Entergy

System Energy Resources, Inc.
1340 Echelon Parkway
Jackson, MS 39213

CNRO-2005-00015

March 12, 2005

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

DOCKET: 52-009

SUBJECT: Response to Request for Additional Information – System Energy Resources, Inc., Early Site Permit Application for the Grand Gulf ESP Site (Seismic Review) (TAC NO. MC 1378)

REFERENCE: 1. System Energy Resources, Inc. (SERI) letter to USNRC – Early Site Permit Application (CNRO-2003-00054), dated October 16, 2003.

CONTACT:

Name	George A. Zinke
Mailing Address	1340 Echelon Parkway Jackson, MS 39213
E-Mail Address	gzinke@entergy.com
Phone Number	601-368-5381

During a conference call on February 24, 2005, the U.S. Nuclear Regulatory Commission requested additional information to support review of the SERI ESP Application. This letter transmits information as outlined in Attachment 1 to this letter.

Should you have any questions, please contact me.

I declare under penalty of perjury that the foregoing is true and correct.
Executed on March 12, 2005.

D069

Sincerely,

George A. Zinke
Project Manager
System Energy Resources Inc.

Attachment: Attachment 1

cc: Mr. R. K. Anand, USNRC/NRR/DRIP/RNRP
Ms. D. Curran, Harmon, Curran, Spielberg, & Eisenberg, L.L.P.
Mr. W. A. Eaton (ECH)
Mr. B. S. Mallett, Administrator, USNRC/RIV
Mr. J. H. Wilson, USNRC/NRR/DRIP/RLEP

NRC Resident Inspectors' Office: GGNS

ATTACHMENT 1

Ground Motion

Question 1.

Please provide references about the statement, "the UHS and consequently the SSE are defined to 0.5 Hz (2 second) as the lowest frequency", appeared on the page 2.5.67.

Response:

The attenuation relationships provided in the EPRI (1993) and EPRI (2004) ground motion models only extend to 2 seconds (0.5 Hz). Thus, the UHS rock spectra typically is defined to 2 seconds (see for example Figure 2.5-59).

SSAR Revision:

Section 2.5.2-3, 2nd paragraph, 2nd sentence, delete clause "... and consequently the SSE...." and replace "are" with "is".

Question 2.

In the figure 2.5-59 (revision 1), the median UHS shows a peak value at 25 HZ, however, the response spectra from all the controlling earthquakes are lower than the UHS. What is the possible cause for the bulge on the UHS curve?

Response:

For the Grand Gulf site the controlling earthquakes are relatively distant events (greater than 80 km), as compared to other sites where the controlling earthquakes for the 5-10 Hz range are typically distances of less than 25 km. As a result, the spectral shapes based on the controlling earthquakes are not as rich at high frequencies (above 10 Hz) and do not produce a peak value at 25 Hz. The peak at 25 Hz in the UHS is produced, in part, from smaller closer earthquakes to the site, but none of which are the controlling earthquake following the guidance provided in Regulatory Guide 1.165.

SSAR Revision:

None required.

Geotechnical/Site Response Comments

Question 2.5.4-1

In RAI 2.5.4-1, the staff requested the applicant to (1) provide basis for categorizing the relatively shallow component of the deep profile as bedrock as opposed to dense sands and gravels, and (2) evaluate the impact of describing the formation as Abedrock as opposed to dense sands and gravels in the various site elevations. From its review of the applicant's response as summarized in Section 2.5.4.1.2 of this report, the staff found that the revised material descriptions for the site indicate a change from the term "Catahoula bedrock" used in the UFSAR to dense sand and gravels in the current descriptions. The information from both the previous extensive site studies described in the UFSAR as well as the limited ESP investigation indicate that the foundation soil properties are consistent and that these soils are stiff enough so as to not impact evaluations of settlement and required strength. The change in nomenclature is indicated to not have any significant impact on findings in the UFSAR and the SSAR. The details provided with this response are considered appropriate as a response to this RAI. However, it is noted that the applicant's response indicates that the depth of new Category I foundations may have to be located lower than the current Grand Gulf foundations for equivalent behavior to be anticipated. This may have significant impact on construction procedures anticipated for the site and needs to be further clarified.

Response:

Additional clarification will be added to the SSAR in response to this comment.

