August 7, 2012

Mr. Peter W. Smith, Director
Nuclear Development
Licensing and Engineering
337 WCB
DTE Energy
One Energy Plaza
Detroit, MI 48226-1221

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 79 RELATED TO CHAPTERS 03.07.02 AND 13.03 FOR THE FERMI 3 COMBINED LICENSE APPLICATION

Dear Mr. Davis:

By letter dated September 18, 2008, Detroit Edison Company (Detroit Edison) submitted for approval a combined license application pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52. The U.S. Nuclear Regulatory Commission (NRC) staff is performing a detailed review of this application to enable the staff to reach a conclusion on the safety of the proposed application.

The NRC staff has identified that additional information is needed to continue portions of the review. The staff's request for additional information (RAI) is contained in the enclosure to this letter. In order to minimize delays to the current licensing schedule, we request that you respond within 30-days of receipt of this RAI.

If changes are needed to the safety analysis report, the staff requests that the RAI response include the proposed wording changes. If you have any questions or comments concerning this matter, I can be reached at 301-415-6197 or by e-mail at tekia.govan@nrc.gov.

Sincerely,

/RA/

Tekia Govan, Project Manager
Licensing Branch 3
Division of New Reactor Licensing
Office of New Reactors

Docket No.: 052-033

eRAI Tracking No. 6605 and 6627

Enclosure: Request for Additional Information

Mr. Peter W. Smith, Director
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Enclosure:
Request for Additional Information

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***Approval captured electronically in the electronic RAI system.**

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Request for Additional Information 79
Issue Date: 8/7/2012
Application Title: Fermi Unit 3 - Docket Number 52-033
Operating Company: Detroit Edison
Docket No. 52-033
Review Section: 03.07.02 - Seismic System Analysis
Application Section: 03.07.02

QUESTIONS

03.07.02-9

10CFR50, Appendix S requires that evaluation for SSE must take into account soil-structure interaction (SSI) effects. To address RAIs 03.07.02-6, 03.07.02-7, 03.07.02-8, 03.08.05-2, 03.08.05-3, and 03.08.05-4, DTE has performed a site-specific SSI analysis of the Control Building (CB) for the Fermi 3 site conditions using the SASSI2000 code, with the backfill material surrounding the CB as well as the bedrock layers included in the analysis. Report SER-DTF-009, Revision 0 submitted by DTE on June 15, 2012, documents the results of this SSI analysis. The staff has reviewed this report and has some concerns. In order to determine that the Fermi 3 analysis has appropriately taken into account the SSI effects, the applicant is requested to address the following issues, including supplementing the responses to the RAIs identified above as necessary.

1. SSI Analysis Methodology and Modeling Issues

Regarding the SSI model of the CB with the surrounding backfill material, the staff has a concern with the horizontal dimension of the FE mesh used to model the excavated soil volume in the SSI analyses documented in the report SER-DTF-009, Revision 0.

The SASSI2000 code User's Manual (Rev. 1, pg. 4-10) indicates that the maximum horizontal mesh dimension should be no more than 20percent of the shear wave length of the subsurface material at the highest frequency of interest. This implies that the SSI model cannot capture frequencies higher than f = 0.2Vs/d, where Vs is the shear wave velocity of the material and d is the horizontal mesh dimension. Section 4.3 of the report indicates that, in the bedrock, the maximum vertical mesh dimension is 1.0 m and the typical horizontal mesh dimension is 4.0 m. In the backfill, the maximum vertical mesh dimension is 1.5 m but the horizontal mesh dimension is not mentioned (however, Figs. 4.3-1 through 4.3-3 appear to indicate that the latter dimension is also 4.0 m). Therefore, assuming a horizontal dimension of 4.0 m for the entire FE mesh, the limiting frequency of the SSI model could be as low as f = (0.2)(170)/(4.0) =8.5 Hz, if based on the shear wave velocity at the top of the backfill, or f = (0.2)(240)/(4.0) =12.1 Hz, if based on the shear wave velocity at the bottom of the backfill. Backfill properties are taken from Table 3.1-1 of the report.

