PMFermiCOLPEm Resource

From: John E Price [pricej@dteenergy.com]
Sent: Friday, August 30, 2013 3:07 PM
To: Govan, Tekia; Muniz, Adrian
Cc: Michael K Brandon
Subject: DTE Letter NRC3-13-0031
Attachments: NRC3-13-0031.pdf

Tekia/Adrian,

Attached is a courtesy copy of NRC3-13-0031, "DTE Electric Company Supplemental Response to NRC Request for Additional Information Letter No. 82 and Letter No. 87," dated August 30, 2013. A paper copy and corresponding data disk (Attachment 2) has be delivered to overnight mail service. If you have any questions, please contact me at the numbers below. Regards,

John E. Price
Nuclear Development - Licensing
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Hearing Identifier: Fermi_COL_Public
Email Number: 1263

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Subject: DTE Letter NRC3-13-0031
Sent Date: 8/30/2013 3:07:05 PM
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From: John E Price

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Recipients:
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DTE Energy

10 CFR 52.79

August 30, 2013
NRC3-13-0031

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. 82 Related to Chapters 02.05.02 and 03.07.02 for the Fermi 3 Combined License Application," dated January 14, 2013 (ML13011A152)
3) 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 (ML13191A094)
4) Letter from Peter W. Smith (DTE Electric) to USNRC, "DTE Electric Company Response to NRC Request for Additional Information Letter No. 82," NRC3-13-0007, dated February 8, 2013 (ML13043A012)
5) Letter from Peter W. Smith (DTE Electric) to USNRC, "DTE Electric Company Submittal of FSAR Subsection 3.7.1 Markups," NRC3-13-0015, dated April 26, 2013 (ML13130A095)
6) Letter from Peter W. Smith (DTE Electric) to USNRC, "DTE Electric Company Response to NRC Request for Additional Information Letter No. 87," NRC3-13-0027, dated August 9, 2013 (ML13232A266)

Subject: DTE Electric Company Supplemental Response to NRC Request for Additional Information Letter No. 82 and Letter No. 87

In References 4, 5 and 6 DTE Electric Company provided initial and supplemental information in response to NRC Request for Additional Information (RAI) question 02.05.02-20 (Reference 2) and RAI question 02.05.02-21 (Reference 3) related to the parameters used to develop the shear wave velocity profiles for backfill. The NRC requested this additional information to support review of details provided in Sections 2.5 and 3.7 of the Fermi 3 Combined License Application (COLA). During two public conference calls on August 8, 2013 and August 22, 2013, the NRC staff requested additional information regarding these parameters. The responses to these requests are provided in Attachment 1 of this letter as a supplement to RAI 02.05.02-21.

Attachment 2 of this letter 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 30th day of August 2013.

Sincerely,

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

Attachment:
1) Supplemental Response to RAI Letter No. 87 (Question No. 02.05.02-21)
2) One CD Containing Requested Electronic Files

cc: Adrian Muniz, NRC Fermi 3 Project Manager (w/o Attachment 2)
Tekia Govan, NRC Fermi 3 Project Manager
Bruce Olson, NRC Fermi 3 Environmental Project Manager (w/o attachments)
Fermi 2 Resident Inspector (w/o attachments)
NRC Region III Regional Administrator (w/o attachments)
NRC Region II Regional Administrator (w/o attachments)
Supervisor, Electric Operators, Michigan Public Service Commission (w/o attachments)
Michigan Department of Natural Resources and Environment
Radiological Protection Section (w/o attachments)

Attachment 1
NRC3-13-0031
(7 pages)

Supplemental 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.

Supplemental Response

The NRC, in Letter No. 82 (dated January 14, 2013) (ML13011A152) and Letter No. 87 (dated July 10, 2013) (ML13191A094), provided Request for Additional Information (RAI) related to the parameters used to develop the shear wave velocity profiles for backfill. The response to RAI 02.05.02-20 (NRC Letter No. 82) was initially provided in DTE Electric Company Letter NRC3-13-0007 dated February 8, 2013 (ML13043A012) and supplemented in Letter NRC3-13-0015 dated April 26, 2013 (ML13130A095). The response to RAI 02.05.02-21 (NRC Letter No. 87) was provided in DTE Electric Company Letter NRC3-13-0027 dated August 9, 2013 (ML13232A266). During two public conference calls on August 8, 2013 and August 22, 2013, the NRC staff requested eight (8) additional clarifications regarding the parameters used to develop the shear wave velocity profiles for backfill.