SSAR Revision:

Add following paragraphs to end of Section 2.5.4.5

Deep temporary construction excavations below the groundwater table will be required for the power block foundations, and possibly for other heavily-loaded structures depending on the reactor technology selected. These excavations will be deeper (on the order of 30 to 80 feet deeper) than those made for the existing plant to reach equivalent foundation materials in the Upland Complex Old Alluvium. Excavation walls will need to be sloped back, reinforced (e.g., soil nails or grout mixing), or supported by temporary tied-back retaining walls similar to those used for the existing plant construction. Although the ESP excavations will be deeper than for the existing plant, these industry-standard deep excavation support measures will permit safe excavation to the required foundation elevations and prevent significant ground movements. If a tied-back wall system similar to that used for the existing plant is selected, the various wall members will need to be of higher capacity to counter greater lateral loads. Alternatively, a combination of ground improvement or back-sloping of the excavation can be used with the tied-back walls to reduce lateral forces on the walls. These methods have been successfully incorporated as part of the current standard of practice for control of deep excavation stability.

Groundwater inflows for the deep excavation likely will be of the same general magnitude as encountered during the existing plant construction, as the materials and groundwater conditions are similar between the sites. The groundwater head will be higher in the lower parts of the ESP excavation due to the greater depth below the groundwater table, but can be controlled with similar typical construction methods to those used for the existing plant (e.g., cutoff walls, collector sumps and pumps, dewatering wells).

Question 2.5.4-2

In RAI 2.5.4-3, the staff requested the applicant to indicate the additional information available for the Grand Gulf Nuclear Plant site to allow characterization to the deeper depths required for the site response. From its review of the applicant's response as summarized in Section 2.5.4.1.2 of this report, the staff found that the new borings and cone penetrometers taken as part of the ESP investigation present site specific information to a maximum depth indicated to be about 73.15 m (240 ft). In the soil profiles developed for the ESP site (Figures 2.5.4-1 and 2.5.4-2 [SSAR Figures 2.5-30 and 2.5-31]), the applicant provided descriptions developed from previously available site investigations. The response includes a general description of the additional geotechnical information available from the UFSAR program that overlaps the ESP area and that was used in the evaluation of the ESP site to relatively shallow depths. The applicant also indicated that they specifically developed the ESP site investigation program to obtain sufficient information to characterize the site subsurface conditions and soil variability that may influence ground motion response. However, as discussed above, all site-specific information obtained for the site was limited to only about 91.44 m (300 ft) of depth and detailed information throughout the additional depth of the soil column was not obtained for this evaluation. In addition, the number of borings available for the site from which to assess site variability, particularly at the deeper depths, and its impact on site response was considered insufficient to characterize the site unambiguously as required in Section 2.5.4.1 of RS-002.

Response:

Additional clarification will be added to the SSAR text in response to this comment.

SSAR Revision:

Add following paragraph to end of Section 2.5.2.3:

During the COL phase additional borings, laboratory testing, and geophysical surveys will be performed to confirm the current base-case material properties as well as their variabilities throughout the site. If the COL phase investigations indicate differences in material properties that may have a significant impact on design motions, we will evaluate the need to perform additional site response analyses with the updated properties to develop revised design motions.

Add following paragraph to end of Section 2.5.4.1.2

During the COL phase additional borings, laboratory testing, and geophysical surveys will be performed to confirm the current base-case material properties as well as their variabilities throughout the site. The base case and additional COL borings will be used for foundation design.

Question 2.5.4-3

In RAI 2.5.4-4, the staff requested the applicant to provide the basis for selecting this generic base case velocity model over any other model that may be generated from available information for the site and its environs. From its review of the applicant's response as summarized in Section 2.5.4.1.2 of this report, the staff found that several unresolved issues remain to address the adequacy of the computed surface response spectrum as a site-specific evaluation. First, comments are provided by the applicant in their response to this RAI to indicate that the site stratigraphy is slowly varying across the entire region from the Gulf Coast to well north of the Memphis area. The applicant did not provide, either in the SSAR or in their response to this RAI, the basis for making this evaluation. The response indicates that these decisions are based on the use of old well logs to make judgments of regional stratigraphy. However, the applicant did not discuss the appropriateness of using such information to make judgments on shear wave velocities at depth. The range in wave velocities for the deep profile considered in the sensitivity study provided in the response varies from about 231.36 m/sec (700 fps) to 762 m/sec (2,500 fps) at a depth of 1 km (0.62 mile). The staff's concern rests with the selection of this range in velocities. The applicant's response does not indicate the basis for these bounding values, nor the sensitivity of the computed responses to velocity values outside this range at the depth of about 1 km (0.62 mile).

