

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)	)	

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NRC STAFF's PROPOSED FINDINGS OF FACT AND  
CONCLUSIONS OF LAW IN THE MANDATORY HEARING

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I. INTRODUCTION

These findings and rulings address all issues with respect to this uncontested proceeding on the application filed by System Energy Resources, Inc. ("SERI" or "the Applicant") for an early site permit ("ESP"), under 10 C.F.R. Part 52. For the reasons stated below, the Board hereby makes the following findings of fact and conclusions of law.

II. PROCEDURAL BACKGROUND

On October 16, 2003, SERI filed an ESP application with the NRC, requesting approval for a site in Claiborne County, Mississippi. On January 16, 2004, the Commission issued a notice announcing the opportunity to petition to intervene in a hearing on the application. 69 Fed. Reg. 2636 (Jan. 16, 2004) ("Hearing Notice"). On March 22, 2004, this Board was established to rule on petitions for hearing and for leave to intervene, and to preside over the adjudicatory proceeding held in connection with the SERI application.<sup>1</sup>

Several petitioners filed requests for hearing and petitions to intervene, but the Board denied intervention after finding that the petitioners had failed to submit at least one admissible contention. See *System Energy Resources, Inc.* (Early Site Permit for Grand Gulf ESP Site),

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<sup>1</sup> The Board was reconstituted with new panel members on December 15, 2005. See Notice of Reconstitution, December 15, 2005.

LBP-04-19, 60 NRC 277 (2004). This ruling was affirmed by the Commission on appeal. See *System Energy Resources, Inc.* (Early Site Permit for Grand Gulf ESP Site), CLI-05-04, 61 NRC 10 (2005). While the proceeding is therefore uncontested, the mandatory component of the hearing remains before the Board, as described below in Part III.

On April 7, 2005, the NRC Staff ("Staff") issued its Draft Safety Evaluation Report ("DSER") for public comment [ADAMS Accession No. ML050910331]. On April 21, 2005, the Staff issued its draft Environmental Impact Statement ("DEIS") discussing the results of its evaluation of the environmental report for the Grand Gulf ESP site [ADAMS Accession No. ML051110531]. During the comment period after issuance of the DEIS, the environmental staff conducted a public meeting in Port Gibson, Mississippi, on June 28, 2005, to describe the results of the NRC environmental review, answer questions, and provide members of the public with information to assist them in formulating comments on the DEIS.<sup>2</sup> FEIS at xxvii.

The Advisory Committee on Reactor Safeguards ("ACRS") independently reviewed those aspects of the application that concern safety, as well as the safety evaluation report, and provided the results of its review to the Commission in an interim report dated June 14, 2005 [ADAMS Accession No. ML051650415], and in a final report dated December 23, 2005 [ADAMS Accession No. ML053620401]. On April 14, 2006, the ACRS found acceptable the changes the Staff had made to its SER in response to earlier ACRS comments [ADAMS Accession No. ML061060003].

In April 2006, the Staff issued its Safety Evaluation Report ("SER"). NUREG-1840, "Safety Evaluation Report for an Early Site Permit (ESP) at the Grand Gulf Site." [ADAMS Accession No. ML052860041]. Also in April 2006, the Staff issued its Final Environmental

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<sup>2</sup> The environmental staff conducted a public scoping meeting in Port Gibson, Mississippi, on January 21, 2004, and visited the Grand Gulf ESP site on July 29, 2003, January 21, 2004, and April 12 and 13, 2004. FEIS at xxvi.

Impact Statement (“FEIS”). NUREG-1817, “Environmental Impact Statement for an Early Site Permit (ESP) at the Grand Gulf ESP Site,” Final Report [ADAMS Accession No. ML060900037].

### III. LEGAL STANDARDS

The NRC is required by the Atomic Energy Act and agency regulations to hold a hearing for license applications for early site permits, regardless of whether the issuance of the application is contested. Atomic Energy Act section 189a, 42 U.S.C. § 2235; *see also* 10 C.F.R. §§ 52.18, 52.21, 52.24 (extending hearing requirements for construction permits to ESP applications). These hearings are known as “uncontested” or mandatory hearings. The purpose of a mandatory hearing differs from that of a “contested” hearing, which refers to “(1) a proceeding in which there is a controversy between the [NRC Staff] and the [applicant] concerning the issuance of the license or any of the terms or conditions thereof or (2) a proceeding in which a petition for leave to intervene in opposition to an [application] has been granted or is pending before the Commission.” 10 C.F.R. § 2.4. If a license application for a type of facility subject to the mandatory hearing requirement is contested, the hearing will be bifurcated into contested and uncontested portions on an issue-by-issue basis. *Exelon Generation Company, LLC* (Early Site Permit for Clinton ESP Site), CLI-05-17, 62 NRC 5, 34 (2005).

For contested hearings on construction permits,<sup>3</sup> 10 C.F.R. § 2.104(b)(1) requires the Board to consider a number of issues, including:

(i) Whether in accordance with the provisions of § 50.35(a) of [10 C.F.R., regarding the issuance of construction permits for nuclear power reactors]:

(a) The applicant has described the proposed design of the facility, including, but not limited to, the principal architectural and engineering criteria for the

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<sup>3</sup> In contested hearings involving early site permits, however, the issues identified in § 2.104(b)(1)(i)(a) through (i)(c) are not necessarily ripe for Board consideration, because the reactor design typically has not even been chosen at the ESP stage.

design, and has identified the major features or components incorporated therein for the protection of the health and safety of the public;

(b) Such further technical or design information as may be required to complete the safety analysis, and which can reasonably be left for later consideration will be supplied in the final safety analysis report;

(c) Safety features or components, if any, which require research and development, have been described by the applicant and the applicant has identified, and there will be conducted, a research and development program reasonably designed to resolve any safety questions associated with such features or components; and

(d) On the basis of the foregoing, there is reasonable assurance that (1) such safety questions will be satisfactorily resolved at or before the latest date stated in the application for completion of the proposed facility; and (2) taking into consideration the site criteria contained in Part 100 of this chapter, the proposed facility can be constructed and operated at the proposed location without undue risk to the health and safety of the public;

(ii) Whether the applicant is technically qualified to design and construct the proposed facility;

(iii) Whether the applicant is financially qualified to design and construct the proposed facility;

(iv) Whether the issuance of a permit for the construction of the facility will be inimical to the common defense and security or to the health and safety of the public;

(v) If the application is for a construction permit for a nuclear power reactor . . . or other facility whose construction or operation has been determined by the Commission to have a significant impact on the environment, whether, in accordance with the requirements of Subpart A of Part 51 of this chapter, the construction permit should be issued as proposed.

In contrast, for hearings on uncontested applications<sup>4</sup> (or on uncontested portions of otherwise contested applications), the Board, pursuant to 10 C.F.R. § 2.104(b)(2), must consider the following:

(i) Without conducting a *de novo* evaluation of the application, whether the application and the record of the proceeding contain sufficient information, and the review of the application by the Commission's staff has been adequate to support affirmative findings on (b)(1)(i) through (iii) specified in [10 C.F.R. § 2.104] and a negative finding on

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<sup>4</sup> Similar to § 2.104(b)(1), although the regulation refers only to hearings for construction permits, both issues in § 2.104(b)(2) are proper for Board consideration in hearings for early site permits.

(b)(1)(iv) specified in [§ 2.104] proposed to be made and the issuance of the construction permit proposed by the Director of Nuclear Reactor Regulation . . . and

(ii) If the application is for a construction permit for a nuclear reactor . . . or other facility whose construction or operation has been determined by the Commission to have a significant impact on the environment, whether the review conducted by the Commission pursuant to the National Environmental Policy Act (NEPA) has been adequate.

The instructions in the Commission's Hearing Notice for this proceeding are consistent with these considerations. See Hearing Notice, 69 FR at 2636.

In addition, pursuant to 10 C.F.R. § 2.104(b)(3) (in accordance with 10 C.F.R. § 51.105(a)), the Board has responsibility for three "baseline" NEPA issues, regardless of whether the proceeding is contested or uncontested. As such, the Board must:

- (1) Determine whether the requirements of section 102(2)(A), (C) and (E) of [NEPA] and the regulations in [10 C.F.R. Part 51, Subpart A] have been met;
- (2) Independently consider the final balance among conflicting factors contained in the record of the proceeding with a view to determining the appropriate action to be taken; and
- (3) Determine, after weighing the environmental, economic, technical, and other benefits against environmental and other costs, and considering reasonable alternatives, whether the construction permit . . . should be issued, denied, or appropriately conditioned to protect environmental values.

On July 28, 2005, the Commission issued a Memorandum and Order responding to six questions certified by the ASLB Panel concerning the NRC's statutory duty to conduct a "mandatory" (or uncontested) hearing for certain license applications. *Exelon*, CLI-05-17, 62 NRC at 26. Among the questions raised was whether in uncontested hearings the Board

should conduct a “*de novo*” review of the license application. The Commission determined that a *de novo* review is not necessary for mandatory hearings. Rather,

when considering safety and environmental matters not subject to the adversarial process – so-called ‘uncontested’ issues – the boards should decide simply whether the safety and environmental record is ‘sufficient’ to support license issuance. In other words, the boards should inquire whether the NRC staff performed an adequate review and made findings with reasonable support in logic and fact.

*Id.* at 39. With respect to NEPA considerations, the Commission stated that “licensing boards must reach their own independent determination on uncontested NEPA ‘baseline’ questions—*i.e.*, whether the NEPA process ‘has been complied with,’ what is the appropriate ‘final balance among conflicting factors,’ and whether the construction permit should be issued, denied or appropriately conditioned.” *Id.* at 45.

Therefore, in accordance with the applicable agency regulations, the Commission’s notice of hearing in this proceeding, and the Commission’s instructions in *Exelon*, the Board hereby makes the following findings of fact and conclusions of law.

#### IV. FACTUAL FINDINGS AND LEGAL CONCLUSIONS

##### A. Review of Safety-Related Matters

1. With respect to safety-related matters, the Commission in its January 2004 notice of hearing directed that the Board determine “whether the application and record of the proceeding contain sufficient information, and the review of the application by the Commission’s staff has been adequate to support [the findings] proposed to be made by the Director, Office of Nuclear Reactor Regulation.”<sup>5</sup> Hearing Notice at 2636; see *also* 10 C.F.R. § 2.104(b)(2)(i).

In examining the principal SERI and Staff review documents in the record, the Board sought to

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<sup>5</sup> Thus, the Board has an obligation to determine whether the application and the record of the proceeding support the Staff’s findings, but as part of that determination, it examines whether the Staff findings – made evident in the Staff’s formal review documents – demonstrate the adequacy of the Staff’s review. As the Commission advised, we approached this task by conducting an examination of the factual and logical foundation for the Staff’s conclusions regarding the sufficiency of the application.

determine whether the record would enable it to conclude that the Staff had a reasonable basis for its stated conclusions on safety matters. The Board assumed that such a reasonable basis would be present if the facts underlying a Staff determination were clear and the Staff's decision logically flowed from those facts and from appropriate regulatory guidance. The Board did not, however, undertake any independent review of, or attempt to verify, technical results presented in the SERI application or in the Staff's review documents.

1. Applicable Regulatory Guidance

2. The NRC Staff's SER delineates the scope of technical matters the Staff considered in evaluating the ESP application and the suitability of the proposed site. NRC Review Standard (RS)-002, "Processing Applications for Early Site Permits," issued in May 2004 [ADAMS Accession No. ML040700094], provides detail concerning the scope and bases of the Staff's review of the radiological safety and emergency planning aspects of a proposed nuclear power plant site. SER at 1-2. Prepared specifically to address the evaluation of ESPs, this review standard contains regulatory guidance derived from NUREG-0800, Revision 3, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," issued in July 1981 (hereinafter referred to as the Standard Review Plan or "SRP"). SER at 1-2. The Standard Review Plan reflects the NRC Staff's historical experience in establishing and promulgating guidance concerning the safety of nuclear facilities, as well as in evaluating safety assessments. SER at 1-2. Selected topics in SRP Sections 1.8, 2.4.8, and 2.4.10 relate to design and are not material to a decision on an ESP application. Accordingly, they were omitted from RS-002. Similarly, SRP chapters omitted from RS-002 relate to design and are also not material to a decision on an ESP application. The format of the Grand Gulf SER is essentially consistent with that of the SRP, as well as that of Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants" (RG 1.70). However, because not all portions of the SRP and RG 1.70 are within the



scope of an ESP proceeding, some sections of those guidance documents were not addressed by the Staff's findings. Such issues may be addressed in other licensing actions, as appropriate, such as for a construction permit ("CP") or combined operating license ("COL") application referencing an ESP. SER at 1-2.

