR Reference 3.7.1-203) and four of the shear wave velocity profiles use the empirical relationship of Menq (FSAR Reference 3.7.1-204). The lower-range (LR) site response analysis profile described in FSAR Subsection 3.7.1.1.4.1.1 represents the smallest shear wave velocity for each depth interval from the six shear wave velocity profiles calculated using the empirical relationships of Richart et al. and Menq. The upper-range (UR) site response analysis profile described in FSAR Subsection 3.7.1.1.4.1.1 represents the largest shear wave velocity for each depth interval from the six shear wave velocity profiles calculated using the empirical relationships of Richart et al. and Menq. Use of the smallest and largest shear wave velocities create LR and UR site response analysis profiles that bound all of the values from the six calculated shear wave velocity profiles. The FSAR text will be changed to provide clarification as shown in the markup in Attachment 2.

Part (b)

Electronic versions of the six individual shear wave velocity profiles are provided in the file entitled "Part_B_Six_Shear_Wave_Velocity_Profiles Rev 0.xlsx" contained on the CD in Attachment 3. The individual shear wave velocity profiles for the backfill above the bedrock are provided in the spreadsheet on the tab labeled "Shear_Wave_Velocity_Profiles." Columns B through E of the spreadsheet provide the depth and shear wave velocity (V_s) for the two shear wave velocity profiles calculated using the empirical relationship of Richart et al. Columns F through M provide the four shear wave velocity profiles calculated using the empirical relationship of Menq. Abbreviations are defined and units are provided in Column O.

Table 1 below provides the shear wave velocity profiles from the electronic file contained on the CD in Attachment 3.

Table 1
Shear Wave Velocity Profiles

Richart et al. (FSAR Reference 3.7.1-203)				Menq (FSAR Reference 3.7.1-204)							
e=0.18, phi=50, wt=146		e=0.54, phi=35, wt=119		Cu=3, D50=8, wt=119, e=0.54		Cu=200, D50=8, wt=146, e=0.18		Cu=52.31, D50=12.7, wt=146, e=0.3		Cu=71.43, D50=3.3, wt=146, e=0.26	
Depth (ft)	V_s (ft/s)	Depth (ft)	V_s (ft/s)	Depth (ft)	V_s (ft/s)	Depth (ft)	V_s (ft/s)	Depth (ft)	V_s (ft/s)	Depth (ft)	V_s (ft/s)
0	670	0	418	0	397	0	625	0	594	0	472
2.9	670	2.9	418	2.9	397	2.9	625	2.9	594	2.9	472
2.9	722	2.9	550	2.9	531	2.9	702	2.9	658	2.9	525
5.8	722	5.8	550	5.8	531	5.8	702	5.8	658	5.8	525
5.8	773	5.8	639	5.8	622	5.8	781	5.8	724	5.8	578
10	773	10	639	10	622	10	781	10	724	10	578
10	818	10	703	10	689	10	852	10	781	10	626
13.2	818	13.2	703	13.2	689	13.2	852	13.2	781	13.2	626
13.2	842	13.2	734	13.2	721	13.2	892	13.2	814	13.2	653
15.7	842	15.7	734	15.7	721	15.7	892	15.7	814	15.7	653
15.7	867	15.7	755	15.7	743	15.7	932	15.7	846	15.7	679
20	867	20	755	20	743	20	932	20	846	20	679
20	901	20	781	20	769	20	990	20	892	20	718
25	901	25	781	25	769	25	990	25	892	25	718
25	934	25	806	25	796	25	1046	25	937	25	755
30	934	30	806	30	796	30	1046	30	937	30	755
30	964	30	829	30	820	30	1098	30	979	30	789
35	964	35	829	35	820	35	1098	35	979	35	789
35	991	35	850	35	842	35	1147	35	1017	35	821
40	991	40	850	40	842	40	1147	40	1017	40	821

Notes:

- ft = feet
- ft/s = feet per second
- e = void ratio
- phi = the effective angle of internal friction in degrees
- wt = unit weight/density in pounds per cubic foot
- Cu = uniformity coefficient
- D50 = median grain size at 50 percent passing in millimeters

Part (c)

A standard deviation (sigma) value of 0.2 is used for the natural log of the shear wave velocity (ln [V_s]) for the upper range (UR), intermediate range (IR), and lower range (LR) site response analysis profiles. As an example, FSAR Figure 3.7.1-206 graphically presents the standard deviation value for ln [V_s] used in the IR site response analysis.