However, the applicant stated the following in Section 2.5.1 about the level of uniformity in the site area. Holocene alluvial and deltaic deposits thicken from a few tens of feet in the northern portion of the site region to greater than 183 m (600 ft) in the southern portion of the site region. In the site vicinity, the thickness of Holocene deposits in the Mississippi Alluvial Valley is on the order of 0 to 122 m (400 ft) thick. As an aside, the applicant computed the median amplification factors on the basis of the 1-2 Hz scaled bedrock motion. The corresponding responses for bedrock motions scaled to the UHS at the 5-10 Hz frequency range along with enveloping of the computed amplification factor sets is not provided.

Of additional interest is the development of the material damping factors used in the site response calculations generated from the estimated kappa values chosen. The applicant did not discussed the uncertainty in the selection of the kappa value nor the issue of effective scattering kappa incorporated into the models by the site layering and their impact on effective low strain damping selected for the models. The applicant should address the issue of sensitivity of the computed site response to the assumptions made to characterize the deep site profile.

Response:

In the first paragraph, the comment indicates that no basis is provided for the statement that the deep stratigraphy of the embayment is slowly varying in a north-south direction from Memphis to the Gulf Coast, with the exception of Crowley's Ridge. Publications on the development of the embayment indicate a similar depositional environment throughout this portion of the basin with basement deepening from near zero at Cairo, Illinois to over 10,000 ft at Grand Gulf. While the shallow portions of the embayment show expected lateral variability, the deep basin is comprised of the same general stratigraphic units throughout much of its length. This is typical of unfaulted basins of uniform depositional environments, where the deeper materials have generally very similar dynamic material properties over large distances. Indeed the COV at depths exceeding 300 to 500 ft over all deep profiles (California, Mississippi embayment, Savannah River) is about 0.25. For a lognormal distribution this is about a 25% increase in the median to an 84^{th} fractile. This uniformity suggests that for soils, confining pressure is likely more important than material type in controlling dynamic material properties at depth.

Regarding the velocity range in the sensitivity analyses presented in the RAI response (RAI Figure 2.5.4.4-1), the velocities are in m/sec reflecting a range at a depth of 1 km from 700 m/sec (not 700 ft/sec) to 2,500 m/sec (not 2,500 ft/sec). This range and the range below 200m greatly exceeds velocities for Pleistocene soils at comparable depths. For example, on the low velocity side, even the Younger Bay mud around the San Francisco Bay in California, comprised of very soft clayey soils and alluvium, has shear-wave velocities of about 600 m/sec at a depth of 200m and typical alluvium has median measured shear-wave velocities of about 750 m/sec at a depth of 200m and increasing with depth. On the high velocity side, at a depth of 200m our high velocity in the sensitivity analyses is nearly 1,000 km/sec, generally considered firm rock and increases linearly with depth to 2.5 km/sec at a depth of 1 km. This is clearly an extreme case for any soil profile. In summary, we believe that the range in velocity used for the Grand Gulf soil profile conservatively conditions for the Mississippi embayment Pleistocene soils at the site and represents reasonable bounds for the sensitivity analyses.

In the second paragraph, the comment correctly states that we provided the sensitivity analysis for the 1 to 2 Hz scaled spectrum only, neglecting the 5 to 10 Hz scaled spectrum. Since the combined transfer function applied to the UHS is controlled by the transfer function computed with the 1 to 2 Hz scaled spectrum, we saw no need to perform a redundant sensitivity study using the 5 to 10 Hz scaled spectrum as control motions.

The third paragraph of the comment refers to kappa, specifically that we did not address the uncertainty in kappa, the impacts of scattering kappa, and the sensitivity of the computed response to kappa values. In response, we have added a paragraph to the SAR which replaces the last sentence of the last paragraph in Section 2.5.2.3.

SSAR Revision:

Delete last sentence of paragraph 5 in Section 2.5.2.3.

Replace with following paragraph:

High frequency ($\geq$ 5 Hz) motions input to the softer portion of the profile, at a depth of about 170 ft, are sensitive to the damping in the deeper profile which extends to hard rock conditions. This damping is constrained by the site kappa value (Anderson and Hough, 1984) and is taken as 0.04 sec, a conservative estimate for this portion of the Mississippi embayment with sediment depths exceeding 10,000 ft (Reference 196). The value of 0.04 sec is taken as the total kappa at the surface of the loess. It includes the contribution of the low strain damping in the hysteretic damping curves over the nonlinear portion of the profile (top 500 ft) as well as any scattering damping due to velocity fluctuations in the profile randomization process. Sensitivity of the input motions is such that an increase in kappa to 0.05 sec or a decrease to 0.03 sec would result in about a 15% decrease or increase respectively in motions for frequencies exceeding about 5 Hz (Ref. 214). As a result and because kappa can only be estimated from recordings of earthquakes, a conservative estimate of 0.04 sec is assumed in characterizing the motions. Typical kappa values for deep soils in the western United States range from about 0.05 to 0.07 sec (Ref. 215, 216). Deep soils in the central and eastern United

States are not expected to have significantly different dynamic material properties such as shear-wave velocity and material damping, particularly at depths exceeding 500 ft or so.