## 2. Safety-Related Findings

3. The Staff completed its review and made findings on the safety-related matters addressed in SERI's application, including seismology, geology, meteorology, and hydrology, as well as hazards to a nuclear power plant that could result from manmade facilities and activities on or in the vicinity of the site. SER at 1-1. The Staff also assessed the risks of potential accidents that could occur as a result of the operation of a nuclear power plant(s) at the site and evaluated whether the site would support adequate physical security measures for a nuclear power plant(s). SER at 1-1. The Staff evaluated whether the Applicant's quality assurance measures were equivalent in substance to the measures discussed in Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to Title 10, Part 50, "Domestic Licensing of Production and Utilization Facilities," of the *Code of Federal Regulations* (10 C.F.R. Part 50). SER at 1-1. The NRC has previously found that such measures provide reasonable assurance that any information derived from ESP activities that could be used in the design and/or construction of structures, systems, and components ("SSCs") important to safety would support satisfactory performance of such SSCs once in service. SER at 1-1. The Staff also evaluated the adequacy of the Applicant's program for compliance with the requirements of 10 C.F.R. Part 21, "Reporting of Defects and Noncompliance." SER at 1-1. Finally, the Staff reviewed the Applicant's assessment that no physical characteristics unique to the proposed site could pose a significant impediment to the development of emergency plans (pursuant to 10 C.F.R. § 52.17(b)(1)), and reviewed the

proposed major features of the emergency plan that SERI would implement if a new nuclear unit(s) were eventually to be constructed at the ESP site. SER at 1-1.

a. SER, Chapter 1, "Introduction and General Description"

4. Chapter 1 of the SER presents the Staff's overview of the ESP review process and the procedural background of the SERI application, as well as a general description of the Applicant and of the proposed site.

5. As noted in SERI's application, no specific plant design has been chosen for the new unit(s) that would be located at the ESP site. FEIS at 1-8. Instead, SERI chose postulated design parameters, also known as a Plant Parameter Envelope ("PPE"), to provide bounds for evaluating the impacts from construction and operation of one or more new nuclear power units at the Grand Gulf ESP site. FEIS at 1-8. The PPE for the Grand Gulf ESP site envisions construction and operation of various numbers of new reactors and/or modules, configured as one or more operating units, up to a total of 8600 MW(t) or 3000 MW(e). FEIS at 1-8. Final thermal power would be dependent on the reactor plant type selected for construction at the CP or COL stage. FEIS at 1-8. The PPE states that waste heat would be dissipated by either mechanical draft or natural draft cooling towers. FEIS at 1-8. Makeup water for the cooling towers and water for other miscellaneous cooling needs at the plant would be withdrawn from the Mississippi River through an intake structure. FEIS at 1-8.

6. Based on its review of the application, the Staff found that the Applicant's postulated design parameters (its PPE) were not unreasonable, based on data from a variety of possible reactor designs that might be selected for the site. SER at 1-5. The Staff concluded that these data were generally based on certified design information and the best available information for as yet uncertified designs. SER at 1-4.

7. The Staff also confirmed that all open and confirmatory items from the DSER had been resolved, and it noted the existence of several (18) COL action items, issues that do

not need to be resolved prior to the issuance of the ESP, but that will need to be addressed at the COL stage. SER at 1-7, 1-8. In its review of the application subsequent to issuance of the DSER, the Staff identified several additional COL Action Items; these items are listed in Appendix A to the SER (NUREG-1840). SER at 1-8; SER at App. A. Finally, the Staff noted that it would recommend to the Commission a series of permit conditions; issuance of the ESP would be contingent on these limitations. SER at 1-8. In Appendix A to the SER, the Staff identified 8 proposed permit conditions; a list of all action items that should be addressed in the Final Safety Analysis Report by an applicant referencing a Grand Gulf ESP; a table of proposed site characteristics to be included in any ESP issued for the Grand Gulf site; and the bounding parameter values constituting the PPE for any Grand Gulf ESP. SER at App. A.

b. SER, Chapter 2, "Site Characteristics"

8. In Chapter 2 of the SER, the Staff evaluated a range of information concerning the site characteristics of the proposed Grand Gulf ESP site. In particular, the Staff reviewed the application with respect to geography and demography; nearby industrial, transportation, and military facilities; meteorology; hydrology; and geology, seismology, and geotechnical engineering.

i. Geography and Demography

i-a. Site Location and Description

9. As set forth below, the application describes geographic and demographic characteristics of the site that could affect the design of SSCs important to safety as may be proposed in an application referencing the Grand Gulf ESP. SER § 2.1.1.1.

10. The Grand Gulf ESP site is located in Claiborne County in southwest Mississippi. The site is on the east side of the Mississippi River about 40 km (25 mi) south of Vicksburg, Mississippi, 10 km (6 mi) northwest of Port Gibson, Mississippi, and 60 km (37 mi) north-northeast of Natchez, Mississippi. SER at 2-2 to 2-3. It is situated within the existing

boundaries of the Grand Gulf Nuclear Station ("GGNS") site, with the new nuclear power unit or units to be sited adjacent to the existing Unit 1. SER at 2-2. The Applicant provided information on several aspects of the site location, including the site boundary for a new unit(s) in reference to the existing unit; the site location with respect to political subdivisions and prominent natural and manmade features of the area within the 2-mile low-population zone ("LPZ") and 50-mile population zone; the surrounding topography; the distance (defined as a circular radius of 0.52 miles) to the nearest exclusion area boundary ("EAB"); the location of potential radioactive material release points; the distance from regional U.S. and State highways; and confirmation that no physical characteristics unique to the proposed ESP site were identified that could pose a significant impediment to the development of emergency plans. SER at 2-1, 2-2.

11. The Applicant identified the universal transverse mercator ("UTM") grid coordinates for the new unit(s) in the proposed ESP site as N3,542,873 meters and E684,021 meters, and it defined the EAB as a circular radius of 2760 feet (0.52 miles) and the LPZ as a circular radius of 2 miles, both from the circumference of a 630-foot circle encompassing the proposed powerblock housing the reactor containment structure for new unit(s). SER at 2-2. The Staff verified that the exclusion area distance is consistent with the distance used in the Applicant's radiological consequence analyses. SER at 2-2.

12. The Applicant also stated that the gaseous effluent release point is assumed to be within the proposed construction area designated for the new facility powerblock, and that the liquid effluent release point for the new units would apply at the river downstream of the new facility intake to preclude recirculation to the embalmment area and intake pipes. SER at 2-3. The Staff determined that these release points are acceptable for determining that the radiation exposures to the public to meet the criterion "as low as is reasonably achievable," cited in Appendix I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to

Meet the Criterion 'As Low as is Reasonably Achievable,' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents," to 10 C.F.R. Part 50, "Domestic Licensing of Production and Utilization Facilities." SER at 2-3.

13. The Staff therefore concluded that the Applicant provided and substantiated information concerning site location and site area that could affect the design of SSCs important to safety of a nuclear power plant(s) of specified type falling within the Applicant's PPE that might be constructed on the proposed ESP site. SER at 2-3. The Staff concluded that the information was sufficient for the Staff to evaluate compliance with the siting evaluation factors in 10 C.F.R. Part 100 and 10 C.F.R. § 52.17, as well as with the radiological consequence evaluation factors in 10 C.F.R. § 50.34(a)(1). SER at 2-3. The Staff further concluded that the Applicant provided sufficient details about the site location and site area to allow the Staff to evaluate whether the Applicant met the relevant requirements of 10 C.F.R. Part 100 and 10 C.F.R. § 52.17. SER at 2-3.

i-b Exclusion Area Authority and Control

14. The Applicant presented information concerning its plan to obtain legal authority to determine all activities within the designated exclusion area, if it decides to proceed with the development of a new reactor unit(s) at the proposed ESP site.

15. To meet the exclusion area control requirements of 10 C.F.R. § 100.21(a) and 10 C.F.R. § 100.3, the Applicant must provide reasonable assurance that it has or can acquire the required control (i.e., that it has the legal right to obtain control of the exclusion area). SER at 2-5, 2-6. Although the application indicated that SERI has site surface rights "for all practical purposes," the application noted that the Applicant does not at this time have total control over the property. SER at 2-3, 2-5. One county road (Grand Gulf Road) runs through the GGNS plant site property and another county road (Bald Hill Road) traverses the proposed ESP EAB. SER at 2-4. The Applicant also stated that it has authorized Entergy Operations to maintain

control of ingress and egress from the current exclusion area for GGNS Unit 1 and to evacuate individuals from the area in the event of an emergency. SER at 2-5. Furthermore, the Applicant identified some exceptions to its surface ownership of the site, because South Mississippi Electric Power Association ("SMEPA") maintains a 10-percent undivided ownership interest in the property associated with the existing GGNS power plant and support facilities and also maintains certain easement rights, while Entergy Mississippi, Inc., owns the 52-acre plant switchyard area, which is partially located within the plant exclusion area. SER at 2-5.

16. However, SERI stated that it is authorized to act as the general agent for SMEPA with respect to construction and operation of GGNS, and also has authority to exercise complete control and determine all activities in the exclusion area, including exclusion of Entergy Mississippi, Inc., personnel and third parties. SER at 2-5.

17. Consequently, the Applicant stated that for all practical purposes, it controls the surface rights within the ESP exclusion area, and that at such time as it elects to apply for a COL, it intends to have entered into an agreement with the selected operator of the new unit(s) to authorize the operator to exercise complete control and determine all activities within the exclusion area, including maintaining control of ingress to and egress from the exclusion area, and to provide for the evacuation of individuals from the area in the event of an emergency. SER at 2-5. The Applicant stated that at the time a COL application is submitted, arrangements would also be in place with the selected operator and the appropriate State and local law enforcement authorities for control of traffic on county roads traversing the ESP exclusion area in the event of an emergency. SER at 2-5.

18. Based on its assessment, the Staff found that SERI provided information concerning its plan to obtain legal authority to determine all activities within the designated exclusion area, and that the information is sufficient to assure compliance. SER at 2-6. The Staff also found that the Applicant appropriately described the exclusion area and the methods

by which it will control access and occupancy of the exclusion area during normal operation and in the event of an emergency situation. SER at 2-6. However, in addition to the Applicant's current exclusion area authority, the Staff concluded that a permit condition would be appropriate to require confirmation of that authority as part of any COL application referencing a Grand Gulf ESP. SER at 2-6.

i-c. Population Distribution

19. The Applicant also presented information concerning the population distribution surrounding the proposed ESP site. The Applicant provided estimates for up to a 50-mile radius from the center of the proposed powerblock location for a new facility on the proposed ESP site, based on the most recent U.S. census, and also indicated the resident population distribution within the LPZ, the nearest population center, and population densities up to a 30-mile radius from the proposed ESP site. SER at 2-7. The Applicant projected population estimates up to 2070, 5 years beyond the projected year for end of new plant life, and also estimated weighted transient populations. SER at 2-7, 2-10.

20. The Staff reviewed the Applicant's data on the population in the site environs to determine whether the exclusion area, LPZ, and population center distance for the proposed ESP site comply with the requirements of 10 C.F.R. Part 100. SER at 2-11. The Staff found that SERI provided an acceptable description of current and projected population densities in and around the site and properly specified the LPZ and population center distance. SER at 2-11. The Staff considered the Applicant's estimate of the transient population, including for both work force and recreational transients, to be reasonable. SER at 2-10.