Section 4.3 of the report explains that the limiting frequency is considered to be f=(0.2)(240)/(1.5) =31Hz; however, this is based on the maximum vertical mesh dimension in the backfill, 1.5m, and the shear wave velocity at the bottom of the backfill, 240 m/s. This is not consistent with the recommendations of the SASSI2000 User's Manual, and also ignores the vertical variation of the backfill properties.

Enclosure

In Section 4.3 of the report it was concluded that "since the dominant frequency of the backfill above the bedrock is estimated to be about f= Vs/(4h) = 240/4/11.3 = 5.3 Hz, the higher frequency range of input motion energy will be reduced in nature." The staff however needs further quantitative assessment demonstrating that the results using the existing soil mesh size will be conservative when compared to an analysis using a more refined soil mesh size (meeting the element thickness and horizontal element dimension criteria) adequate for transmitting up to the maximum frequency of interest.

In Section 4.3 of the report it is indicated that: "the DCD mesh sensitivity study (for the excavated volume) provided by GEH in MFN 06.252 Dated September 13.2006 (ML0627202441) can be applied to the Fermi site-specific conditions." However, the soil profile assumed in the DCD study differs significantly from the soil profile at the Fermi 3 site. In the DCD study, the backfill has a shear wave velocity of 300 m/s and extends to a depth of 5.1 m below the bottom of the CB foundation; the soil underlying the backfill has a shear wave velocity of 800 m/s. At the Fermi 3 site, the CB is partially embedded in bedrock with shear wave velocity in the order of 2000 m/s. As a result, the transfer functions obtained in the DCD study differ significantly from those at the Fermi 3 site (as reported in SER-DTF-009 Revision 0, Appendix A). The conclusions of the DCD study depend on the shape of the computed transfer functions. As such, the staff could not determine the applicability of the DCD mesh sensitivity study to the Fermi 3 site-specific SSI analyses with backfill included.

Since the maximum frequency that can be captured with fidelity by the SSI model is significantly less than the minimum requirement of 50 Hz set in ISG-1, and the FE mesh of the SSI model deviates from the guidance in SRP Section 3.7.2, which indicates that element mesh size should be selected on the basis that further refinement has negligible effect on the solution results, the applicant is requested to provide a quantitative technical justification to demonstrate that the SSI model used is acceptable. This technical justification should take into account the energy content of the input motions, which is known to be substantial at frequencies above 8.5 Hz and non-negligible between 25 Hz and 50 Hz. The staff needs this information to ensure that the existing soil mesh size used in the SSI analysis adequately accounts for the SSE frequencies of interest in the evaluation of SSI effects.

2. Comparison of SASSI2000 Direct Method (DM) versus Subtraction Method (SM) - Transfer Functions and FRS

Appendix of A of SER-DTF-009 Revision 0 describes a comparative study of SSI response performed using the DM (denoted case CFB1a) and the SM (denoted case CFB1). A limitation of the study is that the same input motions and bedrock properties were not used in both cases. Case CFB1 a used the revised (i.e., "enhanced") input motions and bedrock properties described in the response to RAI 03.07.01-6, while case CFB1 did not. Therefore, it is not always clear whether the identified discrepancies are due to methodology (SM vs. DM), input motions, or bedrock properties.

The discussion in Appendix A is predicated on the assumption that the SSI analysis results for the DM can be used as the basis for comparing transfer functions and FRS at frequencies above 8.5 Hz. However, as indicated in item 1 of this RAI, it is not clear whether the SSI model can capture frequencies higher than 8.5 Hz with sufficient fidelity.

As such, the staff cannot determine the acceptability of the comparative study until the SSI modeling issues are resolved, and until it is demonstrated that the SSI analysis results using both the DM and SM are valid for the frequency range of interest. Therefore, in light of the issues raised in item 1 of this RAI, the applicant is requested to reevaluate the information presented in Appendix A of SER-DTF-009 Revision 0 using an acceptable SSI model, and using the same revised input motions and bedrock properties for both cases CFB1a and CFB1.