Part (d)

Electronic versions of the IR, LR, and UR shear modulus reduction and damping curves are provided in the file entitled "Part_D_Modulus_Reduction_Damping Rev 0.xlsx" contained on the CD in Attachment 3. The IR, LR, and UR shear modulus reduction and damping curves are provided in the spreadsheet on the tabs labeled "Modulus_Reduction" and "Damping", respectively. FSAR Subsection 3.7.1.1.4.1.1.2 describes the development of the shear modulus and damping relationships. Columns C, D, and E of the spreadsheet on the "Modulus_Reduction" tab provide the IR, LR, and UR modulus reduction values for the 0 to 20 feet depth range as a ratio of shear modulus (G) to the small-strain shear modulus (G_{max}). Columns H, I, and J of the spreadsheet on the "Modulus_Reduction" tab provide the IR and LR modulus reduction values for the 20 to 37.6 feet depth range, and the UR modulus reduction values for the 20 to 50 feet depth range as a ratio of G to G_{max}. Columns C, D, and E of the spreadsheet on the "Damping" tab provide the IR, LR, and UR damping values for the 0 to 20 feet depth range as a percent damping value. Columns H, I, and J of the spreadsheet on the "Damping" tab provide the IR and LR damping values for the 20 to 37.6 foot depth range, and the UR damping values for the 20 to 50 feet depth range as a percent damping value. Columns B and G of the spreadsheets on both tabs provide the corresponding cyclic shear strains as a percent value.

Tables 2 and 3 below provide the rounded shear modulus reduction and damping values, respectively, for the engineered granular backfill from the electronic file contained on the CD in Attachment 3.

Table 2
Shear Modulus Reduction Values – Engineered Granular Backfill

Depth Range(s):	0 to 20 feet				Depth Range(s):	20 to 37.6 feet		20 to 50 feet
	Intermediate-Range	Lower-Range (Menq)	Upper-Range (EPRI)			Intermediate-Range	Lower-Range (Menq)	Upper-Range (EPRI)
Strains (%)	G/G_{max}	G/G_{max}	G/G_{max}		Strains (%)	G/G_{max}	G/G_{max}	G/G_{max}
0.0001	0.98	0.970	1.00		0.0001	0.99	0.977	1.00
0.0003	0.96	0.929	1.00		0.0003	0.97	0.944	1.00
0.001	0.90	0.830	0.98		0.001	0.92	0.859	0.99
0.003	0.79	0.666	0.91		0.003	0.83	0.707	0.95
0.01	0.59	0.428	0.75		0.01	0.64	0.465	0.82
0.03	0.37	0.234	0.51		0.03	0.43	0.256	0.61
0.1	0.19	0.103	0.27		0.1	0.24	0.110	0.36
0.3	0.08	0.045	0.12		0.3	0.11	0.047	0.17
1	0.03	0.017	0.04		1	0.04	0.017	0.06

Notes:

G = shear modulus
G_{max} = small-strain shear modulus

Table 3
Damping Values – Engineered Granular Backfill

Depth Range(s):	0 to 20 feet				Depth Range(s):	20 to 37.6 feet		20 to 50 feet
	Intermediate-Range	Lower-Range (Menq)	Upper-Range (EPRI)			Intermediate-Range	Lower-Range (Menq)	Upper-Range (EPRI)
Strains (%)	Damping (%)	Damping (%)	Damping (%)		Strains (%)	Damping (%)	Damping (%)	Damping (%)
0.0001	1.12	0.83	1.40		0.0001	0.98	0.76	1.20
0.0003	1.35	1.20	1.50		0.0003	1.13	1.07	1.20
0.001	2.07	2.35	1.80		0.001	1.73	2.05	1.40
0.003	3.81	4.82	2.80		0.003	3.19	4.28	2.10
0.01	7.09	9.18	5.00		0.01	6.12	8.65	3.60
0.03	12.15	15.00	9.30		0.03	10.03	13.05	7.00
0.1	15.00	15.00	15.00		0.1	13.70	15.00	12.40
0.3	15.00	15.00	15.00		0.3	15.00	15.00	15.00
1	15.00	15.00	15.00		1	15.00	15.00	15.00

Part (e)

The assigned weights presented in FSAR Figure 3.7.1-210 for the Fermi 3 LR, IR, and UR site response analysis profiles have not been modified from previous FSAR revisions and are based on the anticipated material properties of the engineered granular backfill.