21. In addition, based on the assumption that construction of a new nuclear reactor(s) at the proposed site would begin near the end of the term of the ESP, as well as on its review of the Applicant's population density data and projections, the Staff found that the site also meets the guidance of RS-002 regarding population densities over the facility lifetime

because the population density over that period would be expected to remain below 500 persons per square mile averaged out to 20 miles from the site. SER at 2-11. In light of the above, the Staff concluded that the proposed LPZ and population center distance meet the definitions in 10 C.F.R. § 100.3 and that the Applicant's population data and population distribution therefore satisfy the requirements of 10 C.F.R. § 52.17 and 10 C.F.R. Part 100. SER at 2-11.

22. We find that the facts described and referenced in Section § 2.1 of the SER include all geographic and demographic factors relevant to the safety review of the proposed Grand Gulf ESP site.

23. Further, we find that the Staff evaluation documented in SER § 2.1, as described above, is based on these facts, and provides reasonable support in logic to support the Staff findings in SER § 2.1.

24. Accordingly, we find that the Staff's review of geographic and demographic site characteristics was adequate.

ii. Nearby Industrial, Transportation, and Military Facilities

ii-a. Identification of Potential Hazards in Site Vicinity

25. As set forth below, the application provided information on the relative location and separation distance of the ESP site from industrial, military, and transportation facilities and routes, including air, ground, and water traffic; pipelines; and fixed manufacturing, processing, and storage facilities. SER at 2-12. Noting that the ESP site is in a rural and agricultural area where forest products are the leading industry, the Applicant stated that no military installations, industrial facilities, mining operations, or airports exist within 5 miles of the ESP site. SER at 2-12.

26. The Applicant also identified commercial or municipal airports and airways in the wider region around the ESP site, as well as the site's proximity to the Mississippi River



(including the barge port at Port Claiborne) and State Route 61. SER at 2-12. The application also discussed the underground natural gas pipeline several miles east of the site, the storage of hazardous and explosive materials on the existing GGNS site, and the transportation of hazardous materials on Route 61. SER at 2-12.

27. The Staff focused its review on potential external hazards or hazardous materials that are present or which may reasonably be expected to be present during the projected lifetime of a nuclear power plant(s) that might be constructed on the proposed site. SER at 2-12. The Staff's review relied on the application, several responses to Staff Requests for Additional Information ("RAIs"), the Staff's site visit, and other publicly available reference material, including maps and airport data. SER at 2-13, 2-14.

28. The Staff found that the application provided information in accordance with the requirements of 10 C.F.R. § 52.17 and the guidance of RG 1.70, permitting Staff to evaluate the Applicant's compliance with the requirements of 10 C.F.R. § 100.20, "Factors to be Considered When Evaluating Sites," and 10 C.F.R. § 100.21, "Non-Seismic Site Criteria." SER at 2-14. On the basis of its evaluation of the site safety analysis report ("SSAR"), as well as information obtained independently, the Staff concluded that potential hazards exist from the onsite storage of hazardous and explosive materials at GGNS, and that the Applicant identified all potentially hazardous activities on and in the vicinity of the site. SER at 2-14.

#### ii-b. Evaluation of Potential Accidents

29. The application also identified potential accident situations on and in the vicinity of the ESP site. SER at 2-16. These accidents included flammable vapor clouds, toxic chemicals, fires, collisions with the intake structure, and liquid spills. SER at 2-16. The Applicant found that, with one exception, the separation distances between the ESP site and the potential hazards identified are large enough that the effects of associated potential accidents (those exceeding the probability threshold of a DBE) would not affect the

safety-related systems of the ESP facility. SER at 2-16 to 2-18. Relevant separation distances included those to the highway, natural gas pipeline, barges, onsite truck delivery points, and onsite storage tanks. SER at 2-16 to 2-18.

30. The one exception that the Applicant identified concerned the possibility of mishaps involving barge shipments of hazardous materials on the Mississippi River past the site that could lead to overpressures in excess of the RG 1.91 criterion of 1 psi due to insufficient separation distance. SER at 2-18. In response to a Staff RAI, the Applicant conducted an analysis that indicated that the likelihood of a barge mishap leading to an explosion that could exceed 1 psi overpressure at the proposed site is on the order of  $10^{-8}$  per year. SER at 2-18.

31. The Staff reviewed this information to determine its completeness, as well as the bases upon which these potential accidents may need to be considered in the design of a nuclear power plant(s) that might be constructed on the proposed site. SER at 2-16. The Staff reviewed SERI's analyses of the probability of potential accidents involving hazardous materials or activities on and in the vicinity of an ESP facility that might be constructed on the proposed site to determine whether these analyses used the appropriate data and analytical models. SER at 2-16. The Staff also reviewed the analyses of the consequences of accidents involving nearby industrial, military, and transportation facilities to determine if any should be identified as design-basis events ("DBEs"). SER at 2-16.

32. The Staff found that the Applicant properly selected those potential accidents that should be considered as DBEs at the COL stage, in accordance with 10 C.F.R. Part 100. SER at 2-24. The Applicant identified and evaluated hazards from nearby facilities and the Staff concluded that such facilities pose no undue risk to the type of facility proposed for the site, subject to confirmation at the COL stage regarding design-specific hazard interactions. SER at 2-24. In particular, based on its finding that the Applicant used difficult-to-verify assumptions concerning the likelihood of spill frequencies and explosion probabilities, the Staff

conducted a thorough confirmatory analysis of the Applicant's assessment of the likelihood and consequences of a barge mishap. SER at 2-19 to 2-23. On the basis of its analysis, the Staff agreed with the Applicant's conclusions that the explosion hazard due to barge traffic on the Mississippi River meets the acceptance criterion of RS-002. SER at 2-23. Therefore, the Staff concluded that the ESP site location is acceptable with regard to potential accidents that could affect such a facility or facilities built on the site, and that it meets the requirements of 10 C.F.R. § 52.17(a)(1)(vii), 10 C.F.R. § 100.20(b), and 10 C.F.R. § 100.21(e). SER at 2-24.

33. However, because SERI elected to use the PPE approach for analyzing potential accidents and has not determined the specific design of the ESP facility, the Staff concluded it will need to review certain potential accidents (including some that might affect control room habitability) at the COL stage using the guidance in Section 6.4 of NUREG-0800, Revision 3. SER at 2-16, 2-23, 2-24.

34. We find that the facts described and referenced in Section § 2.2 of the SER include all factors concerning nearby industrial, transportation, and military facilities that are relevant to the safety review of the proposed Grand Gulf ESP site.

35. Further, we find that the Staff evaluation documented in SER § 2.2, as described above, is based on these facts, and provides reasonable support in logic to support the Staff findings in SER § 2.2.

36. Accordingly, we find that the Staff's review of site characteristics associated with nearby industrial, transportation, and military facilities was adequate.

### iii. Meteorology

37. As set forth below, the application describes meteorological characteristics of the site acceptable for use as part of the design bases for SSCs important to safety as may be proposed in an application referencing the Grand Gulf ESP. SER § 2.3.1.4.

iii-a. Regional Climatology

38. To establish site characteristics, the Applicant collected data from its own meteorological instruments on a tower on the Grand Gulf Nuclear Station ("GGNS") site; from National Weather Service ("NWS") stations at Vicksburg, Jackson, and Port Gibson, Mississippi; and from publications by the National Climatic Data Center ("NCDC"), the Structural Engineering Institute ("SEI"), the American Society of Civil Engineers ("ASCE") and the American Society of Heating, Refrigeration, and Air Conditioning Engineers ("ASHRAE"), all of which have been substantiated. SER §§ 2.3.1.1 at 2-25, 2.3.1.4 at 2-41.

39. The NRC Staff, in addition to the data identified in b.iii.2, evaluated data collected from the NWS station in St. Joseph, Louisiana, and from publications by the National Severe Storms Laboratory ("NSSL") and the Southern Regional Climate Center ("SRCC"). SER at 2-33.

40. The Applicant analyzed the data in accordance with methodologies generally acceptable to the Staff and yielding acceptable results (SER at 2-32 to 2-41), consistent with the SRP and Regulatory Guide (RG) 1.27, RG 1.70 and RG 1.76, as clarified by the following:

41. The Staff found more extreme high (Vicksburg data) and low (St. Joseph data) temperatures for a 100-year return period than did the Applicant. SER at 2-34. This was reflected in SER Open Item 2.3-1, to which the Applicant responded by statistically generating 100-year return period extreme temperatures based on Port Gibson data for the period 1930-2001. SER at 2-34. The Staff, having performed an equivalent analysis and having obtained similar results, agreed with the Applicant, because the Port Gibson station is approximately 5 miles from the Grand Gulf ESP site and at a similar elevation above mean sea level, while the Vicksburg and St. Joseph stations are 26 and 11 miles from the site, respectively. SER at 2-34.

42. Based on tornado data from January 1950 through August 2003, the Staff calculated an annual tornado strike probability of  $7.4 \times 10^{-4}$ , which corresponds to a mean

recurrence interval (return period) of 1350 years. SER at 2-35. The Applicant, however, used a different methodology and period of record and calculated a less-conservative tornado return period of 2860 years. SER at 2-35. The Applicant ultimately chose the tornado maximum wind speed site characteristic (300 mi/h) in accordance with Revision 1 to NUREG/CR-4461, and other tornado site characteristics consistent with the Staff's interim position on such characteristics. SER at 2-38.

43. RG 1.70 specifies that an Applicant should calculate the 100-year return period snowpack and the weight of the 48-hour probable maximum winter precipitation ("PMWP"). SER at 2-36. The Applicant determined the values of the 100-year return period snowpack and the 48-hour PMWP in accordance with Staff guidance, which would be added together, in accordance with Staff guidance, for use in design. SER at 2-36, 2-37. A CP or COL applicant referencing the ESP may propose and justify a different method for combining these values for use in design. SER at 2-36, 2-37.

44. Since the amount of water available in the ultimate heat sink ("UHS") can depend on the amount of that water that may freeze, the Staff identified the need for a site characteristic reflecting the potential for water in the UHS to freeze. SER at 2-38. The Applicant proposed a cumulative degree-day below freezing site characteristic based on the worst case cold spell recorded at the Port Gibson NWS station from 1930-2001. SER at 2-38. The Staff performed a similar analysis based on Port Gibson data reported in an NCDC database and obtained results similar to the Applicant's. SER at 2-38. Therefore, the Staff accepted the value of this site characteristic calculated by the Applicant. SER at 2-38.

45. In addition to the Staff analyses described above, the Staff examined the data the Applicant presented on dry-bulb and wet-bulb temperature at the Grand Gulf ESP site; frequency and intensity of hurricanes and tornadoes affecting the site; and wind speed at the

site. SER at 2-33 through 2-39. The Staff agreed with the Applicant's treatment of these data. SER at 2-33 through 2-39.

46. The Staff also found that the Applicant had considered the most severe regional weather phenomena, as described above, in establishing meteorological site characteristics. SER at 2-41.

47. The Staff concluded that the Applicant's use of the data and methodologies described above resulted in site characteristics containing margin sufficient for the limited accuracy, quantity, and period of time in which the data were accumulated. SER at 2-41.