Add the following three references to the SSAR.

214. Silva, W.J. and R. Darragh (1995). "Engineering characterization of earthquake strong ground motion recorded at rock sites." Palo Alto, California: Electric Power Research Institute, TR-102261.
215. Anderson, J. G. and S. E. Hough (1984). "A Model for the Shape of the Fourier Amplitude Spectrum of Acceleration at High Frequencies." *Bulletin of the Seismological Society of America*, 74(5), 1969-1993.
216. Silva, W.J., N. Abrahamson, G. Toro, C. Costantino (1997). "Description and validation of the stochastic ground motion model." Report Submitted to Brookhaven National Laboratory, Associated Universities, Inc. Upton, New York.

Question 2.5.4-4

In RAI 2.5.4-11, the staff requested the applicant to evaluate the impact of the velocity cutoff on the minimum depth for future siting, especially since the staff qualified all of the advanced reactor designs by requiring shear velocities of at least 304.8 m/sec (1,000 fps). From its review of the applicant's response as summarized in Section 2.5.4.1.2 of this report, the staff found that the applicant agrees with the observation that S-wave velocities measured at the ESP site fall below the target velocity of 304.8 m/sec (1,000 fps) at depths below those indicated in the SSAR to be probable depths of new foundations. The applicant's response also refers to these low velocity zones at depth as _localized_ zones. Since only three borings are available for the ESP site evaluation, one may find the S-wave velocity in these _soft_ zones to be even lower during the detailed site investigations to be conducted during the COL stage. The applicant should revise the SSAR to clearly indicate the potential depths of foundations of safety-related facilities and the evaluation program needed to evaluate any new facility founded above such _soft_ zones.

Response:

Additional clarification will be added to the SSAR text in response to this comment.

SSAR Revision:

Add following paragraph at end of Section 2.5.4.6:

The minimum required shear wave velocity at the foundation level for all example reactor types considered for the site is 1,000 feet per second (fps). Potential power plant foundation depths are in the range of about 35 to 140 feet (elevations 97 to -7 feet) below plant grade, depending on the type of reactor that is chosen. ESP investigations show that average shear wave velocities are greater than 1000 fps below an elevation of about 97 feet, and that minimum shear wave velocities are greater than 1,000 fps below an elevation of 0 feet. Additional site investigations to be performed throughout the plant site in the COL phase will confirm the depth to reach a minimum shear wave velocity of 1,000 fps. These investigations shall include multiple methods to obtain shear wave velocity profiles (e.g., P-S suspension logging, downhole surveys, crosshole surveys) to permit a comparison between interval and average velocities measured by different techniques against the minimum velocity requirements for plant design. Soils underlying the elevation of the selected plant foundations that are found to have shear wave velocities below the design requirement will require removal and recompaction (with or without additives) and/or in situ improvement using methods such as cellular deep soil mixing or consolidation grouting to achieve the required shear wave velocity.

Question 2.5.4-5

In RAI 2.5.4-14, the staff requested the applicant to (1) provide the basis for making the statement that the shear wave data was of excellent quality in the three boreholes, (2) indicate that the statement applies equally well to the quality of the corresponding P-wave profiles and (3) explain the cause of the difference in P-wave velocity changes at elevation near the water table between boreholes. From its review of the applicant's response as summarized in Section 2.5.4.1.2 of this report, the staff found that the explanations provided by the applicant with respect to the quality of P- and S-wave data is considered adequate since (a) the process used to generate wave velocities used multiple measurements and (b) the process was independently reviewed. However, the basis for the statement associated with the rise and fall in P-wave data in boring WLA B-2A needs to be clarified in the SSAR. The response also indicates that the process used to advance the borings precluded obtaining good information on ground water depths. Although the potential of encountering a perched water table appears reasonable, the uncertainty in the ground water data cannot be used to support the supposition. The applicant needs to clarify the response to this RAI and to incorporate them into the SSAR.