For the purposes of continuity only RAI 02.05.02-21 is being supplemented in response to these eight additional clarifications provided below. However, references to FSAR text, tables, or figures described below include the changes provided in DTE Electric Company Letter

NRC3-13-0015 dated April 26, 2013 (ML13130A095) and Letter NRC3-13-0027 dated August 9, 2013 (ML13232A266).

1. Please explain why it was necessary to additionally randomize each of the LR, IR, and UR shear-wave velocity profiles?

The three engineered granular backfill profiles, lower range (LR), intermediate range (IR), and upper range (UR), represent alternative estimates of the average dynamic properties of engineered granular backfill materials. As such, the LR, IR, and UR profiles represent epistemic uncertainty in the base case profile for the engineered granular backfill. Amplification functions for each base case were developed consistent with the approach described in Regulatory Guide 1.208. This approach includes randomization to incorporate the effects of variability in the soil depth, shear wave velocities, layer thicknesses, and strain-dependent dynamic nonlinear material properties at the site about the base cases (LR, IR, and UR).

During the August 22, 2013 open items call with the NRC, an additional question was raised by the NRC staff about the use of Approach 2 outlined in NUREG/CR-6728 (see FSAR Reference 3.7.1-202 in the Section 3.7.1 markup from letter NRC3-13-0015 dated April 26, 2013 [ML13130A095]) to adequately capture the effects of epistemic uncertainty in the engineered granular backfill properties in developing the performance based surface response spectrum (PBSRS) and the foundation input response spectra (FIRS) for the Reactor Building/Fuel Building (RB/FB) and Control Building (CB). The RB/FB and CB are to be founded within the Bass Islands Group in-situ bedrock. Calculations performed for development of the RB/FB and CB FIRS show that the alternative base case engineered granular backfill velocities produced only small differences in the site amplification functions at the RB/FB and CB foundation levels and these differences occur in the frequency range of 2 to 10 Hz. Comparisons shown in Section 6 of NUREG/CR-6769 (McGuire et al., 2002) indicate that the use of either Approach 2 or Approach 3 produces uniform hazard response spectra (UHRS) that compare well with the exact approach (Approach 4, which consists of development of a site-specific ground motion model for surface motions) for cases where the standard deviation in the natural logarithm of the site amplification variability is 0.2. It is expected that the overall variability in site amplification at the RB/FB and CB foundation levels is on this order, because the standard deviations in the natural log of site amplification for individual cases are typically about 0.2 or smaller and the differences in site amplification between individual cases are small. Thus, the comparisons shown in NUREG/CR-6769 indicate that Approach 2 produces adequate results for the conditions at the RB/FB and CB FIRS level. In addition, as described in Subsection 3.7.1.1.4.4 and shown in Figures 3.7.1-228 and 3.7.1-229, the RB/FB and CB FIRS were enhanced in order to produce input acceleration time histories for site-specific soil-structure interaction (SSI) analyses that produced surface motions computed with the three SSI profiles that enveloped both the PBSRS and GMRS at all frequencies between 0.1 and 100 Hz. As indicated by comparing values in Table 3.7.1-212 with those in Table 3.7.1-214 from the markup of Section 3.7.1, the RB/FB horizontal FIRS amplitude at 10 Hz was increased from 0.4437g to 0.5036g, and the amplitude at 2 Hz was increased from 0.1766g to 0.2605g. Similarly, the CB horizontal FIRS amplitude at 10 Hz in Table 3.7.1-213 of the markup was increased from 0.4440g to 0.5039g, as listed in Table 3.7.1-215 of the markup and the amplitude at 2 Hz was increased from 0.1767g to 0.2605g. Outside of this frequency range, the variability in the engineered granular backfill base case velocity has negligible impact on the computed site amplification functions at the RB/FB and CB elevations. These increases provide additional margin that addresses the effects of uncertainty. Therefore, the enhanced RB/FB and CB FIRS shown in Figures 3.7.1-228 and 3.7.1-229 of the markup, respectively, are considered to adequately incorporate the effect of the epistemic uncertainty in the dynamic properties of the potential engineered granular backfill materials.