48. Based on the foregoing, the Staff accepted the following site characteristics:

Maximum Dry-Bulb Temperature:

- |                          |       |
|--------------------------|-------|
| • 2% annual exceedance   | 92°F  |
| • 0.4% annual exceedance | 95°F  |
| • average annual highest | 98°F  |
| • 100-year return period | 108°F |

Minimum Dry-Bulb Temperature:

- |                           |      |
|---------------------------|------|
| • 99% annual exceedance   | 25°F |
| • 99.6% annual exceedance | 21°F |
| • average annual lowest   | 14°F |
| • 100-year return period  | -6°F |

Maximum Wet-Bulb Temperature:

- |                          |      |
|--------------------------|------|
| • 2% annual exceedance   | 78°F |
| • 0.4% annual exceedance | 80°F |

Basic Wind Speed:

- |                 |         |
|-----------------|---------|
| • Fastest mile  | 83 mi/h |
| • 3-second gust | 96 mi/h |

Tornado:

- |                                      |   |
|--------------------------------------|---|
| • Maximum Wind Speed                 | 300 mi/h                                  |
| • Translational Speed                | 60 mi/h                                   |
| • Maximum Rotational Speed           | 240 mi/h                                  |
| • Radius of Maximum Rotational Speed | 150 ft                                    |
| • Pressure Drop                      | 2.0 lb <sub>f</sub> / in. <sup>2</sup>    |
| • Rate of Pressure Drop              | 1.2 lb <sub>f</sub> / in. <sup>2</sup> /s |

Winter Precipitation:

- 100-year snowpack 6.1 lb<sub>f</sub>/ft<sup>2</sup>
- 48-hour PMWP 35 inches of water

Ultimate Heat Sink:

- Meteorological Conditions Resulting in the Minimum Water Cooling during Any 1 Day 81.0°F wet-bulb temperature with coincident 86.3°F dry-bulb temperature
- Meteorological Conditions Resulting in the Minimum Water Cooling during Any 5 Days 80.2°F wet-bulb temperature with coincident 86.2°F dry-bulb temperature
- Meteorological Conditions Resulting in the Maximum Evaporation and Drift Loss during Any Consecutive 30 Days 78.5°F wet-bulb temperature with coincident 83.1°F dry-bulb temperature
- Meteorological Conditions Resulting in Maximum Water Freezing in the UHS Water Storage Facility 98.°F degree days below freezing

SER § 2.3.1.3, Table 2.3.1-7, at 2-39 and 2-40.

49. We find that the data of record described above sufficient for the Staff to make the findings documented in SER § 2.3.1.4.

50. Further, we find that the Staff evaluation documented in SER § 2.3.1, as described above, is based on these facts, and provides reasonable support in logic to support the Staff findings in SER § 2.3.1.4.

51. Accordingly, we find that the Staff's review of meteorological site characteristics was adequate.

iii-b. Onsite Meteorological Measurements Program

52. The Applicant installed a new meteorological monitoring tower with instrumentation at tower elevations of 33 and 162 feet on the GGNS site in 2001. SER at 2-49. The Staff evaluated the types of meteorological variable measured and the heights at which these variable are measured and found them compatible with RG 1.23. SER at 2-52. The Staff reviewed the sensor types and performance specifications; data transmission and recording

methods; and inspection, maintenance, and calibration procedures and frequencies. The Staff found all these to be consistent with the guidance in RG 1.23. SER at 2-52.

53. The primary tower is far enough away from existing plant structures to preclude any adverse impact on measurements. SER at 2-51. The wind sensors are mounted on 6-foot booms to preclude tower influence on wind measurements. SER at 2-51. The temperature and relative humidity sensors are housed in motor-aspirated shields to insulate them from the effects of precipitation and thermal radiation. SER at 2-51.

54. Trees as much as 50 feet tall are located approximately 362 feet to the west of the primary tower, and 50-foot to 60-foot tall trees are located approximately 396 feet to the east and 489 feet to the south of the primary tower. SER at 2-52. Although these trees are closer to the primary tower than recommended by RS-002, they are at least 6 times their height from the tower, and the Staff does not consider their influence on the tower significant. SER at 2-52.

55. Although the Applicant originally based its dispersion estimates on data collected from January 1996 through December 2000, these data apparently lacked easterly winds, so the Staff requested the Applicant to recalculate dispersion characteristics based on data from the new tower. SER at 2-52. The Applicant used hourly data collected from the new tower from 2002 to 2003 to generate a joint (wind speed and direction, and atmospheric stability) frequency distribution for input to the PAVAN and XOQDOQ atmospheric dispersion computer codes. SER at 2-52 and 2-53.

56. The Staff reviewed the 2002-2003 hourly data using the methodology described in NUREG-0917, "[NRC] Staff Computer Programs for Use with Meteorological Data," issued July 1982. SER at 2-52. The data revealed generally stable and neutral atmospheric conditions at night and unstable and neutral conditions during the day, as the Staff expected. SER at 2-52. The 2002-2003 data were reasonably similar from year to year, and were



generally consistent with data collected in 1972-1976, as set forth in the GGNS UFSAR. SER at 2-52. The Staff generated a joint frequency distribution and compared it to the Applicant's. SER at 2-52 and 2-53. The Staff found the two distributions similar. SER at 2-52 and 2-53.

57. In view of the Staff findings in ¶¶ 52-56, the Staff found the 2002-2003 meteorological data collected by the Applicant to be representative of the dispersion conditions at the Grand Gulf ESP site. SER at 2-53. Accordingly, the Staff found the data acceptable for estimating atmospheric dispersion characteristics for the site and for otherwise satisfying 10 C.F.R. Part 100 requirements. SER at 2-53.

58. We find that the facts described in ¶¶ 52-57 above sufficient for the Staff to make the findings documented in SER § 2.3.3.4.

59. Further, we find that the Staff evaluation documented in SER § 2.3.3, as described above, is based on these facts, and provides reasonable support in logic to support the Staff findings in SER § 2.3.3.4.

60. Accordingly, we find that the Staff's review of meteorological data collection at the Grand Gulf ESP site was adequate.

#### iii-c. Local Meteorology

61. The Staff reviewed local meteorological conditions that are necessary for safety analysis or that may have an impact on plant design, and evaluated the potential threats arising from such conditions to a facility located at the site. In performing this review, the Staff determined whether construction and operation of a nuclear power plant or plants falling within the site characteristics would influence such conditions and air quality, which could, in turn, affect plant design and operation. SER at 2-46.

62. In its evaluation, the Staff considered some severe weather phenomena discussed in SER § 2.3.1, and which are discussed above in ¶¶ 38-51. We rely on our previous discussion of such matters and do not repeat it here.

63. In evaluating the effect of a new plant on local meteorological conditions, the Staff also considered the following:

- wind speed frequency distributions and average wind speeds measured at the 33-foot height of the GGNS meteorological tower (SER at 2-46)
- temperatures (annual mean, high monthly mean, and low monthly mean; and annual mean wet-bulb, high monthly mean and low monthly mean wet-bulb), and annual mean relative humidity near the site based on NCDC data (SER at 2-47)
- rainfall (annual average, maximum and minimum monthly, and 24-hour amounts) based on NWS, NCDC and SRCC data, as compared to data collected at the GGNS site (SER at 2-47)
- precipitation wind roses (*i.e.*, rainfall associated with wind direction) (SER at 2-47)
- average seasonal snowfall, based on SRCC data for Port Gibson, Mississippi (SER at 2-47)
- atmospheric stability based on temperature differences measured between the 33-foot height and the 162-foot height of the GGNS meteorological tower (SER at 2-47)

64. The Staff stated that terrain modifications associated with the development of the ESP facility would be limited and localized. SER at 2-48. Accordingly, the Staff determined that such modifications, along with resulting plant structures and associated improved surfaces, and would not have enough of an impact on local meteorological conditions to affect plant design and operation. SER at 2-48.

65. The Staff considered shadowing, salt deposition, fogging, and icing from cooling tower operation. The Staff found that these atmospheric impacts would not affect plant design and operation. In particular, the Staff found that the probability of ground-level plumes occurring during freezing conditions was low, and that ground-level icing would be insignificant. SER at 2-48.

66. The Staff stated that the region in the vicinity of the Grand Gulf ESP site is of a predominantly rural character, and that the air quality there is generally good. Accordingly, the

Staff found that site air quality should not be a significant factor in the design and operating bases for the ESP facility. SER at 2-48.

67. In view of the Staff evaluation described in ¶¶ 61-66 above, the Staff found that the Applicant had identified and considered meteorological, air quality and topographical characteristics of the site and met the requirements of 10 C.F.R. §§ 100.20(c) and 100.21(d), and that these characteristics were sufficient to determine site acceptability. SER at 2-48.

68. We find the facts of record described above include all factors relevant to the potential for a plant constructed on the Grand Gulf ESP site to affect local meteorological conditions, namely, changes to topography, effects of structures, and effects of plant emissions. Such facts include normal ambient meteorological conditions, data for which are evaluated in ¶¶ 52-60, and are in addition to the severe meteorological conditions discussed in ¶¶ 38-51. Accordingly, we find these facts sufficient for the Staff to make the findings documented in SER § 2.3.2.4.

69. Further, we find that the Staff evaluation documented in SER § 2.3.2, as described above, is based on these facts, and provides reasonable support in logic to support the Staff findings in SER § 2.3.2.4.

70. Accordingly, we find that the Staff's review of these matters was adequate.

iii-d. Short-Term Diffusion Estimates

71. The Applicant calculated short-term atmospheric dispersion site characteristics ( $\chi/Q$ ) for use in calculating the radiological consequences of postulated accidents to show compliance with the radiological consequence evaluation factors in 10 C.F.R. § 50.34(a)(1). To do so, the Applicant applied the guidance in RG 1.23 (for onsite meteorological measurements), RG 1.70 (for considerations relevant to estimating dispersion at the EAB and LPZ based on meteorological data), and RG 1.145 (for calculating and choosing  $\chi/Q$  values to evaluate radiological consequences). SER at 2-53 through 2-57.

72. As set forth in paragraphs b.iii.12. through b.iii.20., above, the Staff found the data collected onsite acceptable for estimating atmospheric dispersion characteristics for the site. See SER at 2-57. In addition, the Staff found that the Applicant made conservative assumptions (*i.e.*, which minimize dispersion, thereby resulting in higher calculated doses) by ignoring building wake effects and treating all releases as ground level releases. SER at 2-57.

73. The Applicant applied the PAVAN code described in NUREG/CR-2858, which implements the guidance provided by RG 1.145, to calculate and choose  $\chi/Q$  values to evaluate radiological consequences. SER at 2-56, 2-57. The Staff found that no topographic features precluded use of the PAVAN code at the Grand Gulf ESP site, and that the Applicant used appropriate assumptions concerning plant configuration and release characteristics to calculate  $\chi/Q$  values at the EAB and the LPZ boundary. SER at 2-57. In addition, the Staff independently evaluated the Applicant's chosen dispersion estimates by running the PAVAN computer model. SER at 2-57. The Staff found results similar to those obtained by the Applicant. SER at 2-57. Accordingly, the Staff found that the Applicant has calculated representative atmospheric transport and diffusion conditions for the EAB and the LPZ. SER at 2-58.

74. Based on the foregoing, the Staff found the following short-term atmosphere site characteristics acceptable for the Grand Gulf ESP site:

•	0-2 hr $\chi/Q$ value @ EAB	$5.95 \times 10^{-4}$ s/m <sup>3</sup>
•	0-8 hr $\chi/Q$ value @ LPZ	$8.83 \times 10^{-5}$ s/m <sup>3</sup>
•	8-24 hr $\chi/Q$ value @ LPZ	$6.16 \times 10^{-5}$ s/m <sup>3</sup>
•	1-4 day $\chi/Q$ value @ LPZ	$2.82 \times 10^{-5}$ s/m <sup>3</sup>
•	4-30 day $\chi/Q$ value @ LPZ	$9.15 \times 10^{-6}$ s/m <sup>3</sup>

SER at 2-57, 2-58. The Staff proposed to include these site characteristics in any ESP that might be issued for the Grand Gulf ESP site. SER at 2-57.

75. We find the facts of record described above address the matters relevant to the calculation of short-term atmospheric dispersion characteristics of the Grand Gulf ESP site,

namely, use of the PAVAN code, assumptions regarding inputs to the code, and meteorological data, which are addressed in ¶¶ 52-60, used for input to the code. Accordingly, we find these facts sufficient for the Staff to make the findings documented in SER § 2.3.4.4.

76. Further, we find that the Staff evaluation documented in SER § 2.3.4, as described above, is based on these facts, and provides reasonable support in logic to support the Staff findings in SER § 2.3.4.4.

