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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the matter of	)	
	)	
SYSTEM ENERGY RESOURCES, INC.	)	Docket No. 52-009-ESP
	)	
(Early Site Permit for Grand Gulf ESP Site)	)	ASLBP No. 04-823-03-ESP

PRE-FILED TESTIMONY OF LORI M. EVANS, WILLIAM R. LETTIS, AND JEFFREY L. BACHHUBER ON BEHALF OF APPLICANT CONCERNING HEARING ISSUE A (SITE CHARACTERIZATION)

Q1. Please state your name, current position, and by whom you are employed.

A1. My name is Lori M. Evans ("LME"). I am employed as Senior Project Manager for ENERCON Services, Inc.

A1. My name is William R. Lettis ("WRL"). I am employed as the President and Principal Geologist of William Lettis & Associates, Inc.

A1. My name is Jeffrey L. Bachhuber ("JLB"). I am employed as the Vice President, Senior Principal Engineering Geologist of William Lettis & Associates, Inc.

Q2. On whose behalf will are you testifying in this proceeding?

A2. (LME, WRL, JLB) We are providing testimony on behalf of the applicant in this early site permit ("ESP") proceeding, System Energy Resources, Inc. ("SERI" or the "Applicant").

Q3. Please describe your professional qualifications.

A3. (LME) I hold a B.S. degree in Geology from Tennessee Technological University. I have over fourteen years of experience that includes project management, a varied technical background, and environmental risk analysis. I have acted as task leader for hydrologic analyses

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for a proposed expansion of an existing nuclear power plant, have assisted in development of new bank environmental policy guidance documents, and have been responsible for managing multiple-site Phase I environmental site assessment projects. A full statement of my professional qualifications is contained in SERI Exhibit 1.

A3. (WRL) I hold a Ph.D. and an M.S degree in Geology from the University of California, Berkeley, and a B.S. degree in Geology and a B.S. degree in Forestry from Humboldt State University. I have over 20 years experience performing regional and site investigations to assess geologic and seismic hazards for large engineered facilities, including bridges, dams, nuclear and fossil fuel plants, pipelines, and liquid natural gas ("LNG") terminals. A full statement of my professional qualifications is contained in SERI Exhibit 1.

A3. (JLB) I hold M.S. and B.A. degrees in Geology from San Jose State University. I am a Certified Engineering Geologist in California with over 20 years of professional experience performing geologic/geotechnical studies for nuclear and other critical facilities throughout the United States, Peru, Dominican Republic, Puerto Rico, Korea, Indonesia, Japan, and Turkey. I have performed detailed site investigations in a variety of geologic settings, in addition to regional hazard mapping and facility siting and routing studies. These projects involved assessment of earthquake hazard and sources, fault rupture and ground failure analysis, slope stability analysis and mitigation design, karst and void identification and treatment, foundation characterization with borings and geophysical techniques, laboratory testing, failure mode assessment, and development of foundation criteria for detailed static and dynamic stability and site response analyses (including soil-structure interaction) A full statement of my professional qualifications is contained in SERI Exhibit 1.

Q4. Please describe your professional responsibilities with regard to the Grand Gulf ESP application, including the basis for your familiarity with that application.

A4. (LME) I am task leader for the hydrologic analysis sections of the Grand Gulf ESP application. As task leader, I was responsible for assessing the potential impacts on the surface water and groundwater of constructing and operating a nuclear power generating facility at the Grand Gulf site.

A4. (WRL) As Project Manager for the seismic and geotechnical work in support of the Entergy Grand Gulf Nuclear Station ("GGNS") ESP, my responsibilities include preparation of Sections of 2.5.1 through 2.5.6 of the SSAR, including seismic source characterization and probabilistic seismic hazard analysis to develop the safe shutdown earthquake ("SSE") design ground motion in compliance with Regulatory Guide 1.165, and, geotechnical characterization of the site in partial compliance with Regulatory Guides 1.138 and 1.132.