The requirements for the engineered granular backfill at the Fermi 3 site are described in Fermi 3 FSAR Subsection 2.5.4.5.4.2 as follows:

> "The Fermi 3 engineered granular backfill surrounding the Seismic Category I structures will meet the following Referenced DCD requirements:
>
> i. Product of peak ground acceleration α (in g), Poisson's ratio ν and density γ
>
> $\alpha(0.95\nu + 0.65)\gamma$: 1220 kg/m^3 (76 lb$_f$/ft^3) maximum
>
> ii. An angle of internal friction equal to or greater than 35 degrees when properly placed and compacted.
>
> iii. Soil density
>
> γ: 2000 kg/m^3 (125 lb$_f$/ft^3) minimum"

The minimum soil density required is 125 pounds per cubic foot (lb$_f$/ft^3); therefore, the Fermi 3 LR site response analysis profile is given the lowest weight (0.15) since it assumes a soil density of 119 lb$_f$/ft^3. A soil density of 119 lb$_f$/ft^3 is considered to assess a wide range of soil properties, but is less than the required minimum soil density and is lower than expected during placement of the well-graded engineered granular backfill. The Fermi 3 IR site response analysis profile is given the highest weight (0.5) since it assumes a soil density of 132.5 lb$_f$/ft^3. A soil density of 132.5 lb$_f$/ft^3 exceeds the required minimum soil density and is considered reasonably achievable for the engineered granular backfill following controlled placement and compaction consistent with FSAR Subsection 2.5.4.5.4.2. The Fermi 3 UR site response analysis profile is given an intermediate weight (0.35) since it assumes a soil density of 146 lb$_f$/ft^3. A soil density of 146 lb$_f$/ft^3 is considered achievable but is at the high end of likely material properties. Based on the densities of the Fermi 3 LR, IR, and UR site response analysis profiles, the IR is given the highest weight, the UR is given an intermediate weight, and the LR is given the lowest weight.

Six shear wave velocity profiles were calculated for the engineered granular backfill at the Fermi 3 site using two empirical relationships and a range of material properties to assess the potential variability of the engineered granular backfill shear wave velocities (FSAR Subsection 3.7.1.1.4.1.1). The shear wave velocity profiles documented in Tables 2.5.4-10 and 2.5.4-10a of the Vogtle Early Site Permit (ESP) Application (Reference 1) were compared to the calculated Fermi 3 LR, IR, and UR shear wave velocity profiles to demonstrate the estimated shear wave velocities and assigned weights are reasonable for each of the Fermi 3 site response analysis profiles. The following is stated in Reference 1 regarding the data provided in Tables 2.5.4-10 and 2.5.4-10a:

a. "Data for existing Units 1 and 2 is used (Bechtel 1984), and the backfill shear wave velocity values are summarized in Table 2.5.4-10."
b. "A shear wave velocity profile was calculated based on field measurements of velocity in the test pad and in laboratory samples. This profile is discussed in Section 2.5.4.7.1.1 and is presented in Table 2.5.4-10a."

The Vogtle ESP indicates the groundwater table is deeper than the 11.5 meter (37.6 feet) thickness of the Fermi 3 engineered granular backfill and the maximum historical high groundwater level elevation at the Fermi 3 site, which is at Elevation 175.6 meters (576.11 feet) NAVD 88 or about 13.2 feet below the finished ground level grade of Elevation 179.6 meters (589.3 feet) NAVD 88. To facilitate comparing the Vogtle ESP data with the Fermi 3 shear wave velocity profiles estimated with the two methods used for Fermi 3, the LR, IR, and UR shear wave velocity profiles discussed in Parts (a) and (b) of this response were recalculated with the groundwater table at a depth of more than 40 feet below the finished ground level grade. On Figure 1 of this response, the adjusted Fermi 3 LR, IR, and UR shear wave velocity profiles, recalculated with the groundwater table deeper than 11.5 meters (37.6 feet), are compared to the shear wave velocity profiles documented in Tables 2.5.4-10 and 2.5.4-10a of the Vogtle ESP.

Figure 1 demonstrates that the Vogtle ESP shear wave velocity profiles are most similar to the adjusted Fermi 3 IR shear wave velocity profile based on the following observations

1. The Vogtle ESP shear wave velocity profile in Table 2.5.4-10 exceeds the adjusted Fermi 3 IR shear wave velocity profile from about 6 to 25 feet below grade by up to about 75 feet per second.
2. From a depth of 25 to 40 feet, the Vogtle ESP shear wave velocity profile in Table 2.5.4-10 is very similar to the adjusted Fermi 3 IR profile, being only up to about 20 feet per second less than the adjusted Fermi 3 IR shear wave velocity.
3. The Vogtle ESP shear wave velocity profile in Table 2.5.4-10a exceeds the adjusted Fermi 3 IR shear wave velocity profile from about 3 to 30 feet below grade by up to about 100 feet per second.
4. From a depth of 30 to 40 feet, the Vogtle ESP shear wave velocity profile in Table 2.5.4-10a is very similar to the adjusted Fermi 3 IR shear wave velocity profile.
5. At depths shallower than 20 feet, both Vogtle ESP shear wave velocity profiles approach the adjusted Fermi 3 UR shear wave velocity profile.
6. The Vogtle ESP shear wave velocity profile in Table 2.5.4-10a is similar to the adjusted Fermi 3 UR shear wave velocity profile between about 6 and 15 feet below grade.
7. Both of the Vogtle ESP shear wave velocity profiles are greater than the adjusted Fermi 3 LR shear wave velocity profile.