77. Accordingly, we find that the Staff's review of these matters was adequate.

iii-e. Long-Term Diffusion Estimates

78. The Applicant calculated long-term atmospheric dispersion site characteristics ( $\chi/Q$ ) and deposition characteristics ( $D/Q$ ) for use in showing that radiological release limits for gaseous effluents resulting from normal operation can be met for any individual located offsite, in accordance with 10 C.F.R. § 100.21(c)(1). SER § 2.3.5.1 at 2-58, § 2.3.5.2 at 2-60. To do so, the Applicant applied the guidance in RG 1.70 (for considerations relevant to estimating dispersion to discrete areas beyond the site boundary to a distance of 50 miles from the plant, based on meteorological data), RG 1.109 (for identifying specific receptors of interest), and RG 1.111 (for characterizing transport, deposition, and diffusion conditions for evaluating the consequences of routine releases). SER at 2-60.

79. The evaluation of long-term dispersion characteristics differs from that of short-term dispersion characteristics as follows: For short-term dispersion characteristics, PAVAN calculates the  $\chi/Q$  that is exceeded only 0.5% of the time for the applicable time period for each of 16 sectors, depending on wind speed and direction and atmospheric stability, at the EAB or LPZ boundary, as applicable. SER at 2-54. PAVAN also calculates the  $\chi/Q$  that is exceeded only 5% of the time for the applicable time period for the entire boundary, independent of wind direction, and the highest of the 17 values is selected as the  $\chi/Q$  for that time period following the accident. SER at 2-54. In contrast, doses resulting from effluents from normal operation

occur over the long term through various dose pathways, and annual average D/Q values, as well as annual average  $\chi$ /Q values, are calculated for the site boundary and special receptors of interest (e.g., nearest home and garden within 5 miles in each downwind section). SER at 2-59. Radiological consequences are calculated to a hypothetically maximally exposed member of the public from the gaseous effluents. SER at 11-2. Accordingly, the long term dispersion characteristics ( $\chi$ /Qs) cannot be established except at specific locations, in conjunction with D/Qs, as discussed below.

80. As set forth in ¶¶ 52-60, above, the Staff found the meteorological data collected onsite acceptable for estimating atmospheric dispersion characteristics for the site. See SER at 2-61. In addition, the Staff found that the Applicant made conservative assumptions (*i.e.*, which minimize dispersion, thereby resulting in higher calculated doses) by ignoring building wake effects and treating all releases as ground level releases. SER at 2-61.

81. The Applicant applied the XOQDOQ code described in NUREG/CR-2919, which implements RG 1.111, to calculate  $\chi$ /Q and D/Q values to evaluate radiological consequences from effluents resulting from normal operation. SER § 2.3.5.1 at 2-58, § 2.3.5.3 at 2-61. The Staff found that no topographic features precluded use of the XOQDOQ code at the Grand Gulf ESP site, and that the Applicant used appropriate assumptions concerning plant configuration and release characteristics to calculate  $\chi$ /Q and D/Q values for specific locations of interest (e.g., nearest home, garden, meat animal, and milk animal). SER at 2-61, 2-62. In addition, the Staff independently evaluated the Applicant's dispersion and deposition estimates by running the XOQDOQ computer model. SER at 2-61. The Staff found results similar to those obtained by the Applicant. SER at 2-61. Accordingly, the Staff found that the Applicant used an appropriate atmospheric dispersion model and adequate meteorological data to calculate  $\chi$ /Q and D/Q values at the specific locations of interest. SER at 2-62, 2-63.

82. Based on the foregoing, the Staff found the following long-term atmosphere site characteristics acceptable for the Grand Gulf ESP site:

SITE CHARACTERISTIC	$\chi/Q$ (DEPLETED, NO DECAY)	$\chi/Q$ (UNDEPLETED, NO DECAY)	D/Q
• Annual average @ site boundary	$8.8 \times 10^{-6} \text{ s/m}^3$	$7.8 \times 10^{-6} \text{ s/m}^3$	$1.2 \times 10^{-8} \text{ 1/m}^2$
• Annual average @ nearest home	$2.2 \times 10^{-6} \text{ s/m}^3$	$1.9 \times 10^{-6} \text{ s/m}^3$	$7.0 \times 10^{-9} \text{ 1/m}^2$
• Annual average @ nearest garden	$2.0 \times 10^{-6} \text{ s/m}^3$	$1.7 \times 10^{-6} \text{ s/m}^3$	$5.4 \times 10^{-9} \text{ 1/m}^2$
• Annual average @ nearest milk cow	$7.0 \times 10^{-8} \text{ s/m}^3$	$4.7 \times 10^{-8} \text{ s/m}^3$	$8.7 \times 10^{-11} \text{ 1/m}^2$
• Annual average @ nearest meat cow	$1.4 \times 10^{-7} \text{ s/m}^3$	$1.1 \times 10^{-7} \text{ s/m}^3$	$4.0 \times 10^{-10} \text{ 1/m}^2$

SER at 2-62, 2-63. The Staff proposed to include these site characteristics in any ESP that might be issued for the Grand Gulf ESP site. SER at 2-62.

83. We find the facts of record described above address the matters relevant to the calculation of long-term atmospheric dispersion characteristics of the Grand Gulf ESP site, namely, use of the XOQDOQ code, assumptions regarding inputs to the code, and meteorological data, which are addressed in ¶¶ 52-60, used for input to the code. Accordingly, we find these facts sufficient for the Staff to make the findings documented in SER § 2.3.5.4.

84. Further, we find that the Staff evaluation documented in SER § 2.3.5, as described above, is based on these facts, and provides reasonable support in logic to support the Staff findings in SER § 2.3.5.4.

85. Accordingly, we find that the Staff's review of these matters was adequate.

iv. Hydrology

86. As set forth below, the Application describes the location of the Grand Gulf ESP site, its hydrological characteristics, and site elevations. SER at 2-64, 2-69, 2-80. (While the Applicant analyzed water use in the vicinity of the site and the Staff discussed this topic in SER

§ 2.4.1, we will address it separately below.) The site is located just over 26 miles from Vicksburg, Mississippi, which is to the north-northeast, about 5 miles from Port Gibson, Mississippi, which is to the southeast, and about 37 miles from Natchez, Mississippi, which is to the southwest. SER at 2-69. The site is bounded on the east by bluffs and on the west by the Mississippi River. SER at 2-63. The Applicant identified the Universal Transverse Mercator (“UTM”) coordinates for the center of the proposed power block area (“PPBA”), which will contain all safety-related structures of any new plant, and described the location of the PPBA with reference to surface features (e.g., streams). SER § 2.4.1.1 at 2-65, § 2.4.1.3. at 2-72, 2-73. The Applicant provided a cross-section of the ESP site subsurface, which shows the ground water table for the area. SSAR Figure 2.4-37; SER § 2.4.1.1 at 2-67. The Applicant estimated that the ground water table lies between 70 to 100 feet below the ground surface, at about 55 to 63 feet above mean sea level (“MSL”). SER at 2-64, 2-67.

87. The Staff independently verified the Applicant’s description of the ESP site location. The Staff used publicly available data sources, such as State boundaries, city locations, digital raster maps (“DRMs”) of topographic maps from the U.S. Geological Survey (“USGS”), and aerial photographs from the Mississippi Automated Resource Information System to create maps of the ESP site and its vicinity. SER at 2-69, 2-73. Although the Applicant’s description of the location of the center of the PPBA as originally submitted was in error, the corrected location of this point was only 16.8 feet from the coordinates estimated by the Staff. SER at 2-74. Since this distance is small compared to the overall dimensions of the ESP footprint, the Staff found that the Applicant’s corrected UTM coordinates for the center of the PPBA are acceptable. SER at 2-74.



iv-a. Hydrologic Description

88. Construction of a new plant will alter the subsurface environment and its alignment with the existing hydrogeological environment. SER at 2-75. While the Applicant stated that foundation depths would range from 35 to 140 feet, the Applicant did not identify a particular depth for the foundation. SER at 2-75. Since detailed design information is not now available, and the design can affect general site drainage characteristics, the Staff identified COL Action Item 2.4-2, which relates to the design of the site dewatering system. SER at 2-75. The adequacy of this system would be judged if a COL application is filed that reference any ESP that might be issued. SER at 2-78. The necessity for, and location of a dewatering system has not yet been determined, and such a system can also cause ground subsidence, which could affect safety-related structures and piping. SER at 2-76. Further, active drainage systems can affect liquid effluent pathways. SER at 2-71. Accordingly, the Staff identified COL Action Item 2.4-5, which relates to site grading and drainage system design, the adequacy of which would be judged in connection with a COL application referencing any ESP that might be issued. SER at 2-75, 2-89.

89. The Staff used the data described in ¶ 87, as well as USGS streamflow data, to verify the Applicant's hydrological description of the site. SER at 2-69. The Staff determined the locations of two drainage basins, denoted as Basin A and Basin B, and two streams, denoted as Stream A and Stream B, which are shown on SER Figures 2.4-4 and 2.4-5, respectively. SER at 2-72 through 2-74. The Staff also identified culverts important to drainage. SER at 2-79. With respect to flooding, as will be discussed in more detail below, the Staff determined that local intense precipitation controls flooding in Streams A and B and on the ESP site. SER at 2-120. Accordingly, the Staff's evaluation of drainage of local intense precipitation was affected by these basins, streams and culverts. SER at 2-78, 2-79.

90. In addition to topographic features identified above, the Applicant described aspects of the site relevant to the probable maximum flood (“PMF”), including the following:

- The flood plain of the Mississippi River near the site ranges in elevation from 55 to 75 feet of mean sea level (MSL). SER § 2.4.1.1 at 2-64. The applicant described Mississippi River flood plain width and depth near the site, as well as streams that flow through the site. SER at 2-64. The U.S. Army Corps of Engineers (USACE) has finished revetments on the east bank of the river near the GGNS site to maintain the river channel. The design project flood (DPF) elevation at the GGNS site is 102.1 feet above MSL, as given in USACE, “1994 Flood Control and Navigation Maps—Mississippi River,” issued 1994.
- The existing GGNS Unit 1 site has a grade elevation 132.5 feet above MSL. SER at 2-64. While the proposed Grand Gulf ESP site is adjacent to the existing GGNS Unit 1 site and the Applicant identified approximate UTM coordinates for the center of the powerblock (*id.* at 2-65), the Applicant has not selected the design for a new unit, nor has it determined final grade for a new plant. SER at 2-67.

As relevant to local intense precipitation, as discussed further below, the Applicant stated that it would place all safety-related SSCs for a new unit above the maximum flood elevation, or that it would provide flood protection such as drainage provisions, grading, culverts, dams, and water-tight doors. SER at 2-67.

91. Based on the above, the Staff found that the Applicant has provided sufficient information pertaining to the general hydrologic characteristics of the Grand Gulf ESP site, including descriptions of rivers, streams, lakes, and water-control structures, except with respect to water availability and users, which we discuss separately below in ¶¶ 128-130, 132-140. SER at 2-80. Therefore, the Staff concluded that the Applicant met the requirements for general hydrologic description of the site required by 10 C.F.R. §§ 52.17(a) and 100.20(c).

92. We find that the facts of record described above include all facts necessary to describe the location of the Grand Gulf ESP site, its hydrological characteristics, and site elevations. Accordingly, we find these facts sufficient for the Staff to make the findings documented in SER § 2.4.1.4 (except for water use, which is discussed below).

93. Further, we find that the Staff evaluation documented in SER § 2.4.1, as described above, is based on these facts, and provides reasonable support in logic to support the Staff findings in SER § 2.4.1.4.