The comparisons presented in NUREG/CR-6769 do not address differences between the various site response approaches for cases with larger variability in the site amplification functions and it is anticipated that the differences between approaches may increase as the variability in site amplification increases. The variability in site amplification at the Fermi 3 finished ground level grade is larger than at the foundation elevations and encompasses a wider frequency range. The finished ground level grade amplification functions are used to construct the PBSRS, which in turn is used for the final check of the SSI input time histories. These checks are shown on Figures 3.7.1-230 and 3.7.1-231 for the horizontal ground motions. As shown on those figures, the envelope of the surface motions computed using the SSI input time histories and the three SSI site profiles exceeds the computed PBSRS by a substantial margin at most frequencies. For example, at a frequency of 1 Hz, the horizontal PBSRS amplitude is 0.1373g (Table 3.7.1-205 of the markup), while the minimum amplitudes of the horizontal envelope values are 0.1927g for the RB/FB case and 0.1924g for the CB case. As the frequency increases above 1 Hz, the margin between the PBSRS and the envelopes of the computed surface motions increases, as shown on Figures 3.7.1-230 and 3.7.1-231 of the markup. The margin between the envelope of the computed surface motions and the PBSRS is generally smaller at frequencies below 1 Hz. However, the effect of the alternative engineered granular backfill base case dynamic properties on the site amplification function also decreases at frequencies below 1 Hz due to the limited thickness (37.6 feet) of the engineered granular backfill. Thus, it is expected that the SSI input time histories developed to represent the enhanced RB/FB and CB FIRS adequately account for epistemic uncertainty in the fill properties.

2. FSAR Figure 3.7.1-206 shows that the sigma (ln(Vs)) is 0.2 for the IR shear-wave velocity profile. Provide justification for the 0.2 sigma value.

The standard deviation of low strain ln(Vs) in the in-situ Bass Islands Group bedrock was assessed to be 0.15. The standard deviation of low strain ln(Vs) in the engineered granular backfill materials is expected to be somewhat larger as this material will not have been subject to aging and consolidation. In addition, the standard deviation in ln(Vs) typically are largest near the surface. For example, the Seismic Evaluation Guidance: Screening, Prioritization and Implementation Details (SPID) for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1 (EPRI, 2013) suggests a value of 0.25 for the depth range of 0 to 50 feet, decreasing to 0.15 below 50 feet. Although the engineered granular backfill will be placed in a controlled manner, some variation in dynamic properties is expected due to variations in the actual level of compaction and grain size distribution. Therefore, a standard deviation of low strain ln(Vs) value of 0.2 was selected to reflect greater variability than the in-situ bedrock and typical larger values near the surface. The standard deviation of low strain ln(Vs) of 0.2 is also similar to the value 0.25 suggested in the SPID for near surface materials (depth 0 to 50 feet).

3. Provide the individual randomized profiles.

Attachment 2 of this letter contains a CD with three (3) MS Excel data files providing the randomized profiles for the engineered granular backfill used in developing the PBSRS and Soil Column Outcrop Response (SCOR) FIRS. Files Fermi3_Fill_LR_Randomized_Profiles.xlsx, Fermi3_Fill_IR_Randomized_Profiles.xlsx, and Fermi3_Fill_UR_Randomized_Profiles.xlsx contain the profiles for the LR, IR, UR engineered granular backfill base cases, respectively. Each file contains 60 tabs, one for each of the randomized profiles. For each profile, the information provided consists of material type (1 or 2, which identify the shear modulus reduction and damping relationships for the different depths), layer thickness in feet, low strain damping ratio as a decimal value, unit weight in kips (1,000 pounds per cubic foot), and shear wave velocity in feet per second.

4. Did you assign maximum and minimum shear-wave velocities to the randomization? Provide the values.

In the randomization process, the velocity in any one layer was restricted to the range of plus or minus two standard deviations ($\pm 2\ \sigma_{ln(Vs)}$) about the natural log of the base case median velocity for each layer. This is consistent with recommendations in the SPID.

5. Please explain why it was necessary to pair the Menq shear modulus and damping curves with the LR velocity profile, which has a weight of 0.15, and the EPRI curves with the UR profile, which has a higher weight? Why not both?

The response to RAI 02.05.02-20 (Letter NRC3-13-0007 dated February 8, 2013 [ML13043A012]) previously described why the Menq curves were paired with the LR profiles and the EPRI curves were paired with the UR profile, as follows:

> "The EPRI generic sand modulus reduction and damping curves produce less modulus reduction and damping than the Menq estimates; therefore, they will be applied to the UR shear wave velocity profile of the engineered granular backfill. The Menq modulus reduction and damping relationships apply to material properties similar to those used to estimate the LR shear wave velocity values; therefore, they will be applied to the LR shear wave velocity profile of the engineered granular backfill. The use of both the EPRI and Menq modulus reduction and damping relationships, along with randomization of the relationships to account for variations in the material properties, results in a wider range of modulus reduction and damping curves used to establish the LB and UB profiles.
>
> The IR shear wave velocity values estimated for the engineered granular backfill will use an intermediate modulus reduction and damping relationship. The intermediate range modulus reduction and damping values will be developed by averaging the LR values based on Menq and the UR values based on EPRI generic sand curves."

