PMFermiCOLPEm Resource

From: Berrios, Ilka
Sent: Monday, November 02, 2009 8:52 AM
To: LaShawn G Green; Peter W Smith; petersonn@dteenergy.com
Cc: FermiCOL Resource; Kevern, Thomas
Subject: DRAFT RAIs Chapter 2
Attachments: RAI 3936.doc

All,

Attached file is DRAFT RAI related to FSAR section 2.5.4. Please review it and let me know if a call is needed to clarify any of these questions. If we don't hear from you by Thursday, we'll assume that a call is not needed and the RAI letter will be issued.

Any questions, please let me know.

Ilka T. Berrios
Project Manager
Office of New Reactors
Division of New Reactor Licensing
Phone: 301-415-3179
Mailstop: T-6D38M

Hearing Identifier: Fermi_COL_Public
Email Number: 724

Mail Envelope Properties (87B1F1BDFE5A554CA9DC5EAA75EB6D0D14FF14B63B)

Subject: DRAFT RAIs Chapter 2
Sent Date: 11/2/2009 8:52:10 AM
Received Date: 11/2/2009 8:52:13 AM
From: Berrios, Ilka

Created By: Ilka.Berrios@nrc.gov

Recipients:
"FermiCOL Resource" <FermiCOL.Resource@nrc.gov>
Tracking Status: None
"Kevern, Thomas" <Thomas.Kevern@nrc.gov>
Tracking Status: None
"LaShawn G Green" <greenl@dteenergy.com>
Tracking Status: None
"Peter W Smith" <smithpw@dteenergy.com>
Tracking Status: None
"petersonn@dteenergy.com" <petersonn@dteenergy.com>
Tracking Status: None

Post Office: HQCLSTR01.nrc.gov

Files	**Size**	**Date & Time**
MESSAGE	471	11/2/2009 8:52:13 AM
RAI 3936.doc	68602	

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

Request for Additional Information No. 3936 Revision 0

Fermi Unit 3
Detroit Edison
Docket No. 52-033
SRP Section: 02.05.04 - Stability of Subsurface Materials and Foundations
Application Section: 2.5.4

QUESTIONS for Geosciences and Geotechnical Engineering Branch 1 (RGS1)

02.05.04-***

FSAR Section 2.5.4.2.1.1.1 suggests that the fill material can be processed to produce a gradation suitable for use as engineered granular backfill, if desired. FSAR Figures 2.5.4-202, 2.5.4-203, and 2.5.4-204 indicate that many buildings including the reactor building and the control building will be surrounded by engineered granular backfill. Please provide information regarding the general gradation constraints likely to be needed for processing if the fill is to be reused for the engineered granular backfill. In addition, please provide the expected static and dynamic properties of the as-specified compacted borrow material, such as compaction ratio, density, shear strength and shear wave velocity, as appropriate. Please also justify whether the results of the safety analysis provided in FSAR Section 2.5.4 would likely be affected by the static and dynamic engineering properties of the processed fill.

02.05.04-***

FSAR Section 2.5.4.2.1.2.1 “Bass Islands Group” states that: “Twelve rock direct shear tests were performed along sample discontinuities to provide the residual friction angle along the discontinuities presented in FSAR Table 2.5.4-206. The residual friction along discontinuities ranges between 33 and 74 degrees, with a mean of 52 degrees.” Please provide information on how prevalent these discontinuities are and whether there are any preferential directions involved. Also please provide information on how representative are the discontinuities provided by the twelve rock direct shear tests.