Response:

Additional clarification will be added to the SSAR text in response to this comment.

SSAR Revision:

Add following paragraph after third paragraph of Section 2.5.4.1.4

As shown on Figure 2.5-71, a 3 to 4 foot thick zone of lower compressive (Vp) wave velocity was encountered in Boring 2A between elevations of about 69 and 73 feet (60 to 64 feet depth), and above the regional groundwater table that is at about elevation 58 feet (75 feet depth). The shear wave velocity measured in the boring at the same elevation interval does not decrease, and a Modified California sample drive blowcount of 38 was obtained directly below this zone in the boring. A Shelby tube sample obtained directly above the zone consisted of silty clay with a laboratory-measured wet density of 127.9 pounds per cubic foot (PCF), and dry density of 104.7 pcf. These data show that the localized Vp velocity decrease probably is not the result of a soft or unusually weak soil horizon. In addition, most proposed foundation excavations will be near or below this zone, such that the zone will either be removed or can be over excavated and recompacted. Geotechnical investigations performed during the COL phase will provide additional verification of the soil properties within this low Vp velocity zone.

Question 2.5.4-6

In RAI 2.5.4-5, the staff requested the applicant to indicate the values of the BE, UB and LB velocities selected for each primary component of the profile and to provide bases for their selection in either SSAR Section 2.5.4 or SSAR Section 2.5.2. From its review of the applicant's response as summarized in Section 2.5.4.1.3 of this report, the staff found that the response provided by the applicant does not indicate the implementation of the randomization scheme used in the response calculation. For example, it is typical to specify not only the best estimate velocity profile, but also the corresponding plus/minus one sigma values of log shear wave velocities for the entire site column above hard rock, from which the randomization scheme can move forward. The basis for the selection of such profile properties needs to also be provided in the SSAR.

Response:

We have added tables of strain compatible shear-wave damping and velocities resulting from the 1 to 2 Hz and 5 to 10 Hz scaled spectra site response analyses for the relevant case which has the top 50 ft of loess removed.

SSAR Revision:

Add following sentence to the last paragraph of Section 2.5.2.4, and add new Table 2.5-27:

Strain compatible shear-wave velocities and material damping values resulting from the development of the 1 to 2 Hz and 5 to 10 Hz soil transfer functions are listed in Table 2.5-

27. These values are based on an analysis with the top 50 ft of loess removed to provide a foundation initial stiffness of 1,000 ft/sec.

Table 2.5-27

Strain Compatible Dynamic Material Properties Obtained In Developing The 1 to 2 Hz and 5 to 10 Hz Transfer Functions For The Profile With 1,000 ft/sec Material Outcropping at The Surface

	Vs (ft/sec) 1 to 2 Hz		
Depth (ft)	16th	Median	84th
4.8	685.7	920.5	1235.8
14.3	674.5	921.9	1256.0
23.8	665.6	905.7	1232.3
33.3	649.3	900.2	1248.0
42.8	682.5	940.3	1295.4
52.3	677.7	934.8	1289.3
61.8	662.3	939.8	1333.6
71.4	687.0	1006.8	1475.6
80.9	719.2	1065.7	1579.2
90.4	783.8	1159.0	1713.8
98.5	836.1	1258.0	1892.7
105.1	952.8	1390.7	2029.8
111.8	1024.6	1527.2	2276.2
123.2	1300.5	1794.5	2476.1
139.2	1358.0	1848.0	2514.7
155.3	1414.2	1917.1	2598.9
171.4	1428.5	1981.6	2748.8
187.5	1538.5	2095.5	2854.1
203.6	1546.0	2086.0	2814.6
219.6	1544.0	2110.7	2885.5
235.7	1493.3	2062.5	2848.7
251.8	1509.4	2102.1	2927.5
267.9	1463.0	2075.6	2944.7

Depth (ft)	Damping (%) 1 to 2 Hz		
	16th	Median	84th
4.8	0.8	1.2	1.7
14.3	1.1	1.7	2.8
23.8	1.3	2.2	3.6
33.3	1.5	2.3	3.5
42.8	1.6	2.4	3.7
52.3	1.7	2.6	4.2
61.8	1.7	2.8	4.4
71.4	1.6	2.7	4.5
80.9	1.5	2.6	4.5
90.4	1.5	2.5	4.2
98.5	1.4	2.3	3.9
105.1	1.3	2.2	3.5
111.8	1.2	2.0	3.4
123.2	0.8	1.3	1.9
139.2	0.8	1.3	1.9
155.3	0.8	1.3	1.9
171.4	0.8	1.2	1.9
187.5	0.8	1.2	1.8
203.6	0.8	1.2	1.9
219.6	0.8	1.2	1.9
235.7	0.8	1.3	2.0
251.8	0.8	1.3	2.0
267.9	0.8	1.3	2.1