The purpose of using a wide range of material properties for the engineered granular backfill was to evaluate the effects of fill properties in the sensitivity SSI analyses. The pairing of the Menq curves with the LR velocities and the EPRI curves with the UR properties was done to obtain a wide range of strain-compatible properties. As the Menq curves are more nonlinear, pairing them with the LR shear wave velocities and the more linear EPRI curves with the UR shear wave velocities produces a wider range of SSI profile properties than would be obtained using a mixture of the modulus reduction and damping relationships with each shear wave velocity profile. The resulting analyses produced a coefficient of variation (COV) in the strain-compatible engineered granular backfill properties for the SSI analysis that exceeded the minimum COV of 1 given in the Standard Review Plan, Section 3.7.2, for sites that are not well investigated, as suggested in discussions with the staff.

6. We requested justification in RAI 7170 for the weighting factors used for the LR, IR, and UR shear wave velocity profiles.

Justification for the weighting factors used for the LR, IR, and UR site response analysis profiles were provided in the response to RAI 02.05.02-21 (NRC3-13-0027 dated August 9, 2013 [ML13232A266]).

7. Please explain why an envelope of the amplification results would not be more appropriate given that the different shear-wave velocity profiles are developed from a very wide range of parameters?

The process used for developing the PBSRS amplification function uses mean values calculated across epistemic uncertainty distributions and is consistent with the process applied throughout the analysis of site ground motion hazard. Mean values are used to incorporate the epistemic uncertainty in the in-situ rock damping at the Fermi 3 site, and this process is consistent with the use of mean values to incorporate epistemic uncertainties in other seismic hazard assessment inputs, such as maximum magnitude, earthquake recurrence rates, and ground motion models.

8. Please describe your justification for using a friction angle of 50 degrees and a surge charge of 500psf to develop the velocity profile.

A friction angle of 50 degrees is used as an upper-end value to evaluate a range of possible friction angles for the engineered granular backfill. As stated in letter NRC3-13-0015 dated April 26, 2013 (ML13130A095) (markup to FSAR Section 3.7.1, Insert 13, Page 4 of 102), this upper-end value of 50 degrees is based on FSAR Reference 3.7.1-205. FSAR Reference 3.7.1-205 gives a range of values from 35 to 50 degrees for the angle of internal friction for sandy gravel based on both undrained and consolidated-drained triaxial compression tests. FSAR Reference 3.7.1-205 in the markup indicates a range from 40 to 55 degrees for medium-sized gravel; however, an upper-end value of 50 degrees is considered reasonable for the engineered granular backfill at the Fermi 3 site.

A surcharge load is not applied to the ground surface for development of the shear wave velocities in the site response analysis profiles. At grade, a depth of 0 feet, the vertical stress is 0 psf. As stated in letter NRC3-13-0015 dated April 26, 2013 (ML13130A095) (markup to FSAR Section 3.7.1, Insert 13, Page 4 of 102), "a constant effective lateral earth pressure of 500 psf is used for the UR estimate to a depth of about 15.7 feet to account for compaction." The 500 psf effective lateral earth pressure is included in the calculation of the shear wave velocity profiles and increases the horizontal effective stress, but not the vertical stress, near the top of the profile. This increase in the horizontal effective stress is included to consider the effect of preshearing of soils by vibration or compaction that leads to a significant increase in the coefficient of at-rest earth pressure (K_0) (FSAR Reference 2.5.4-251).

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, Report 1025287, February 2013.

2. McGuire, R.K., W.J. Silva, and C.J. Costantino, "Technical Basis for Revision of Regulatory Guidance on Design Ground Motions: Development of Hazard- and Risk-consistent Seismic Spectra for Two Sites," NUREG/CR-6769, U.S. Nuclear Regulatory Commission, Washington D.C., 2002.

Proposed COLA Revision

None.

Attachment 2
NRC3-13-0031

One CD Containing Requested Electronic Files

Directory of D:\

08/30/2013	11:19 AM	67,079 bytes	Fermi3_Fill_LR_Randomized_Profiles.xlsx
08/30/2013	11:19 AM	67,480 bytes	Fermi3_Fill_IR_Randomized_Profiles.xlsx
08/30/2013	11:19 AM	66,912 bytes	Fermi3_Fill_UR_Randomized_Profiles.xlsx

3 Files(s)	24,272,896 bytes
0 Dir(s)	712,685,568 bytes free