02.05.04-***

FSAR Section 2.5.4.2.1.2 provides for Bass Islands Group, Salina Group Units F, E, C, and B, the characterized parameter values of the following material properties often in terms of upper bound, mean, and lower bound values, or minimum, maximum, median, mean, and standard deviation values. Said parameters are specified in terms of a single number associated for the entire bedrock unit or provided for each borehole.

a) Please provide additional information on why it is appropriate to provide single value of each parameter for the entire bedrock group rather than to provide inferred spatial variation of these parameter values reflecting some spatial gradients or to reflect the potential for these parameters varying with depth or over horizontal directions.

b) Please provide the reason and justification for using the Hoek-Brown criterion for each of these bedrock groups including descriptions of each bedrock unit as applied in specifying the Hoek-Brown parameters. For example, what was the relationship between the residual friction angle values associated with discontinuities in the Bass Islands Group and the parameters in the Hoek-Brown criterion for that material? How were the effects of Oolitic Dolomite (FSAR Figures 2.5.4-202 and 2.5.4-203) reflected in the Hoek-Brown criterion for the Bass Islands Group?

c) It is assumed that the Hoek-Brown criteria were converted to “equivalent” Mohr-Coulomb values because of the limitation of the programs used in analysis. Please provide the effective confining pressure ranges and the rationale for the selected effective confining pressure ranges used to convert Hoek-Brown criterion into the equivalent Mohr-Coulomb values.

02.05.04-***

FSAR Section 2.5.4.2.2.1.4 states that where “poor bedrock core recovery was obtained, optical televiewer logging was performed to gather information on the bedrock where the core was not recovered”, and, among other things, results from downhole logging were used to “correlate the bedrock geology across the site.” Please provide information regarding whether the results of downhole logging provided additional information where good core recovery was not obtained.

02.05.04-***

FSAR Section 2.5.4.2.2.1.7 provides a list of chemical tests for groundwater and surface water. However, no test result is presented and no discussion is provided for any of the tests performed. Since the foundation and/or sub-foundation concrete may be exposed to the groundwater, please address whether the chemical in groundwater is aggressive or not. Please provide some discussions on these results.

02.05.04-***

FSAR Sections 2.5.4.2.2.2 and 2.5.4.3 refer to figures and tables showing the locations of explorations and various geologic cross-sections including those through the Seismic Category I structures. .

a) The scale of FSAR Figures 2.5.1-235 and 2.5.1-236 is such that it is difficult to locate various borings or geophysical and other test results with respect to the buildings and other site features. Please provide the aforementioned figures at “large enough scale” with adequately detailed information to be helpful in locating and evaluating various results from the field investigation with respect to various proposed buildings and other features at the site.

b) Please provide key figures referenced in FSAR Section 2.5.4.3 at scales and with adequately detailed information that would facilitate various evaluations. For example, such figures might make it easier to evaluate potential effects of various buildings and their proximity and their relationships to foundation materials and boring logs and other subsurface information without addressing different figures (and tables) often at rather small scales.

02.05.04-***

Appendix D, "Spacing and Depth of Subsurface Explorations for Safety-Related Foundations," to Regulatory Guide 1.132, "Site Investigations for Foundations of Nuclear Power Plants," Revision 2 (October 2003), provides guidance for site exploration plans for safety-related foundations. It suggests at least one boring per 900 m^2 (10,000 ft^2) (approximately 30 m (100 ft) spacing), and a number of borings along the periphery and at corners. FSAR Figure 2.5.1-236 illustrates the exploration locations. For seismic category I Control Building (CB) and Fire Water Service Center (FSWC), the figure indicates that the recommendation of corners boring locations is not followed. Please justify the limited number of borings and whether this number is sufficient to adequately characterize the foundations of the CB and FWSC.

02.05.04-***

FSAR Section 2.5.4.2.2.2.5.2 states that "the selection of Eur from last cycle as an estimate of the in-situ modulus is reasonable because the condition of the bedrock at the highest pressure level is probably closer to the in-situ undisturbed bedrock than at the lower pressure levels and previous unlodad/reload cycles." It also states that the "material being tested was a very complex geological unit consisting of interbedded limestone/dolomite/claystone/siltstone/shale and breccias with varying degrees of induration." Given that an applicable strain range and applied unload/reload cycles may be affecting the values of Eur and possible effects of macro-features may not be present within the influence zone of the pressuremeter test, please provide additional information regarding why the Eur from the last cycle (2nd or 3rd cycle) is an appropriate representation of the modulus of in-situ undisturbed bedrock. Please describe how the results were used and identify the calculations where these pressuremeter test values were used.