A4. (JLB) I was responsible for developing detailed site geotechnical characterization for the Grand Gulf ESP site. My work regarding the Grand Gulf ESP included developing quality assurance/quality control ("QA/QC") technical procedures and workplans to guide all field and laboratory activities, directing field investigations consisting of geologic mapping, deep mud rotary borings, cone penetrometer soundings, borehole P-S velocity surveys, and SASW surface surveys. I also prepared Sections 2.5.4 to 2.5.6 for the site safety analysis report ("SSAR"), responded to Nuclear Regulatory Commission ("NRC") requests for additional information ("RAIs"), and presented the project to the Advisory Committee on Reactor Safeguards ("ACRS") in a formal meeting.

Q5. In an Order (Requesting Specific Summary Exhibits and Supplemental Briefs; Identifying Hearing Issues and Requesting Evidentiary Presentations on Specific Issues) of

November 6, 2006, the Atomic Safety and Licensing Board ("Board") identified a series of hearing issues on which the Board has required testimony and presentations from the NRC Staff. The Staff submitted its pre-filed testimony on November 20, 2006. *See* NRC Staff Pre-Filed Testimony Concerning Hearing Issue A: "Site Characterization" (Nov. 20, 2006). Have you reviewed the Staff's testimony on Hearing Issue A?

A5. (LME, WRL, JLB) Yes.

Q6. During the October 31, 2006, pre-hearing conference, the Board expressly authorized the Applicant, as appropriate, to submit supplemental pre-filed testimony for the limited purpose of clarifying and/or providing additional factual information that may inform the Board's mandatory hearing review and decision-making process. *See* Transcript of October 31, 2006, Prehearing Conference at 8. Do you wish to provide any such supplemental testimony at this time?

A6. (WRL, JLB) Yes. We are offering supplemental testimony with respect Answers 5 and 11 of the NRC Staff's pre-filed testimony.

A6. (LME) Yes. I am offering supplemental testimony with respect to Answer 3 of the NRC Staff's pre-filed testimony.

Q7. Turning to Answer 5 of the Staff's pre-filed testimony, please provide any additional information that you believe is necessary.

A7. (WRL, JLB) In Answer 5 of its pre-filed testimony (under the section entitled "Characterization Relating to Potential Karst Formation,") the NRC Staff states that "materials below the plant are calcareous and therefore potentially susceptible to the effects of dissolutioning." Staff Issue A Testimony, A.5 at 8. Although SERI agrees with this general comment, it warrants mention that these calcareous deposits beneath the site occur at a minimum

depth of 390 feet below the surface, over 200 feet below the maximum embedment depth for any reactor considered in the ESP application.

The Staff further indicates that deep borings are "most likely inappropriate" to investigate the potential for dissolutioning or karst formation within these calcareous materials at the site, and that the "Applicant should search and investigate the available data base of information for the known site materials, and determine the opinions of recognized geologic experts versed in the area" Staff Issue A Testimony, A.5 at 8. SERI concurs with the Staff position. In fact, in response to Staff RAI 2.5.4-9, SERI performed a three-part investigation of the potential for karst formation at the site. That investigation included: (1) evaluating and documenting the presence or absence of karst features in the Site Area; (2) evaluating and documenting the presence or absence of karst features in outcrop areas of the Vicksburg Group in the Site Area and Site Region, including discussions with recognized geologic experts; and (3) evaluating the zone of influence of any new proposed foundation on the Vicksburg Group strata, assuming that dissolutioning might occur. Each of these evaluations showed that karst development is not present in the site area; that the Glendon Limestone within the Vicksburg Group is not susceptible to dissolutioning; and that even if dissolutioning were to occur within the Glendon Limestone at a depth of 390 feet or more, it would be below the zone of foundation influence at the site. Nevertheless, as discussed in the FSER at 2-236 (Section 2.5.4.3.6), and as required by COL Action Item 2.5-8, a deep boring program will be implemented during the COL geotechnical program to evaluate the potential for karst formation and dissolutioning within the Glendon Limestone beneath the site.