The applicant is also requested to provide the following additional information regarding Appendix A of SER-DTF-009 Revision 0:
(a) Quantify the differences in FRS computed using the DM and SM, currently depicted in Figs. A-1 through A-3 (but may need to be reevaluated). It appears that differences at certain frequencies are in the order of 100 percent (e.g., Fig. A-1a at 10 Hz).

(b) Provide additional comparisons of transfer functions and response spectra computed using the DM and SM, for the critical SDOF oscillators representing out-of-plane slab response. In the response spectra comparisons, include the licensing-basis SSI analysis case (which ignores the backfill).

(c) Explain the ESBWR DCD seismic design process for obtaining seismic input (amplified spectra) for piping and equipment supported on flexible floor slabs and walls. Provide an example of the seismic input that is used at the locations identified in item (b) above.

(d) Explain how the ESBWR DCD seismic design process for piping and equipment supported on flexible floor slabs and walls takes into account the following site-specific issues identified at the Fermi 3 site: (i) potential increases in vertical seismic input due to the backfill surrounding the structure (relative to the licensing-basis SSI analysis which ignores the backfill), and (ii) uncertainties in results computed using the SM vs. DM. This information should be provided in conjunction with item 4, sub-item (d), below.

(e) Explain why it is considered appropriate to extrapolate the conclusions of Appendix A to the Reactor Building (RB).

3. Comparison of SASSI2000 Direct Method (DM) versus Subtraction Method (SM) - Lateral Soil Pressures

The comparative study of SSI response performed using the DM (denoted case CFB1a) and the SM (denoted case CFB1), described in Appendix of A of SER-DTF-009 Revision 0, also includes a comparison of seismic lateral soil pressures.

From comparisons of computed seismic lateral soil pressures for cases CFB1a and CFB1, Appendix A concludes that soil pressures computed using the DM and SM are similar in trend and magnitude but do not correspond exactly; both cases are bounded by the DCD design pressures. Appendix A also indicates that some of the discrepancies may be due to differences in input motions and bedrock properties considered for cases CFB1a and CFB1, which is a limitation of the comparative study identified in Item 2 of this RAI.

As indicated in Item 2 of this RAI, the staff cannot determine the acceptability of the comparative study until the SSI modeling issues are resolved, and until it is demonstrated that the SSI analysis results using both the DM and SM are valid for the frequency range of interest. Therefore, in light of the issues raised in Item 1 of this RAI, the applicant is requested to reevaluate the information presented in Appendix A of SER-DTF-009 Revision 0, including

seismic lateral soil pressures, using an acceptable SSI model and using the same revised input motions and bedrock properties for both cases CFB1a and CFB1.

The soil pressures listed in Appendix A, Table A-2, used for comparison to DCD design pressures, represent averages over the height of each wall segment. It is not acceptable to the staff to average computed lateral soil pressures over the height of the wall segments because this underestimates the soil pressures at elevations close to the backfill-to-bedrock transition. The sharp increase in lateral soil pressures at these elevations reflects a physical discontinuity in the site conditions at these elevations, which should be accounted for in the design. Therefore, the applicant is requested to provide a quantitative assessment of the sidewall design (bending moments and shears) at the locations where the DCD design pressures are exceeded. Provide technical justifications for the use of any averaging.
For the SSI analyses of the RB and CB that ignore the backfill (i.e., the licensing-basis analysis), the applicant is also requested to provide a quantitative assessment of the sidewall design (bending moments and shears) at the locations where the DCD design pressures are exceeded. Provide technical justifications for the use of any averaging.

4. Effect of Assumed Structural Damping Ratios

Section 5.1 of SER-DTF-009 Revision 0 evaluates the impact of considering a 4 percent structural damping ratio, in accordance with the guidance in RG 1.61 (for reinforced concrete when computed stress levels significantly below code limits), compared to the 7 percent value considered in the site-specific SSI analyses performed previously. The SASSI2000 DM was used in this evaluation.