94. Accordingly, we find that the Staff's review of these matters was adequate.

iv-b. Flooding

95. The Staff has explained that flooding can occur at a site through different mechanisms, two of which are the PMF and local intense precipitation. Local intense precipitation is a measure of the extreme amount of water falling in the immediate vicinity of the site no more than one square mile in area that is considered in the engineering design of local site drainage. In response to local intense precipitation, immediate flooding by ponding at the site may occur due to inadequate infiltration capacity and a lack of an efficient drainage system. The difference between the floods caused by local intense precipitation and PMF is that the former occurs at an immediate site, whereas PMF is the routed discharge from a probable maximum precipitation ("PMP") event occurring over an entire watershed within which a site is located.<sup>6</sup>

96. PMF is derived by routing a PMP event through the watershed. National Oceanic and Atmospheric Administration ("NOAA") Hydrometeorological Reports ("HMRs") provide methods for estimation of PMP in watersheds ten to 20,000 square miles for several durations (six to 72 hours). HMRs also provide methods for estimation of so-called "point" PMP of one-hour duration. NOAA recommends that a "point" be interpreted as a one square-mile area. HMRs provide maps to determine PMP values for durations less than one hour for a

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<sup>6</sup> While the information in ¶ 95 is not explicitly stated in the SER, the Staff intends to provide testimony to this effect with its prefiled written testimony answering Board questions.

point (one square-mile area); this PMP is the local intense precipitation (SER Tables 2.4-2 and 2.4-2a).<sup>7</sup>

97. The Staff explained further that mitigation measures for these two flooding mechanisms are different. Specifically, the Staff explained that protection from PMF may be provided by siting the plant above the PMF flood elevation, but flooding from local intense precipitation cannot be controlled by siting. Rather, flooding from local intense precipitation must be mitigated by an effective and efficient site drainage system.<sup>8</sup>

98. With respect to local intense precipitation at the Grand Gulf ESP site, the Applicant stated that there were no historical data for flooding on Streams A and B near the site. SER at 2-81. In response to Staff questions, the Applicant used NOAA HMR 52, "Application of Probable Maximum Precipitation Estimates—United States East of the 105th Meridian," August 1982, to estimate PMP depths for various durations for a one square mile area. SER at 2-88. The Applicant estimated the following PMP depths: For one square mile, 6.2 inches in 5 minutes, 9.7 inches in 15 minutes, 14.1 inches in 30 minutes, and 19.2 inches in 1 hour; and for 10 square miles, 15.8 inches in 1 hour, and 31.2 inches in 6 hours. SER at 2-88.

99. The Staff used RG 1.59, Rev. 2, "Design Basis Floods for Nuclear Power Plants," August 1977, and ANSI/ANS-2.8-1992, "Determining Design Basis Flooding at Power Reactor Sites," July 1992, for estimating the design-basis flooding considering the worst single phenomenon, as well as combinations of less severe phenomena. SER at 2-85.<sup>9</sup> The Staff

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<sup>7</sup> While the information in ¶ 96 is not explicitly stated in the SER, the Staff intends to provide testimony to this effect with its prefiled written testimony answering Board questions.

<sup>8</sup> While the information in ¶ 97 is not explicitly stated in the SER, the Staff intends to provide testimony to this effect with its prefiled written testimony answering Board questions.

<sup>9</sup> The Staff intends to provide testimony as to the use of the ANSI/ANS standard together with its prefiled written testimony answering Board questions.

also used USGS, NOAA, Natural Resources Conservation Service (formerly the Soil Conservation Service), USACE, and applicable State and river basin authority publications to verify the Applicant's data relating to extreme events in the region. SER at 2-85.

100. With respect to the Applicant's revised estimates of PMP depth, the Staff determined that these conformed to the latest HMR-52 criteria. SER at 2-88. The Staff also prepared its own estimates of PMP depths, and the Applicants estimates closely matched those of the Staff. SER at 2-88. Therefore, the Staff concluded that the Applicant's PMP depth estimates were acceptable. SER at 2-88. Accordingly, the Staff established a site characteristic for local intense precipitation, or PMP, of 19.2 inches per hour, of which 6.2 inches falls during the first 5 minutes. SER Table 2.4.14-1 at 2-141. This PMP is for a one square mile area, and is considered as local intense precipitation that would fall on the Grand Gulf ESP site rather than a PMF in the Mississippi River near the site caused by a PMP event in the Mississippi River Basin.<sup>10</sup> The local intense precipitation will also be used to determine the flooding elevation in Streams A and B and to design the site grading as described below.

101. The Staff noted that the area of Basin A is 2.94 square miles, and that there is no guidance for determination of PMP values for areas that are larger than one square mile but smaller than ten square miles. Nonetheless, the PMP value for an area exceeding one square mile in size will be less than that for a one square-mile area (a point), and greater than that for a ten square-mile area. Therefore, one-square mile PMP (point PMP or local intense precipitation) is a conservative estimate (greater than the true value) for the PMP value for

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<sup>10</sup> While this is not explicitly stated in the SER, the Staff intends to provide testimony to this effect with its prefiled written testimony answering Board questions.

Basin A. Accordingly, flooding resulting from local intense precipitation based on a one-square mile PMP value for Basin A will also be conservative (more severe than the true value).<sup>11</sup>

102. Based on the physical site topography and the location of the PPBA to the west of the site access road and downstream of existing culverts, the Staff found that it is reasonable to expect that flood water elevation in Streams A and B adjacent to the PPBA would be substantially less than that of the proposed ESP site grade. SER at 2-79. While a comprehensive flood water elevation analysis for the site cannot now be carried out, the Staff found further that, given the topographic location of the ESP site in relation to Streams A and B, an effective drainage system can be designed when a COL application is filed that references any ESP that might be issued. SER at 2-79, 2-80. Accordingly, the Staff established COL Action Item 2.4-3, which relates to the design of site grading. SER at 2-80. The design of this grading will afford flood protection to safety-related structures for any new unit at the ESP site based on a comprehensive flood water routing analysis for a local PMP (local intense precipitation) event. SER at 2-80. Similarly, since the maximum water surface elevation depends on the site grade and locations of safety-related structures, as well as local intense precipitation, the Staff established COL Action Item 2.4-5, which relates to plant grade and drainage system design based on the maximum water surface elevation on the site. SER at 2-89. COL Action Item 2.4-5 provides that a COL or construction permit applicant should demonstrate that the ESP plant grade is safe from the flooding effects of maximum water surface elevation during local intense precipitation without relying on any active surface drainage systems that may be blocked during this event. SER at 2-89; SER Appendix A.2, Action Item No. 2.4-5.

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<sup>11</sup> While the information in ¶ 101 is not explicitly stated in the SER, the Staff intends to provide testimony to this effect with its prefiled written testimony answering Board questions.

103. Based on the facts and reasoning set forth in ¶¶ 95-102, the Staff found that the Applicant has provided sufficient information pertaining to floods.

104. In addition, the Staff evaluated the potential for flooding at the site from these events:

- Probable maximum flood on streams and rivers
- Potential dam failures induced by seismic forces
- Probable maximum surge and seiche flooding
- Probable maximum tsunami flooding
- Channel diversions

The Staff also evaluated flooding protection provisions. SER §§ 2.4.2 through 2.4.6, 2.4.9, 2.4.10.

105. With respect to flooding on the Mississippi River, the Applicant used flood discharge data for the Mississippi River collected at Vicksburg, Mississippi (1932-2000), and Natchez, Mississippi (1940-2000). SER at 2-81. Based on Vicksburg data, the Applicant estimated the highest recorded water level near the site to be 92.5 feet above MSL. SER at 2-81. The Applicant estimated flooding on the Mississippi River as reaching 103 feet above MSL (the design project flood (“DPF”)), which is about 29 feet below the existing GGNS plant grade of 132.5 feet above MSL. SER at 2-84. The Applicant also stated that levees on the west bank of the Mississippi River can carry a peak discharge of about 3 million cfs. SER at 2-89. Using a calculation recommended by the Staff, the Applicant calculated a peak PMF flowrate of 8.25 million cfs, which would overtop the levees on the west bank of the Mississippi River. SER at 2-89. Since the discharge capacity of the floodplain west of the levees is about 11 million cfs, this PMF will not result in flooding at the ESP plant site. SER at 2-89. The plant-grade elevation of any new facility will be well above the level of the Mississippi River DPF. SER at 2-82. The Applicant concluded, therefore, the design flood for safety-related SSCs will be the PMF caused by local intense precipitation on the ESP site. SER at 2-82.

106. In analyzing the PMF from the Mississippi River, the Staff determined a maximum wave height of 10.9 feet, and added this to the Mississippi River DPF to arrive at maximum water surface elevation. SER at 2-96. The Staff also agreed that the water surface elevation at peak PMF discharge will not be appreciably higher than 103 feet above MSL, the top surface elevation of the levee on the west bank of the Mississippi River. SER at 2-89. In this regard, the Staff established a site grade of 132.5 feet above MSL as a characteristic of the ESP site. SER at A-16. In view of the above, the Staff estimated that the highest water surface elevation in the Mississippi River as a result of the DPF, wind setup, and wave runup will not impact the ESP site since the maximum water surface elevation is significantly below the ESP site grade. SER at 2-87; SER § 2.4.3. Accordingly, a PMF on the Mississippi River will not cause flooding of the proposed Grand Gulf ESP site.<sup>12</sup>

107. With respect to floods from dam failures, the Applicant chose the Kentucky Dam on the Tennessee River for analysis based on its location 450 miles upstream of the site and its storage capacity of 6.13 million acre-feet of water. SER at 2-98. While the Fort Randall Reservoir and Dam on the Missouri River exceeds the capacity of the Kentucky Dam by 0.17 million acre-feet, it is located 1300 river miles from the site, almost three times as far as the Kentucky Dam. SER at 2-98. The Applicant estimated that effect of the failure of the Kentucky Dam, in combination with a DPF at the Grand Gulf ESP site, would be less than the Mississippi River PMF flow rate of 8.25 million cfs (as discussed above in ¶ 105), and would thus be of no consequence. SER at 2-98. (The Applicant had originally used a PMF flow rate of 6.6 million cfs before adopting the Staff's recommended calculation, and the Kentucky Dam failure flowrate was less than this. SER at 2-89, 2-98.)

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<sup>12</sup> While this is not explicitly stated in the SER, the Staff intends to provide testimony to this effect with its prefiled written testimony answering Board questions.



108. The Staff carried out a simplified bracketing estimation of the discharge needed to raise the water surface elevation near the site above the existing GGNS Unit 1 plant grade of 132.5 feet above MSL. SER at 2-100. The Staff assumed a cross-section for the Mississippi River near the GGNS site as shown in SER Figure 2.4-8. SER at 2-100. The Staff conservatively assumed that the width of the floodplain is 60 miles, even at water surface elevation of 132.5 feet above MSL. SER at 2-100. The cross-sectional area of discharge is estimated as 11.5 million square feet. SER at 2-100. The wetted perimeter was estimated as 317,065 feet. SER at 2-100. Based on a Staff-assumed Manning's roughness coefficient of 0.025 for natural channels and a bed slope of 0.2 feet per mile, the Staff estimated the discharge in the Mississippi River corresponding to a water surface elevation of 132.5 feet above MSL as 46.3 million cfs. SER at 2-101. This estimate is more than four times larger than the discharge capacity of the river at a water surface elevation of 103 feet above MSL, and about seven times larger than the Applicant estimated PMF. SER at 2-101. Therefore, the Staff concluded that the ESP site is safe from flooding caused by a seismically induced dam failure upstream of the GGNS site. SER at 2-101. As set forth above, the Applicant has provided sufficient information pertaining to dam failures. SER at 2-101. Therefore, the Staff concluded that the Applicant has met the requirements for dam failures with respect to 10 C.F.R. § 52.17(a) and 10 C.F.R. § 100.20(c). SER at 2-101. The Staff also found that the application is in partial compliance with 10 C.F.R. Part 50, Appendix A, Criterion 2 with respect to the assumption of upstream dam failure caused by a seismic event. SER at 2-101.

109. With respect to maximum surge and seiche flooding, the Applicant stated that the ESP site is not located in a coastal region or on a lake, and, therefore, consideration of surge and seiche flooding was not warranted. SSAR § 2.4.5; SER § 2.4.5.1 at 2-102.