02.05.04-***

FSAR Section 2.5.4.2.3 states that dynamic testing is not required for Salina Group Unit F based on two considerations:

- One was the estimated shear strain being "approximately 0.0252 percent", and
- The other was that the testable samples would have been biased toward the "more intact portions of the bedrock and hence testing under static or dynamic loading conditions would possibly give high values not representative of the overall unit F." This was because core recovery and RQD in Salina Group Unit F were generally poor.

Furthermore, the FSAR states that the "strain level induced in till during the design earthquake would be less than 0.03 percent" and uses this information to focus on resonant column and torsional shear testing of the till.

a) Please provide additional information on the specifics of how the induced seismic shear strains were conservatively estimated for the Salina Group Unit F and the till, to be consistent with the postulated earthquake shaking conditions.

b) The potential role of "weak" zones within the Salina Group Unit F might have contributed to the overall characterization and performance of Salina Group Unit F. Please provide information on possible alternative means of sampling Salina Group Unit F so that appropriate samples of the material would be available. If sampling is not practically feasible, please provide non-laboratory testing alternatives to obtain data regarding the potential effects of these conditions on the characterization of Salina Group Unit F.

02.05.04-***

FSAR Section 2.5.4.3 together with FSAR Figure 2.5.4-202 indicates that two types of low strength lean concrete and structural backfill of granular soil material will be used. One type of lean concrete is to follow the DCD criteria and the other type is unspecified.

a). Please indicate whether the concrete will conform to industry standards such as the American Concrete Institute (ACI 349) for safety-related nuclear plants specification with the required compressive strength.

b) Please provide assurance that the structural backfill material will be obtained from a source with specified minimum acceptance criteria, compacted to specific American Society of Testing and Materials criteria.

02.05.04-***

FSAR Section 2.5.4.4.1, under "Geophysical Surveys for Dynamic Characteristics of Subsurface Materials", states that the dynamic characteristics of soil and bedrock were measured using downhole P-S suspension logging, downhole seismic testing, and SASW logging. It concludes in FSAR Section 2.5.4.4.1.1, under "P-S Suspension Logging and Downhole Seismic Testing in Bedrock Units", that from Figure 2.5.4-216 "the downhole Vs values in general agree with Vs obtained using P-S suspension logging." It also concludes in FSAR Section 2.5.4.4.1.2, under "P-S Suspension Logging and Spectral Analysis of Surface Wave in Soil Layers", that "the results are considered acceptable, because soil shear wave velocities measured using the P-S Suspension method agree with those measured using SASW method."

For downhole seismic testing, and SASW logging, please provide test data for shear wave velocity and compressive wave velocity in addition to average values. Additionally, please discuss how these data may be varying (or not varying) with the depth, and provide information on whether these variability observed from downhole seismic testing and SASW logging may need to be considered in the characterization of those soil and bedrock units.

02.05.04-***

FSAR Section 2.5.4.4.1concludes that overall results obtained from P-S Suspension logging are acceptable for all analysis purposes. However, the staff noted that shear wave velocities obtained from P-S suspension method are generally greater than those from downhole method and SASW method; this is also evidenced by RB-C8 downhole values for Bass Islands, and SASW method for glacial till. Please provide justification exclusive use of P-S logging results rather using average results of downhole, SASW and P-S logging.