Depth (ft)	Vs (ft/sec) 5 to 10 Hz		
	16th	Median	84th
4.8	689.2	923.3	1237.0
14.3	682.2	928.6	1264.0
23.8	676.3	915.1	1238.1
33.3	664.0	911.7	1251.7
42.8	696.1	952.3	1302.7
52.3	692.0	947.7	1297.9
61.8	677.1	953.5	1342.8
71.4	698.9	1019.9	1488.4
80.9	731.2	1078.7	1591.5
90.4	795.7	1171.8	1725.8
98.5	847.8	1270.8	1904.7
105.1	964.4	1403.3	2042.1
111.8	1035.9	1539.4	2287.5
123.2	1308.6	1802.8	2483.8
139.2	1365.8	1856.3	2522.8
155.3	1422.2	1925.4	2606.7
171.4	1436.6	1989.8	2755.8
187.5	1545.6	2102.7	2860.6
203.6	1553.0	2093.3	2821.6
219.6	1550.7	2117.9	2892.5
235.7	1499.8	2069.6	2856.0
251.8	1515.6	2109.1	2935.1
267.9	1469.1	2082.4	2951.9

Depth (ft)	Damping (%) 5 to 10 Hz		
	16^{th}	Median	84^{th}
4.8	0.8	1.2	1.7
14.3	1.0	1.6	2.6
23.8	1.2	2.0	3.2
33.3	1.4	2.1	3.1
42.8	1.4	2.2	3.3
52.3	1.5	2.4	3.7
61.8	1.6	2.5	4.0
71.4	1.4	2.4	4.1
80.9	1.4	2.4	4.1
90.4	1.4	2.3	3.8
98.5	1.3	2.2	3.6
105.1	1.2	2.0	3.2
111.8	1.1	1.9	3.1
123.2	0.8	1.2	1.8
139.2	0.8	1.2	1.8
155.3	0.8	1.2	1.8
171.4	0.8	1.2	1.8
187.5	0.8	1.2	1.7
203.6	0.8	1.2	1.8
219.6	0.8	1.2	1.8
235.7	0.8	1.2	1.9
251.8	0.8	1.2	1.9
267.9	0.8	1.3	2.0

Question 2.5.5-1

In RAI 2.5.5-1, the staff requested the applicant to perform an evaluation to demonstrate the expected behavior of the loess escarpment or the extent to which such movements will not occur. In its response to RAI 2.5.5-1, the applicant indicated that they modified the ESP site plan to restrict the location of the PPBA to a distance of over 30.48 m (100 ft) from the bluff area on the west side of the site. They also indicate that based on a qualitative assessment of stability, the hazard to the ESP site from potential future movements of the loess soils is very low to nil. However, this qualitative assessment was based on potential failure plane relationships and did not consider the potential impact of differences in elevations on SSI evaluations of safety-related facilities.

Response:

Additional clarification will be added to the SSAR text in response to this comment. Please refer, however, to RAI Figure 2.5.5-1-1 for a true scale (i.e., no vertical exaggeration) cross section of the site.

SSAR Revision:

Add following paragraph after last paragraph of Section 2.5.4.3

As shown on Figures 2.5-69 and 2.5-76, a 150-foot setback distance has been established from the top of the 80-foot-high loess bluff that borders the Mississippi River floodplain. This setback is a minimum of 500 feet from the base of the bluff. In addition, the existing ground surface at the ESP site will be locally lowered about 25 feet to develop a uniform plant yard grade at elevation 132 feet. This grading will decrease the elevation differential between the base of the loess bluff and power plant yard to about 55 feet. The post-grading projected slope angle between the base of the bluff and closest approach of the ESP Power Block Area will be about 8 degrees. An existing shallow slump was mapped in the face of the bluff during ESP field studies, and it is possible that the bluff could undergo additional future shallow slumping or erosion from heavy rainfall, earthquake shaking, or flood erosion. Possible future slumping or erosion could result in slight changes in the local topography, but should not result in a measurable reduction in soil lateral capacity for structures in the ESP Power Block Area, or significantly influence the lateral response of the soils under dynamic loading from a future buried structure at the edge of the site. However, future SSI analyses that may be performed for structures that are located in the southwest quadrant of the ESP site should specifically incorporate possible minor effects resulting from the local topography or possible future changes in topography.