From comparisons of FRS computed using the two damping ratios, Section 5.1 concludes that the SSI analyses of the RB and CB, performed previously, are not significantly impacted by using either 7 percent or 4 percent damping ratios, and are within the DCD envelope by a substantial margin. This conclusion, however, is predicated on the assumption that the reported SSI analysis results can be used to compute FRS at frequencies between 8 Hz and 40 Hz. As indicated in item 1 of this RAI, it is not clear whether the SSI model can capture frequencies higher than 8.5 Hz with sufficient fidelity. Therefore, the staff cannot determine the acceptability of the applicant's conclusion until the SSI modeling issues are resolved, and until it is demonstrated that the SSI analysis results are valid in the frequency range of interest. The applicant is requested to reevaluate the information presented in Section 5.1 of SER-DTF-009, Revision 0 in light of the issues raised in item 1 of this RAI.

The applicant is also requested to provide the following additional information regarding Section 5.1 of SER-DTF-009 Revision 0:

(a) Quantify the differences in FRS between the 4 percent damping case and the 7 percent damping case, currently depicted in Figs. 5.1-1 through 5.1-3 (but may need to be reevaluated).

(b) Clarify whether the SSI analyses used the revised (i.e., "enhanced") input motions and bedrock properties described in the response to RAI 03.07.01-6.

(c) Since it appears that the vertical response of the SDOF oscillators is more sensitive to differences in damping ratios, provide comparisons of response spectra for the critical

SDOF oscillator representing out-of-plane slab response.

(d) Explain how the ESBWR DCD seismic design process for piping and equipment supported on flexible floor slabs takes into account the following site-specific issues identified at the Fermi 3 site: (i) increases in vertical seismic input due to 4 percent damping ratios in the structure (relative to the licensing-basis SSI analysis which assumes 7 percent ratio). This information should be provided in conjunction with item 2, sub-item (d), above.

(e) Explain why it is considered appropriate to extrapolate the conclusions of Section 5.1 to the RB.

5. Response Spectra in Adjacent Nodes Used To Assess SSSI Effects

Section 5.2 of SER-DTF-009, Revision 0 describes a comparative study of seismic response of a soil point adjacent to the CB, which is used to assess structure-soil-structure interaction (SSSI) effects. The SSI analysis was performed using the DM (denoted case CFB1a) and the SM (denoted case CFB1c).
The applicant is requested to reevaluate the information presented in Section 5.2 of SER-DTF-009, Revision 0 in light of the issues raised in item 1 of this RAI. The applicant is also requested to clarify whether the SSI analyses used the revised (i.e., "enhanced") input motions and bedrock properties described in the response to RAI 03.07.01-6.

6. Relative lateral wall deflections

Appendix C of SER-DTF-009 Revision 0 summarizes lateral wall deflections of the RB and CB toward each other, to assess potential SSSI effects. The reference point in each case is at the top of the basemat for each building. The SSI analyses cases considered were those reported in Shimizu Engineering Reports SER-DTF-006, Revision 1 and SER-DTF-008, Revision 0.

To complete the staff's evaluation, the applicant is requested to provide the maximum displacement of each reference point relative to a fixed reference system, for all the SSI analyses cases considered. This information is necessary to quantify the relative motions of the basemats toward each other.

Request for Additional Information 79
Issue Date: 8/7/2012
Application Title: Fermi Unit 3 - Docket Number 52-033
Operating Company: Detroit Edison
Docket No. 52-033
Review Section: 13.03 - Emergency Planning
Application Section:

QUESTIONS

13.03-65

The NRC staff requests that you address provisions for enhancing emergency preparedness as it relates to staffing associated with Recommendation 9.3 outlined in Enclosure 5 of the March 12, 2012 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." (ML12053A340).

Enclosure