02.05.04-***

FSAR Section 2.5.4.4.1.1 states that repeated collapse of boreholes was experienced in the 33.5 to 62.5 m (110 to 205 ft) depth range in Salina Group Unit F and “resulted in oversized borehole and irregular borehole shapes.” Further, it was not possible to grout Borings RW-C1 due to grout loss to the formation. The section also states: “Limited measurements were performed in Salina Group Unit F in any of the borings due to oversized holes and irregular hole shapes.” FSAR Figure 2.5.4-208, for example, showing the P-S suspension logging results indicate missing shear wave and p-wave velocity data in a significant portion of the Salina Group Unit F.

a) Please provide information on whether and how these observations were reflected in the characterization of Salina Group Unit F for Vs and Vp. In addition, please provide information on the basis for the decision.

b) Please provide a detailed comparison of the elevations of the collapse of the boreholes under all Category I foundation bases. This comparison is intended to identify any potential for existence of cavities or other unstable subsurface conditions.

c) Please discuss whether or not repeated collapse of the boreholes might not be indicative of cavities below the foundation levels, and why systematic rock grouting should not be applied at this site.

02.05.04-***

FSAR Section 2.5.4.5 “Excavations and Backfill” states: “Excavated material that meets requirements for use as engineered backfill will be segregated.” However, it is not clear where the requirements are provided. FSAR Section 2.5.4.5.1 states: “Excavated material that meets gradation requirements may be used as engineered granular backfill as defined in Subsection 2.5.4.5.4.2.” Furthermore, FSAR Section 2.5.4.5.1 states: “The excavated fill and bedrock may be processed to meet the required grading in accordance with Subsection 2.5.4.5.4.” However, FSAR Section 2.5.4.5.4.2 provides only very general information on gradation or other requirements for the engineered granular backfill. FSAR Section 2.5.4.5.1 also states: “Dense graded aggregate such as Size 21A or 21AA as specified by the Michigan Department of Transportation

(Reference 2.5.4-233) is suitable material. These types of materials are available from local and regional quarry sources."

a) Please provide the specific gradation and other requirements on the engineered granular backfill.

b) If it is planned to use the "dense graded aggregate" referenced above at the site, please provide the specific requirements, properties, and local or regional quarry sources to be tapped.

02.05.04-***

FSAR Section 2.5.4.5.3.2 states that excavation of bedrock at Fermi 3 may be completed using blasting, mechanical excavation, or a combination of blasting and mechanical excavation. It also states that any blasts would be "designed by a qualified blasting professional" and controlled blasting techniques "may" be used with the idea being "to preserve the integrity of exterior bedrock to prevent damage to existing structures, equipment, and freshly placed concrete, and to prevent disruption of Fermi 2 operations." It further states, "During construction, excavated subgrades in bedrock for safety-related structures are mapped and photographed by qualified and experienced geologists." and "Unforeseen geologic features are evaluated."

a) Please provide specific criteria (focusing on engineering properties) to be used to evaluate whether the excavated faces would be acceptable as foundation material.

b) Please provide how geologic evaluations of open faces would be used to confirm the engineering properties of bedrock materials. If the differences between the observed and the used properties are significant, please describe how they would be resolved. Please provide specifics if any engineering property tests are planned for the excavated bedrock materials.

02.05.04-***

FSAR Section 2.5.4.5.4.2 states: "Backfill for the Fermi 3 may consist of concrete fill or a sound, well graded granular backfill. Concrete backfill as required per the Referenced DCD is used to backfill the gap between the foundation mat of R/FB and CB and bedrock." FSAR Section 2.5.4.5.4.2 also states, "Concrete fill mix designs are addressed in a design specification prepared during the detailed design phase of the project." It is noted that some dynamic properties of "lean concrete fill" are provided in this section and FSAR Section 2.5.2.5.1 apparently without supporting data. FSAR Figure 2.5.4-202, for example, indicates that the dynamic properties of the concrete fill may be needed to evaluate the seismic earth pressures; FSAR Section 2.5.2.5.1 indicates the postulated properties of the concrete fill were used in the ground motion work. Please provide information on static and dynamic engineering properties of the concrete fill. Also, please provide specific measure to ensure the shear wave velocity of 3600 fps for backfill concrete beneath FSWC and between the foundation mat of R/FB and CB and bedrock (5 ft gap from FASR Figures 2.5.4-202 to 2.5.4-204).