As a final clarification regarding the Staff's testimony on karst formation, SERI is unaware of any Staff requirement to perform chemical evaluations of available soil samples prior

to planning any deep boring program during the COL site investigation. *See* Staff Issue A Testimony, A.5 at 9. Consistent with COL Action Items 2.5-3 and 2.5-4, SERI will undertake additional borings, laboratory testing, geophysical surveys, and geotechnical investigations during the COL phase.

Q.8 Turning to Answer 11 of the Staff's pre-filed testimony, please provide any additional information that you believe is necessary.

A.8 (WRL, JLB) In Hearing Issue A, Answer A.11 of the NRC Staff pre-filed testimony, the Staff discussed issues related to stability of the river bluff, plant foundation embedment depth, and minimum required shear wave velocity. This testimony provides additional clarification of these issues.

Setback from River Bluff

SERI Exhibit 3 provides a graphic representation of the relationships between the river bluff slope and ESP proposed plant reactor building envelope. This figure shows that the ESP setback distance provides a sufficient safety buffer against any reasonable potential failure surfaces from intersection of the proposed plant envelope. In order to reach the proposed plant envelope area, a failure plane extending from the river bluff would have an inclination significantly less than 15 degrees (above horizontal), which is far below typical estimated residual angles of internal friction (angle of repose) for the loess soil that forms the river bluff and typically stands vertically in excavated cuts.

Existing Fill

Existing fill underlying the ESP proposed reactor building envelope is localized and shallow (depth of fill above approximate elevation 100 feet; SERI Exhibit 3), and does not extend to the foundation depth ranges of planned power plants.

Foundation Depth

The Environmental Report plant parameters envelope (PPE; Table 3.0-1) lists the ESP bounding foundation embedment depth as 140 feet. This depth is the maximum depth of the bottom of the foundation basemat, as measured from the finished plant grade (assumed at approximately elevation 133 feet above mean sea level ("MSL")) for any reactor design considered in the ESP Application. The relative location and elevation of this bounding depth with respect to the existing ground surface is shown on SSAR Figures 2.5-75 through 2.5-77 (geologic cross sections A-A', B-B', and C-C'), and labeled as "likely maximum foundation depth range within Proposed PPBA" (Proposed Power Block Area). The corresponding elevation of this maximum bounding embedment depth is approximately elevation (-)7 feet MSL.

Other plant technologies considered in the ESP Application have basemat elevations that are shallower than the bounding embedment depth, typically within the range of about 30 to 70 feet below finished plant grade. The stability and foundation suitability of subsurface materials that occur between assumed finished plant grade and the bounding maximum foundation depth range (and below this depth range throughout the likely range of foundation influence) were specifically evaluated with respect to the varying technologies and possible embedment depths. This evaluation included compilation and review of about twenty existing borings from the Unit 1 Updated Final Safety Analysis Report ("UFSAR") that are within and adjacent to the ESP reactor building envelope (See SERI Exhibit 3; SSAR Figure 2.5-69), drilling and sampling of three ESP borings, four ESP cone penetrometer soundings, seismic velocity surveys in the ESP borings, and laboratory static and dynamic testing of ESP borehole samples. On the basis of this evaluation, Section 2.5.4.6 of the SSAR recommends that the plant foundations be founded in

Upland Complex alluvium at, or below, the bottom of loess deposits at approximately elevation 97 feet MSL (depth of 36 feet) or lower where the average shear wave velocity exceeds 1,000 feet per second and materials consist of dense alluvium.

Responses provided by NRC Staff in pre-filed testimony reference foundation embedment depths of between 120 and 140 feet (average depth of 130 feet). This depth correlates to the PPE bounding embedment depth for ESP foundations, rather than a minimum or design depth that could be at shallower depths according to the ESP evaluation.