This comparison demonstrates that the estimated shear wave velocities for the adjusted Fermi 3 site are reasonably consistent with measured shear wave velocities in the Vogtle ESP, and that the measured shear wave velocities in the Vogtle ESP are most similar to the adjusted Fermi 3 IR shear wave velocity profile at most depths. At select depths, the measured shear wave velocities in the Vogtle ESP are also similar to the adjusted Fermi 3 UR shear wave velocity profile. This comparison also indicates the assigned weights; which assign a higher weight to the Fermi 3 IR site response analysis profile, an intermediate weight to the UR site response analysis profile, and a lower weight to the LR site response analysis profile, are reasonable.

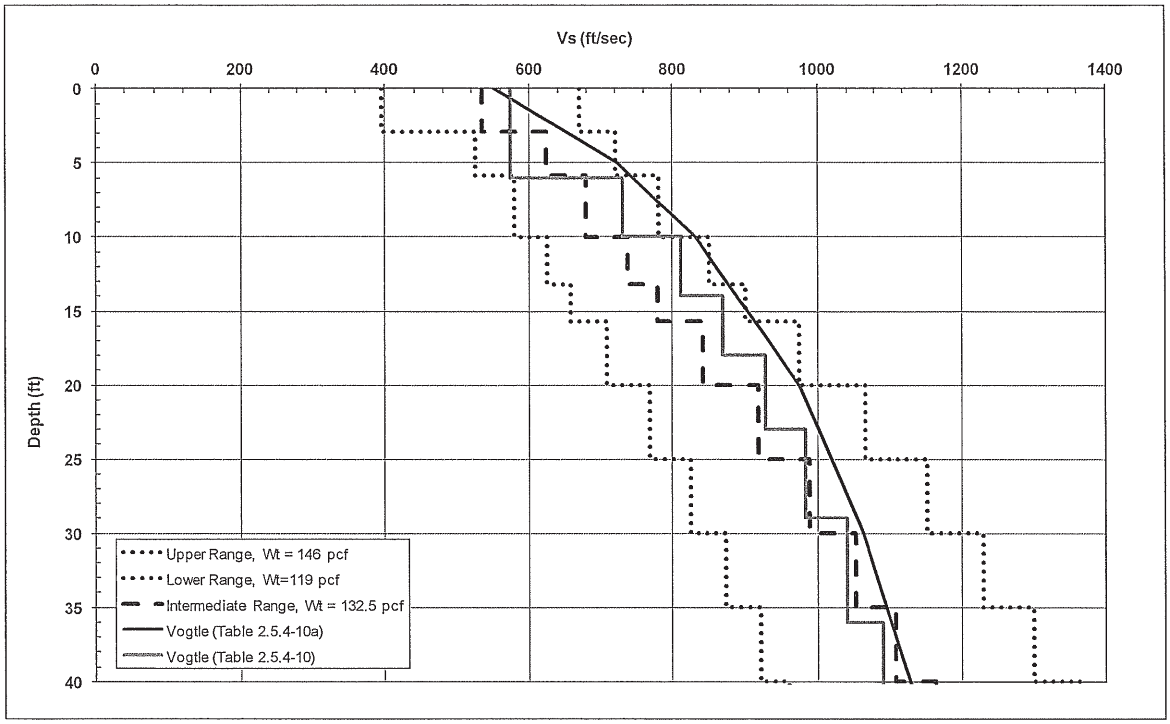

Figure 1 –Comparison of the Adjusted LR, IR, and UR Shear Wave Velocity Profiles (Black, Dashed/Dotted Lines) with the Vogtle ESP Shear Wave Velocity Profiles from Tables 2.5.4-10 and 2.5.4-10a of Reference 1

<u>Reference</u>

1. Southern Nuclear Operating Company, Vogtle Early Site Permit Application, Part 2 – Site Safety Analysis Report, Revision 5, December 2008.