02.05.04-***

FSAR Section 2.5.4.5.4.2 of the FSAR, under “Backfill Materials and Quality Control”, states that engineered granular backfill is “compacted to achieve density that results in the backfill having a minimum of 30 degrees” and based on correlations, “the φ’ of compacted granular soils can achieve 35 degree.” The section thus seems to make the φ’ of compacted granular soils a key consideration. As many structures including the Category I structures at the Fermi 3 site would be surrounded by engineered granular backfill, please provide information on whether any other parameters on the engineered fill, for example, density and compaction ratio, should be important in Section 2.5.4.5.4.2.

02.05.04-***

FSAR Section 2.5.4.5.4.2 states that lean concrete with a design compressive strength of 2,000 psi will be used as fill under the Category 1 structure FWSC. It is noted that the lean concrete fill is about 30’ thick. It is believed that most (if not all) lean concrete fill is exposed to the groundwater.

a) Please specify the groundwater lever at Fermi 3. Please provide a discussion of critical cases of groundwater conditions relative to the foundation settlement and stability of the safety-related facilities of the nuclear power plant.

b) Erosion of porous concrete sub-foundation as describe in NRC IN 97-11, and leaching of calcium hydroxide could be potential problem because of groundwater. Reduction in foundation strength, cracking, and differential settlement can result from erosion of porous concrete sub-foundation. Loss of strength can result from leaching of calcium hydroxide in the concrete. Please address the durability for the low strength lean concrete fill.

02.05.04-***

ESBWR DCD Table 2.0-1 indicates the ratio of the largest to the smallest shear wave velocity over the mat foundation width of the supporting foundation material does not exceed 1.7. Please demonstrate that the ratio of the largest to the smallest shear wave velocity over the mat foundation width of the supporting foundation material is enveloped by the site-related parameter. Provide justification if your ratio exceeds this parameter.

02.05.04-***

FSAR Section 2.5.4.8 states: “Engineered granular backfill is used to fill adjacent to all Seismic Category I structures and is not susceptible to liquefaction.” However, NUREG-0800 Standard Review Plan states “In meeting the requirements of 10 CFR Parts 50 and 100, if the foundation materials at the site adjacent to and under Category I structures and facilities are saturated soils and the water table is above bedrock, then an analysis of the liquefaction potential at the site is required." Please provide specific technical information forming the basis for that the Fermi 3 backfill adjacent to all Seismic Category I structures is not susceptible to liquefaction.

02.05.04-***

FSAR Section 2.5.4.10.1 states: "For the Bass Islands Group, the upper bound Hoek-Brown φ' of 53 degrees matches well with the mean residual friction angle of 52 degrees measured from rock direct shear tests on discontinuities (Table 2.5.4.-206); therefore, φ' equal to 52 degrees is used for the Bass Islands formation." Details of direct shear test results are provided in FSAR Table 2.5.4-223. Please provide information regarding the appropriateness of normal stress values used in the direct shear tests (FSAR Table 2.5.4-223) as applied to the above statements and as used in the bearing capacity analysis reported in Section 2.5.4.10.1. Please provide if there were any dependency of the direct shear test results on the normal stress used in the testing.

02.05.04-***

FSAR Section 2.5.4.10.1 indicates that for the Bass Islands Group, the upper bound Hoek Brown effective angle of friction and effective cohesion were used in the bearing capacity equation. In contrast, for the Salina Group Unit F the lower bound Hoek-Brown angle of friction and effective cohesion were used. Please provide basis and justification on why the upper bound values were used for the Bass Islands Group while the lower bound values were used for the Salina Group Unit F.