Shear Wave Velocity

Some plant designs considered in the ESP Application reference a minimum 1,000 feet-per-second ("fps") shear wave velocity ("Vs") requirement for soils below the safety-related plant foundation basemat. Shear wave measurements of site subsurface materials were obtained by borehole P-S suspension surveys in each of the three ESP borings distributed within the proposed reactor building envelope (SSAR Figure 2.5-80). Based on the results from the ESP velocity surveys, Section 2.5.4.6 of the SSAR states that the average Vs exceeds 1,000 fps (in Upland Complex Alluvium) at, and below, approximately elevation 97 feet MSL (depth of about 36 feet below assumed finished plant grade elevation 133 feet MSL). Plant basemat (foundation) elevations above this level would require overexcavation of soils down to material exhibiting an average shear wave velocity of 1,000 fps, or alternatively in-situ improvement (*e.g.* grouting). Excavated soils would be replaced with engineered fill (*e.g.*, lean concrete) that exhibits an average Vs of 1,000 fps or greater.

The shear wave velocity criteria and foundation engineering approaches presented in the ESP SSAR permit plant foundation basemat embedment in Upland Complex alluvium at depths substantially less than the depth range of 120 to 140 feet referenced by the NRC Staff in their responses.

Q9. Turning to Answer 3 of the Staff's pre-filed testimony, please provide any additional information that you believe is necessary.

A9. (LME) In Answer 3 of the Staff's pre-filed testimony, the Staff refers in several instances to three ground water wells in the Catahoula formation that are used to supply water for general site purposes of the existing plant, referencing SSAR Table 2.4-25. The Staff further states that based on available groundwater characterization data, the Staff determined that it is not unreasonable to expect that a suitable system of groundwater wells can be designed to extract water at a maximum rate of 3570 gpm from the Catahoula formation. The Staff further states in Answer 3 that impacts to the Catahoula aquifer was "unresolved" and if SERI continues to propose to withdraw water from the Catahoula Formation for construction and operation of the ESP facility, the Staff will require further characterization of the Catahoula aquifer.

Regarding the location of the three GGNS ground water wells currently in service, SERI provides the following correction based on current information and recent site investigations conducted as part of the ongoing COLA activities at the GGNS site. The withdrawal permit for two of three wells (TW-1A and TW-1B) referenced by the Staff was renewed in 1996, and the renewal application lists the source as the Catahoula aquifer. The withdrawal permit for the two wells that are currently in routine use was renewed in 2006, and the renewal application lists the source as the Miocene aquifer system (which includes the Catahoula Formation). The ESP application consistently references the source of potable water as the Catahoula formation, based

on the information provided in these recent withdrawal permits. Soil characterization results from recent COLA site investigations, however, in the general area of the location of these wells and review of historical well installation records for the wells, indicate that the wells are in fact screened in terrace materials overlying the Catahoula Formation.

COL Action Item 2.4-8 in FSER Appendix A requires that the COL applicant referencing the GGNS ESP demonstrate that an adequately designed ground water well system is provided for the ESP facility. Regardless of the source of the ground water, *i.e.*, Catahoula or terrace deposits, this COL Action Item still requires satisfactory resolution. Construction and operational impacts on water use and water quality are unresolved in the Environmental Impact Statement ("EIS"); thus, additional characterization of ground water will be required for a COL application, regardless of the eventual source of ground water to provide plant potable water and other possible needs.

Q10. Does this conclude your testimony?

A10. (LME, WRL, JLB) Yes.