110. The Staff conducted its review of maximum surge and seiche flooding in accordance with RS-002, Section 2.4.5, and RG 1.59. SER at 2-104. The Staff found as

follows: Because the ESP site is located on a flowing river, an increase in water surface elevation on one bank of the river because of wind blowing across the water's surface would be minor and negligible during nonflood conditions. SER at 2-104. This conclusion follows because the ESP site is located at an elevation of 132.5 feet above MSL and the normal surface elevation of the Mississippi River is between 55 and 75 feet above MSL. SER at 2-104. As set forth in SER § 2.4.3, wind waves on the water surface during the DPF would not impact the ESP facility or facilities because of the grade elevation of the ESP site. SER at 2-104. Similarly, storm surge flooding is unlikely to have a measurable impact at the ESP site because of the distance (406 river miles), elevation change of the water surface (typically between 55 and 75 feet above MSL) between the site and the mouth of the Mississippi River, and the elevation of the ESP site (132.5 feet above MSL) during nonflood river conditions. SER at 2-104. During a large storm event, a surge in the Gulf of Mexico would hinder flow from exiting the Mississippi River because the difference of elevation between the two water bodies would be less, causing backwater effects. SER at 2-104. The Staff stated that the Applicant took backwater effects into account during the estimation of the DPF, as set forth in SER § 2.3.4, which was also the worst-case scenario for storm surge. SER at 2-104. Accordingly, the Staff found that the Applicant provided sufficient information pertaining to surge and seiche. SER at 2-104. Therefore, the Staff concluded that the Applicant has met the requirements for surge and seiche with respect to 10 C.F.R. § 52.17(a) and 10 C.F.R. § 100.20(c). SER at 2-104.

111. With respect to probable maximum tsunami flooding, the Applicant noted that according to USACE, the Mississippi coast is located in Tsunami Zone 1, with a predicted wave height of 5 feet. SER at 2-105. Conservatively assuming a coastal tsunami wave reached the GGNS site without attenuation and was coincident with the DPF on the Mississippi River, the maximum combined wave height would be 107.1 feet above MSL (102.1 feet from DPF + 5 feet

from tsunami). SER at 2-105. The Applicant concluded that the tsunami wave would not affect the ESP facility or facilities located at an elevation of 132.5 feet above MSL. SER at 2-105.

112. The Staff investigated two potential failure mechanisms that have the potential to cause flooding and that other sections do not cover, including a hill slope failure-generated tsunami-like wave and an inland tsunami generated by an earthquake. SER at 2-107. The Staff stated as follows: Area surrounding the ESP site is relatively flat, except for the bluffs upon which the ESP facility or facilities would be constructed. SER at 2-107. Hill slopes on the bank opposite the ESP site do not have the potential to fail in such a manner that a wave could be produced of sufficient height to flood the ESP site. SER at 2-107. In addition, the integrity of the bank in the vicinity of the plant was evaluated for the construction of GGNS Unit 1. SER at 2-107. As the Applicant stated in SSAR § 2.4.3.6, the new facility would be closer to the bluffs than the existing reactor containment, and the potential impact of a new facility to bank stability will be evaluated before the final design construction. SER at 2-107.

113. Earthquakes have the potential to create tsunami-like waves and have occurred on the Mississippi. SER at 2-107. According to Lockridge, et al. (2002), three earthquakes near New Madrid, Missouri, occurred during the winter of 1811–1812 (December 6, January 16, and February 7) that generated large tsunami-like waves. SER at 2-107. Observers of the New Madrid earthquake reported walls of water that were 15 to 20 feet high. SER at 2-107. Because these events are rare, one is unlikely to occur during the time of the PMF. SER at 2-107. Therefore, assuming a normal mean annual flood elevation of approximately 75 feet above MSL, a tsunami-like wave would have to reach a height greater than 50 feet to inundate the ESP site, which is not credible. SER at 2-107.

114. The Staff stated further that according to NOAA, since 1990, the 10 most destructive tsunamis in the Pacific produced maximum wave heights of 9.8 to 49.2 feet. SER at 2-108. Effects of even the largest ocean tsunamis occurring during an annual flood event

(water surface elevation 75 feet above MSL) would not be of sufficient height to exceed the elevation of the ESP site (grade elevation 132.5 feet above MSL). SER at 2-108. The Staff also examined the possibility of a severe landslide, and concluded that bank slopes on the opposite side of the river from the site are not of sufficient height to generate a wave that could flood the ESP site. SER at 2-108.

115. For the reasons set forth in ¶¶ 113-114, the Staff concluded that the Applicant has provided sufficient information pertaining to probable maximum tsunami flooding. SER at 2-108. Therefore, the Staff concluded that the Applicant met the requirements for probable maximum tsunami flooding with respect to 10 C.F.R. § 52.17(a) and 10 C.F.R. § 100.20(c)(3). SER at 2-108. The Staff concluded further that the ESP site is safe from tsunami flooding, and the application is in partial conformance with General Design Criteria (“GDC”) 2 in that regard. SER at 2-108.

116. With respect to ice jams on the Mississippi River, the Applicant reviewed temperature data collected from a USGS gauging station on the Mississippi at Vicksburg, and concluded that water temperatures in the Mississippi River near the GGNS site are expected to be above the freezing point most of the time. SER at 2-109. The Applicant stated that, in the event of ice-jam-induced high flows, a rise in water level above 103 feet above MSL at the site would result in the overtopping of the levees and the diversion of water into the floodplain on the west bank of the Mississippi River. SER at 2-109. The Applicant also stated that, since the proposed site for a new facility is located on the property’s upland area and is significantly above 103 feet above MSL, ice-jam-induced high flows in the Mississippi River would not affect it. SER at 2-109.

117. The Staff also reviewed temperature data and found that water temperatures are expected to be above the freezing point most of the time in the Mississippi River near the GGNS site. SER at 2-110. In considering ice jams on the Mississippi, the Staff found that the

closest location of a sustained ice jam on the Mississippi River was more than 250 river miles upstream of the GGNS site. SER at 2-111. The Staff searched the USCAE historical database of ice jams on the Mississippi River in Mississippi or Louisiana. SER at 2-111. The Staff review of the ice jam database showed that the likelihood of flooding resulting from an ice jam downstream of the GGNS site is remote. SER at 2-113. In addition, continued development of river control works for navigation, irrigation, and flood control on the Mississippi River and its principal tributaries would reduce the possibility of a sustained ice jam. SER at 2-113. The Staff determined that if an ice jam were to occur, and if ice-jam-induced high flows raise the water level to 103 feet above MSL at the GGNS site, it would result in the overtopping of the levees and diversion of water into the floodplain on the west bank of the Mississippi River. SER at 2-113. Accordingly, the Staff determined that the ESP site, located on the upland area of the GGNS property at a plant grade of 132.5 feet above MSL, will be safe from any potential flooding resulting from ice jams. SER at 2-113.

118. For the reasons set forth in ¶¶ 116-117, the Staff concluded that the Applicant has provided sufficient information pertaining to ice jams. SER at 2-113. Therefore, the Staff concluded that the Applicant met the requirements for ice jams with respect to 10 C.F.R. § 52.17(a) and 10 C.F.R. § 100.20(c). SER at 2-113.

119. With respect to channel diversions, the Applicant described how the USACE protects the banks of the Mississippi River. SER at 2-116. The Applicant stated that the Mississippi River has experienced, and is currently undergoing a shifting phase near the site. SER at 2-116. The Applicant described USACE projects to stabilize the river near the site, concluding with the completion of the revetment on the east bank (ESP site side) of the river in the 1980's, with a small gap at the existing GGNS barge slip. SER at 2-116. In response to a Staff question, the Applicant provided the Staff with references related to geologic features or other characteristics that might preclude channel diversion upstream of the site. SER at 2-117.

120. The Staff described yearly USACE work to sustain embankments and navigable channels. SER at 2-118. The Staff specifically described USACE actions near the ESP site. SER at 2-118. Based on this information, the Staff found that the Applicant adequately described the issues relating to channel diversions near the ESP site. SER at 2-118. The Staff also found that the Lower Mississippi River is heavily navigated, and the USACE, Vicksburg District, is responsible for maintaining navigable conditions. SER at 2-118. Further, the Staff found that the USACE, as part of its responsibilities, actively maintains revetments and dikes that are constructed to minimize risk of channel diversions, bank erosion, and instability. SER at 2-118.

121. For the reasons set forth in ¶¶ 119-120, the Staff concluded that the Applicant has provided sufficient information pertaining to channel diversions. SER at 2-118. Therefore, the Staff concluded that the Applicant met the requirements for channel diversions with respect to 10 C.F.R. § 52.17(a) and 10 C.F.R. § 100.20(c)(3). SER at 2-118.

122. As for flooding protection, the Applicant stated that it had not selected a specific design for the ESP plan, and no final plant grade has been determined. SER at 2-119. The Applicant also stated that all safety related SSCs of the ESP facility or facilities will be located at or above the site grade elevation, which is 132.5 feet above MSL, or protected from flooding. SER at 2-119, A-16.

123. The Staff again emphasized that the only flooding concern resulted from local intense precipitation, and reiterated that a COL applicant should demonstrate that the ESP plant grade is safe from the flooding effects of maximum water surface elevation during local intense precipitation without relying on any active surface drainage systems that may be blocked during this event in accordance with COL Action Item 2.4-5. SER at 2-89, 2-120.

124. For the reasons set forth in ¶¶ 122-123, the Staff concluded that the Applicant has provided sufficient information pertaining to flood protection. SER at 2-118. Therefore, the

Staff concluded that the Applicant met the requirements for flood protection with respect to 10 C.F.R. § 52.17(a) and 10 C.F.R. § 100.20(c)(3).<sup>13</sup> SER at 2-118.

125. We find that the facts of record described in ¶¶ 95-124 above include all facts necessary to describe local intense precipitation at the location of the Grand Gulf ESP site and PMFs, including (1) probable maximum flood on streams and rivers; (2) potential dam failures induced by seismic forces; (3) probable maximum surge and seiche flooding; (4) probable maximum tsunami flooding; and (5) channel diversions. Accordingly, we find these facts sufficient for the Staff to make the findings documented in SER §§ 2.4.2 through 2.4.6, 2.4.9, and 2.4.10.

126. Further, we find that the Staff evaluation documented in these sections, as described above, is based on these facts, and provides reasonable support in logic to support the Staff findings in them.

127. Accordingly, we find that the Staff's review of these matters was adequate.

#### iv-c. Cooling Water Canals and Reservoirs

128. The Applicant indicated that the majority of raw water would be withdrawn from the Mississippi River via an intake structure on the river shoreline and other wells would also be used. SER at 2-114. The Applicant also indicated that it anticipated the UHS would be a closed-loop system with a water reservoir and mechanical draft cooling tower and that makeup water would replenish water losses because of evaporation, drift, and blowdown. SER at 2-114. The Applicant indicated that the UHS could be used for non-emergency operations. SER at 2-114.

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<sup>13</sup> In this regard, the SER states that the requirements are met "subject to the open items." SER at 2-120. The SER, however, does not contain any "open items." This phrase appears to have been inadvertently copied into the SER from the draft SER issued in April 2005. The Staff respectfully requests the Board to ignore this phrase.

129. The Staff visually inspected the ESP site during the site safety analysis visit, and no cooling water canals exist or are planned at the ESP site. SER at 2-115. The Staff found that with respect to several issues that cannot be resolved at the ESP stage, the COL or CP applicant ultimately will need to demonstrate that sufficient separation between the new ESP intake and the combined effluent outfall is provided so that the effluent recirculating back to the new ESP intake will not adversely affect the intake. SER at 2-71. With respect to the UHS, the Staff proposed a COL Action Item. SER at 2-115. COL Action Item 2.4-6 relates to a 30-day cooling water supply for the ESP facility UHS, which should be available as liquid water in any dedicated water storage basin(s), accounting for any losses including, but not limited to, those resulting from evaporation, seepage, icing, and a margin of safety. SER at 2-115.