<u>Proposed COLA Revision</u>

The Fermi 3 COLA is revised as shown in Attachment 2. Please note that the attached markup is a revision to the proposed text provided in DTE Electric Letter NRC3-13-0015 dated April 26, 2013.

Attachment 2
NRC3-13-0027
(following 1 page)

Markup of Fermi 3 COLA

The following markup represents how DTE Electric intends to reflect this RAI response in the next submittal of the Fermi 3 COLA. However, the same COLA content may be impacted by responses to other COLA RAIs, other COLA changes, plant design changes, editorial or typographical corrections, etc. As a result, the final COLA content that appears in a future submittal may be different than presented here.

$$V_S = \sqrt{\frac{G_{max}}{\rho}} \quad \text{[Eq. 5]}$$

Where:

ρ is the soil density in units of mass per volume

Again, a range of values were used to estimate four different profiles of G_{max} and shear wave velocity for the engineered granular backfill using the empirical relationship from Menq (Reference 3.7.1-204). The values of C_U and D_{50} for two of the profiles were based on the MDOT 21A and 21AA gradations (Reference 3.7.1-207). The C_U values for the two other profiles (C_U = 3 and 200) were based on the larger range of values from reconstituted granular samples presented in Menq (Reference 3.7.1-204) and a range of void ratios from 0.18 to 0.54 were considered. The larger range of C_U values used a D_{50} of 8 mm (0.3 inches) based on the average of the MDOT gradations. The four G_{max} and shear wave velocity profiles with the empirical relationship from Menq (Reference 3.7.1-204) used the following material properties:

- A C_U of 52.31, a D_{50} of 12.7 mm (0.5 inches), a unit weight of 22.9 kN/m^3 (146 pcf), and a void ratio of 0.3 (including effects of compaction).
- A C_U of 71.43, a D_{50} of 3.3 mm (0.13 inches), a unit weight of 22.9 kN/m^3 (146 pcf), and a void ratio of 0.26 (including effects of compaction).
- A C_U of 3, a D_{50} of 8 mm (0.3 inches), a unit weight of 18.7 kN/m^3 (119 pcf), and a void ratio of 0.54.
- A C_U of 200, a D_{50} of 8 mm (0.3 inches), a unit weight of 22.9 kN/m^3 (146 pcf), and a void ratio of 0.18 (including effects of compaction).

profile represents the smallest shear wave velocity for each depth interval from

The LR ~~and UR profiles represent the envelope of~~ the six shear wave velocity profiles described above for the empirical relationships of Richart et al. (Reference 3.7.1-203) and Menq (Reference 3.7.1-204). The IR shear wave velocity profile represents the average of the LR and UR shear wave velocity profiles. Figure 3.7.1-201 shows the three estimated shear wave velocity profiles (LR, IR, and UR) for the engineered granular backfill used as input to the site response analysis for computing the PBSRS and SCOR FIRS. A range of values for the engineered granular backfill is used to assess the potential variability of the fill shear wave velocities in the full soil column site response analyses. The three shear wave velocity profiles for the engineered granular backfill are provided in layers 1 through 10 in Table 3.7.1-201, Table 3.7.1-202, and Table 3.7.1-203 for the LR, IR, and UR profiles, respectively. As stated in Subsection 2.5.2.5.1, a single velocity profile is appropriate for the in situ material at the Fermi 3 site; therefore, the velocity profile does not change below the engineered granular backfill. The groundwater table is assumed to be at the maximum historical groundwater elevation of 175.6 m (576.11 ft) NAVD 88 (Subsection 2.4.12) for estimating the shear wave velocities of the engineered granular backfill.

The UR profile represents the largest shear wave velocity for each depth interval from the six shear wave velocity profiles described above for the empirical relationships of Richart et al. (Reference 3.7.1-203) and Menq (Reference 3.7.1-204).

The FWSC is to be founded on fill concrete with shear dowels (i.e., steel reinforcing) extending to the top of the Bass Islands Group bedrock. The site response analysis profile for the FWSC FIRS was constructed by placing approximately 9.1 m (29.9 ft) of fill concrete between the bottom of the FWSC foundation basemat and the top of the Bass Islands Group bedrock. The

Attachment 3
NRC3-13-0027

One CD Containing Requested Electronic Files

Directory of D:\

08/09/2013	9:15 AM	16,384 bytes	Part_B_Six_Shear_Wave_Velocity_Profiles Rev 0.xlsx
08/08/2013	5:30 PM	22,528 bytes	Part_D_Modulus_Reduction_Damping Rev 0.xlsx

2 File(s) 29,585,408 bytes
0 Dir(s) 707,958,056 bytes free