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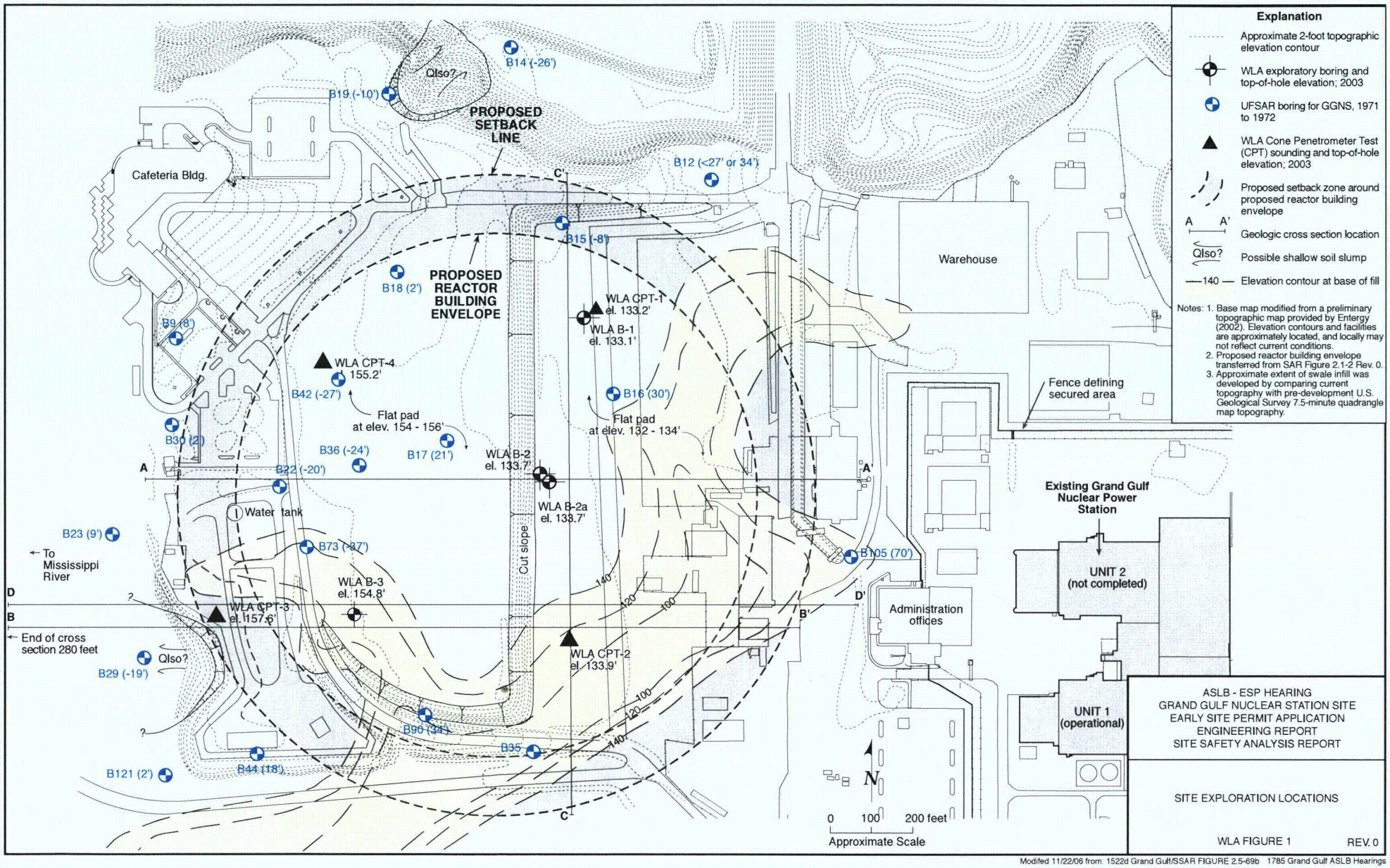

Modifed 11/22/06 from: 1522d Grand Gulf/SSAR FIGURE 2.5-69b 1785 Grand Gulf ASLB Hearings

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CERTIFICATE OF SERVICE

I hereby certify that copies of System Energy Resources Inc. Prefiled Testimony Concerning Hearing Issue [A Through I], with associated exhibits, in the above captioned proceeding have been served as shown below by deposit in the United States Mail, first class, this 22nd day of November, 2006. Additional service has also been made this same day by electronic mail as shown below.

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