COL Comments/Questions

COL Comment 2.5.4-1

In RAI 2.5.4-2, the staff requested the applicant to describe the character of the fill material and controls, if any, that were placed on the fill at the time of their deposition. From its review of the applicant's response as summarized in Section 2.5.4.1.2 of this report, the staff found that the applicant indicated that they filled the original southwest trending swales that existed in the area during the site grading associated with the prior development of the GG site. The fill placed at that time brought the ESP area to its current configuration. The applicant further indicated that the current state of the fill is relatively loose with measured SPT blow counts in the range of 5 to 7 blows per foot. Grain size characteristics of this fill are unknown but no unusual behavior has been noted over the years since its original placement. Since this material does not extend to significant depths, it was indicated that this fill would not impact foundations of any power block facilities to be constructed in the area. The procedure used by the applicant is consistent with industry practice and is acceptable. In the response, the applicant indicated that they will update the SSAR to include these revised descriptions. The applicant also indicated that the COL applicant will conduct detailed studies of the fill material and the required treatment during the COL stage.

Response:

SERI concurs with COL Comment 2.5.4-1

SSAR Revision:

SSAR text has been revised as indicated in response to RAI 2.5.4-2

COL Comment 2.5.4-2

Section 2.5.4.3 in RS-002 directs the staff to compare the applicant's plot plans and profiles of all seismic Category I facilities with the subsurface profile and material properties. Based on the comparison, the staff can determine if (1) the applicant performed sufficient exploration of the subsurface materials and (2) the applicant's foundation design assumptions contain adequate margin of safety. On this basis, the staff finds the applicant's description of the relationship of foundations and underlying materials acceptable. The applicant plans to provide this information as part of its COL submittal. Submission of the applicant's plot plans and profiles of all seismic Category I facilities for comparison with the subsurface profile and material properties is a COL Action Item.

Response:

SERI concurs with COL Comment 2.5.4-2

SSAR Revision:

None required.

COL Comment 2.5.4-3

The staff notes that the applicant should evaluate, during the COL stage, potential excavation procedures that may be used as well as impact of the adjacent bluff on temporary support conditions and how this may impact standoff distances in the ESP area.

Response:

SERI concurs with this COL Comment.

SSAR Revision:

See response to Comment 2.5.5-1.

COL Comment 2.5.4-4

In RAI 2.5.4-9, the staff requested the applicant to provide basis for indicating that the Grand Gulf ESP site is not susceptible to potential long-term problems such as dissolution cavities and/or sinkholes. From its review of the applicant's response as summarized in Section 2.5.4.1.4 of this report, the staff found that karst formations as indicated by the applicant are probably not of concern in the calcareous clays and limestone deposits at the site. However, the applicant further indicated that additional site investigations would need to be conducted during the COL phase of the nuclear project including deep borings in the footprint of the power block structures. To properly evaluate this potential during the COL stage, the future performance of the boring program needs to evaluate the potential for such karst formation in addition to other requirements described in RG 1.132 and documented in the SSAR.

Response:

SERI concurs with this COL Comment.

SSAR Revision:

None required.

COL Comment 2.5.4-5

In SSAR Section 2.5.4.6, the applicant indicates that specific design criteria will be developed during the COL stage when the specific characteristics of the operating system will be known. Design criteria associated with structural design such as potential wall rotations, facility sliding and overturning will need to be developed for specific facilities.

Response:

SERI concurs with this COL Comment.

SSAR Revision:

None required.

COL Comment 2.5.6-1

The staff's review found that although no impoundment structures lie within the ESP area, the effect of potential flooding of the Mississippi River on the behavior and possible future erosion of the bluff has not been evaluated. The COL applicant should evaluate these effects and their impact on SSI effects.

Response:

SERI concurs with this COL Comment.

SSAR Revision:

None required.

Confirmatory Comments

Confirmatory Comment 2.5.4-1

See COL Comment 2.5.4-1 above.