02.05.04-***

FSAR Section 2.5.4.10.1 states that the two methods, Terzaghi approach and Uniform Building Code were used in evaluating bearing capacity. Please provide information on why these two methods (particularly the second method) are adequate and appropriate for the bearing capacity at the Fermi 3 site, considering apparently weaker Salina Group Unit F beneath the Bass Islands Group.

02.05.04-***

FSAR Section 2.5.4.10.2 states that for "analysis of settlements, the lower bound E based on the Hoek-Brown criterion for each bedrock unit were selected. It is believed that the average E of the bedrock units will be greater than the lower bound E from the Hoek-Brown criterion".

a) Please provide some information on how the modulus values following the Hoek-Brown criterion were developed and the basis for the belief that" the average E of the bedrock units will be greater than the lower bound E from the Hoek-Brown criterion."

b) Please explain if there were any unconfined compression tests conducted on the material under the safety-related foundations? If there were, how do the tested values compare with the values used in the calculations for foundation settlement analysis?

c) For the total rebound and settlement evaluations, the selected parameter values may be “conservative”, but please provide additional information for the appropriateness and conservativeness of the selected modulus values as affecting the results of differential settlement evaluations.

02.05.04-***

FSAR section 2.5.4.10.2 states that the settlement analysis was performed in stages to calculated excavation rebound and total foundation settlements (settlement from the rebounded position). The section further states that the second stage simulated the rebound associated with load removal when excavation was performed to appropriate foundation elevations or to top of bedrock in the power block area. The section also concludes that only elastic settlements are considered in the analysis and there is no long-term (post-construction) settlement anticipated at the Fermi 3 site.

a) Referred Table 2.5.4-230 shows that rebound at the FWSC foundation level is not applicable because the foundation soil under the FWSC will be removed to top of bedrock. However, the rebound at excavated level under the FWSC during excavation stage is important in order to determine the FWAC settlements. Please provide these values.

b) Please clarify whether presented total foundation settlements for the FWSC in Table 2.5.4-231 are referenced to the rebounded position or the top of lean concrete fill. Please describe the loading and construction procedures and explain how the rebound at excavation level is taken into account for the FWSC settlements.

c) Taking into account of 30’ thick low strength lean concrete fill, please provide justification on how long-term deformation (or creep) is not anticipated for FWSC settlements.

02.05.04-***

FSAR Section 2.5.4.10.3 states that a surcharge pressure of 24 kPa (500 psf) is to be used due to the small to medium sized compaction equipment normally used for compaction of backfill behind rigid retaining wall. It appears that FSAR Reference 2.5.4-245 is the basis for this selection. Please provide some information regarding the basis for the adopted value and its adopted distribution with depth.

02.05.04-***

ESBWR DCD rev. 6 has changed significantly from the revision used in the preparation of the Fermi FSAR. The following changes refer to Table 2.0-1 of the latest revision of the ESBWR DCD and its corresponding notes:

a. FSAR Section 2.5.4.11 “Design Criteria” states “DCD Table 2.0-1 requires that that φ’ ≥ 30°.” As per revision 6, the angle of internal friction for both in-situ and backfill is updated from φ’≥30° to φ’≥35°. Please demonstrate that both in-situ material and backfill meet this updated requirement.

b. Note 7 stipulates the criteria needed to compare the maximum dynamic bearing demand with the allowable bearing pressure. FSAR Table 2.5.4-227 illustrates the results of the Bearing Capacity Analysis. Please make corresponding changes in Table 2.5.4-227 in order to incorporate the new requirements set forth in Note 7 of the revised DCD.

c. Note 8 establishes a new method to estimate the minimum shear wave velocity. Equation 2 in FSAR Section 2.5.4.7.2 states the method used to calculate the equivalent shear wave velocity under each Category I structure. According to revision 6 of the DCD, said equation is no longer valid. Please demonstrate that your shear wave velocity at minus one sigma from the mean is enveloped by the site-related minimum shear wave velocity parameter.