Response:

SERI concurs with COL Comment 2.5.4-1

SSAR Revision:

SSAR text has been revised as indicated in response to RAI 2.5.4-2

Confirmatory Comment 2.5.4-2

In RAI 2.5.4-6, the staff requested the applicant to provide the basis for the selection of the EPRI93 curves as opposed to other models that may be more appropriate based on site specific information described in the geotechnical report. From its review of the applicant's response as summarized in Section 2.5.4.1.2 of this report, the staff found that the applicant used the EPRI93 curves to represent the nonlinear properties of the three primary units of the shallow portion of the site profile (loess, alluvium and old alluvium). They selected the EPRI93 curves for deeper depths to account for the more linear behavior of these materials expected due to their overconsolidated state. Below a depth of about 152.4 m (500 ft) of the profile, they considered the soil properties to be linear. With respect to the issue of the appropriateness of using the EPRI93 curves to represent gravel units of the profile, the applicant's response indicates that at the Grand Gulf site the gravels of the profile are relatively fine gravels in a matrix of a sandier matrix. These zones are also indicated to be no more than 1.52 m (5 ft) thick and appear to be discontinuous across the site. The samples viewed by the staff during the site visit corroborated this description. On this basis discussed above, the staff considers that the use of EPRI93 curves (soil model) to represent site soils is consistent with industry practice, and therefore, acceptable. The applicant committed, in their response, that they will update the SSAR to properly indicate which curves of the EPRI93 data set were used for each member of the site profile.

Response:

SERI concurs with this Confirmatory Comment.

SSAR Revision:

SSAR text has been revised as indicated in response to RAI 2.5.4-6.

Question 2.5.4-1

In RAI 2.5.4-8, the staff requested the applicant to explain how the values of shear wave velocity developed at the ESP site compare with the best estimate (BE), upper bound (UB) and lower bound (LB) values used in the site response calculations and why the mean velocity values for all the material layers not approximately centered on the ranges listed in ER-02 Table 8.2. From its review of the applicant's response as summarized in Section 2.5.4.1.2 of this report, the staff found that the best estimate S-wave velocity profile used by the applicant in the site response calculations is based on a visually averaged composite of the three P-S velocity profiles. Further, these data are not associated with specific stratigraphic units. Since the modulus degradation and hysteretic damping properties used in the calculations are also not related to stratigraphic units, the staff considers the applicant's response acceptable. However, the applicant should incorporate these responses into the SSAR.

Response:

SERI concurs.

SSAR Revision:

Delete last sentence of Section 2.5.4.1.3.1.
Delete last sentence of Section 2.5.4.1.3.2
Delete last sentence of Section 2.5.4.1.3.3
Delete second to last sentence of Section 2.5.4.1.3.4

Add following statement to Section 2.5.2.3, 3rd paragraph, after the 8th sentence. Continue text with a paragraph break.

The best estimate velocity profile adopted for the site response analysis is presented in Figure 2.5-60. This profile is based on a visual average of the composite, elevation-correlated P-S velocity profiles from the three ESP boreholes. It is an averaged smoothed profile that does not use extreme values. The site soil response velocity profile best estimate interval velocities are not set at stratigraphic unit boundaries, but rather are assigned at visually determined velocity breaks in the composite P-S profile. For this reason, the best estimate site soil response average velocities are not centered on the mean values listed for material layers provided in Engineering Report ER-02, Table 8-2.

Question 2.5.4-2

Although the geotechnical evaluation of many ordinary facilities encountered issues of budget concerns impacting the numbers of samples taken and samples tested, it is unusual for such reasoning to impact foundation design issues for critical facilities, especially for a program where so few borings and samples were taken as compared to the guidelines provided in RS-002, RG 1.132 and RG 1.138. It is important that the SSAR should indicate if these parameters described above are of serious concern to site response issues associated with the ESP program or are more of concern for detailed foundation design that will be performed during the COL stage.

Response:

The level of geotechnical investigation performed for the Grand Gulf ESP application is considered appropriate to provide reasonably conservative dynamic soil and rock properties for use in the site response analysis and foundation assessment. Three borings and four Cone Penetrometer Test (CPTs) soundings, supplemented by twenty borings in the ESP site area performed for the existing Grand Gulf UFSAR, provide the basis for our estimation of soil properties at the site. This level of investigation provides reasonable assurance that the actual site conditions determined during the COL phase of site investigation will be consistent with the site subsurface model developed to support the ESP application as indicated in RS-002. During the COL phase, additional geotechnical borings and laboratory analyses will be performed in accordance with Regulatory Guides 1.132 and 1.138. As indicated in response to Comment 2.5.4-2 above, if the additional site investigations performed during the COL phase indicate differences in material properties that may have a significant impact on design motions, we will evaluate the need to perform additional site response analyses with the updated properties to develop revised design motions.

SSAR Revision:

See response to Comment 2.5.4-2.