130. Based on the information in ¶¶ 128-129, the Staff found that the Applicant provided sufficient information pertaining to cooling water canals and reservoirs, and it concluded that SERI met the requirements for cooling water canals and reservoirs with respect to 10 C.F.R. § 52.17(a) and 10 C.F.R. § 100.20(c)(3).

iv-d. Frazil Ice

131. With respect to frazil ice, the Staff considered the Applicant information identified in ¶ 116, above. Since the UHS for the ESP facility or facilities would have a dedicated water storage basin, the Staff considered the effect of sustained low temperatures at the ESP site to evaluate the potential for freezing of the UHS water storage basin. SER at 2-113. In SER § 2.3.1.1, the Staff discussed the resolution of the cooling parameter at the ESP site. To account for frazil ice, the Staff has identified a characteristic value of 98 °F degree days (i.e., 98 accumulated freezing degree days), based on daily minimum and maximum temperatures recorded at Port Gibson for the period 1930–2001. SER at 2-113.



iv-e. Low-Water Considerations

132. With respect to water supply, the Mississippi River would supply makeup and normal service water for any ESP facility. SER at 2-63. The Applicant examined records of low-water conditions at the Vicksburg USGS Gauging Station, and identified the minimum streamflow observed during the period of record as 99,400 cfs. SER at 2-121. The Applicant concluded that the corresponding historical low-flow elevation at the site was approximately 28 feet above MSL, and mean 30-day low flow was 108,000 cfs. SER at 2-121.

133. The Applicant proposed that an intake located on the east bank of the Mississippi River, on the north side of the existing barge slip, supply the makeup and service water for the ESP facility or facilities. SER at 2-121. The Applicant estimated that an ESP facility or facilities would use a maximum makeup flow rate of approximately 190 cfs of water and that the maximum expected withdrawal for the ESP facility or facilities would be approximately 0.2 percent of the minimum historical streamflow in the Mississippi River near the GGNS site. SER at 2-121, 2-122. The Applicant noted that design details of the intake would consider the minimum water surface elevation in the river to determine the location of inlet screens. SER at 2-122.

134. The Staff independently evaluated the Applicant's stream flow measurements and historical low-flow surface elevation. SER at 2-124, 2-125. The Staff estimated water surface elevation near the site as 28.4 feet above MSL, corresponding to the historical low-water surface elevation observed at Vicksburg. SER at 2-125, 2-126. The Applicant proposed locating the ESP facility intake screens at an elevation of 23.5 feet above MSL, and the Staff found this to be 4.9 feet below the Staff-estimated minimum water surface elevation near the site and 14 feet below the USACE low-water reference plane. SER at 2-126. The Staff also found that in the event of low flow from ice blockage, safety-related facilities would not be adversely affected, as the UHS would provide a source of cooling and service water to maintain

the plant in a safe mode. SER at 2-126. Accordingly, the Staff concluded that low water elevations resulting from ice jams or other causes would not adversely affect safety of the ESP facility or facilities. SER at 2-126.

135. For the reasons set forth in ¶¶ 132-134, the Staff found that the Applicant provided sufficient information pertaining to low-water considerations, and it concluded that the Applicant met the requirements for low-water considerations with respect to 10 C.F.R. § 52.17(a), 10 C.F.R. § 100.20(c).

iv-f. Ground Water

136. The Applicant described regional and site hydrogeology and ground water conditions. SER at 2-126. The Applicant generally used the GGNS UFSAR to derive the information presented in the SSAR, including the subsurface site characterization performed for the two previously proposed GGNS units, as well as the ongoing monitoring for the constructed GGNS Unit 1. SER at 2-126. The Applicant obtained an additional three borings as part of its pre-ESP application activities; these borings further confirmed the site hydrogeologic conceptual model presented in the UFSAR. SER at 2-126. The Applicant described in detail the principal sources of ground water for both the region and the ESP site, composed of the Holocene Mississippi River alluvium, Pleistocene terrace deposits, and Miocene series, primarily the Catahoula Formation. SER at 2-126, 2-127. The Applicant identified permeable zones, and published values of hydraulic conductivity values. SER at 2-127.

137. The Applicant indicated that two wells it routinely uses operate near full capacity during refueling outages, and additional ground water supply wells would be needed for both construction and operational needs of an ESP facility. SER at 2-127. The Applicant estimated that the maximum consumption of ground water for potable, sanitary, fire protection, demineralized water, and landscape maintenance use would not exceed 3570 gpm. SER at 2-127. This operational water flow rate exceeded the Applicant's estimate of water demands

during construction. SER at 2-127. Based on population projections, the Applicant estimated that the ground water withdrawal within a 2-mile radius of the plant by the year 2070 will be only 2610 gallons per day (gpd). SER at 2-127. Therefore, the ground water demand for the GGNS and the ESP facility or facilities is projected to dominate the water use in the immediate vicinity of the ESP site for many years. SER at 2-127.

138. The Staff reviewed the USGS "Ground Water Atlas of the United States," and determined that the Applicant's description of regional hydrogeologic conditions was adequate. SER at 2-130. The Staff summarized its independent findings, and identified the various subsurface formations (physiographic province, etc.) and aquifer systems located near the ESP site. SER at 2-130, 2-131. In view of this information, the Staff determined that the Applicant adequately described onsite and offsite ground water use. SER at 2-131.

139. Further, the Staff determined that, for a ground water well system, the Applicant-stated maximum withdrawal capacity of 3570 gpm is large and may require installation of a network of several wells at the ESP site. SER at 2-131. However, the Staff also determined that the detailed design of the ESP facility, including the design of a well system to provide ground water for potable, sanitary, fire protection, demineralized water, and landscape maintenance, will not be available until the COL stage. SER at 2-131. At that time, a COL applicant should demonstrate that an adequately designed ground water well system capable of withdrawing a maximum of 3570 gpm is provided for the ESP facility. SER at 2-131. The Staff identified this as COL Action Item 2.4-8. SER at 2-131.

140. In addition, the Staff determined that additional ground water characterization will be carried out by the applicant at the COL stage as part of the design of the dewatering well system, including adequate characterization of the local subsurface environment. SER at 2-131. This characterization is expected to include detailed information on ground water

elevation and locations of perched water zones, and any potential impact perched water zones may have on construction and operation of the ESP facility. SER at 2-132.

141. Based on its independent review of the USGS “Ground Water Atlas of the United States,” the Staff determined that the Applicant’s description of regional hydrogeologic conditions is adequate and that the application adequately describes onsite and offsite ground water use, as set forth in ¶¶ 132-140. Accordingly, the Staff found that the Applicant provided sufficient information pertaining to ground water, and concluded that the Applicant met the requirements for ground water with respect to 10 C.F.R. § 52.17(a) and 10 C.F.R. § 100.20(c)(3).

iv-g. Accidental Releases of Liquid Effluents to Ground and Surface Waters

142. The Staff determined that this issue could be resolved if there were no releases of radionuclides to the ground water. SER at 2-140. Accordingly, the Staff proposed to include a condition in any ESP that might be issued for the Grand Gulf site requiring that an applicant referencing such an ESP design include features in any new unit’s radwaste systems to preclude any and all accidental releases of radionuclides into any potential liquid pathway. SER at 2-140. This is Permit Condition 2. SER at A-2.

143. We find that the facts of record described in ¶¶ 127-142 above include all facts necessary to describe cooling water canals and reservoirs, frazil ice, low water considerations, ground water, and accidental releases of liquid effluents to ground and surface waters. Accordingly, we find these facts sufficient for the Staff to make the findings documented in SER §§ 2.4.7, 2.4.8, and 2.4.11 through 2.4.13.

144. Further, we find that the Staff evaluation documented in these sections, as described above, is based on these facts, and provides reasonable support in logic to support the Staff findings in them.

145. Accordingly, we find that the Staff’s review of these matters was adequate.

iv-h. Site Characteristics Related to Hydrology

146. Based on Staff findings set forth above in ¶¶ 87-142, which resulted from the Staff review of SSAR Section 2.4, the Staff identified hydrological site characteristics that it determined should be included in any ESP that might be issued for the proposed site. SER at 2-140, 2-141. These site characteristics are set forth in SER Table 2.3.14.1.

147. Based on our findings in ¶¶ 92-94, 125-127, and 143-145, we find that the Staff's review and establishment of hydrological site characteristics was adequate.

v. Geology, Seismology, and Geotechnical Engineering

v-a. Regional and Site Geology

148. The Applicant described the regional geology, including the physiography, geological provinces, geologic history, stratigraphy, tectonic settings, and seismicity of the site region. SER at 2-144. The Applicant described these items in detail, including the geologic periods (era, period) in which they formed. SER at 2-144 through 2-159. The Applicant discussed each of the following seismic source zones surrounding the ESP site:

- Appalachian Mountains
- Ouachita Orogenic Belt
- Arkoma and Black Warrior Basins
- Reelfoot Rift
- New Madrid Seismic Zone (NMSZ)
- Gulf Coast Basin
- Pickens-Gilberttown and Southern Arkansas Fault Zones
- Saline River Source Zone (SRSZ)
- nontectonic structural features

SER at 2-151 through 2-159.

149. The Staff evaluated the geological and seismological information submitted by the Applicant in SSAR Section 2.5.1. as follows: The technical information presented in Section 2.5.1 of the application resulted from the Applicant's surface and subsurface geological and seismological investigations performed in progressively greater detail as these investigations approached the site. SER at 2-162. Through its review, the Staff determined

whether the Applicant complied with the applicable regulations and conducted its investigations with an appropriate level of thoroughness, as required by 10 C.F.R. § 100.23. SER at 2-162. SSAR Section 2.5.1 contains the geologic and seismic information gathered by the Applicant in support of the vibratory ground motion analysis and site SSE spectrum provided in SSAR Section 2.5.2. SER at 2-163.

150. The Staff stated that, according to RG 1.165, applicants may develop the vibratory design ground motion for a new nuclear power plant using either the Electric Power Research Institute ("EPRI") or Lawrence Livermore National Laboratory ("LLNL") seismic source models for the central and eastern United States ("CEUS"). SER at 2-163. However, RG 1.165 recommends that applicants update the geological, seismological, and geophysical database and evaluate any new data to determine whether revisions to the EPRI or LLNL seismic source models are necessary. SER at 2-163. As a result, the Staff focused its review on geologic and seismic data published since the late 1980s that could indicate a need for changes to the EPRI or LLNL seismic source models. SER at 2-163. To thoroughly evaluate the geological and seismological information presented by the Applicant, the Staff obtained the assistance of USGS. SER at 2-163. In addition, the Staff and its USGS advisors visited the ESP site and surrounding area to evaluate and confirm the interpretations, assumptions, and conclusions presented by the Applicant concerning potential geologic and seismic hazards. SER at 2-163.

151. The Staff's review focused on the Applicant's characterization of the regional and local geologic structure and seismic potential. SER at 2-163. The Staff considered the Applicant's descriptions of physiographic provinces within the site region, the Mississippi embayment and Gulf Coast Basin, tectonic evolution for major geologic features, and the stratigraphy of the site region. SER at 2-163. The Staff determined that these descriptions reflected well-documented geologic information, and the Staff concluded that they were an

accurate and thorough description of regional site geology. SER at 2-163. Similarly, the Staff reviewed the Applicant's characterization of the tectonic features in the EPRI seismic source model from the late 1980's, focusing on two seismic zones. SER at 2-163. With the addition of another seismic source to one of these, which only enhances the conservative estimate of ground motions for the ESP site, the Staff found that the Applicant accurately characterized the tectonic features and their correlations with the regional seismicity. SER at 2-164. Finally, the Staff considered, among other things, a seismic catalog the Applicant revised in response to a Staff question, and the Staff determined that the Applicant had provided an accurate and thorough description of the regional seismicity. SER at 2-164.

152. As for site geology, as opposed to regional geology, the Applicant described the geologic information of both the site area (8 kilometers) and the site location (1 kilometer) in terms of the (1) site physiography and geomorphology, (2) site geologic history, (3) site geologic conditions, (4) site structure, and (5) geotechnical properties of subsurface materials. SER at 2-159. The Applicant described these matters in detail. SER at 2-159 through 2-162. The Applicant did not identify any faults with the 8-kilometer radius of the site area. SER at 2-161.

153. With respect to site geology, the Staff found that the Applicant provided a thorough and accurate description of the surface features and characteristics for the ESP site. SER at 2-164. The Staff also found that the Applicant provided an accurate and thorough description of the site area stratigraphy, with emphasis on the younger layers of rock and soils. SER at 2-165. The Staff found further that the Applicant's description of the geological structures was complete and accurate. SER at 2-165. Nonetheless, the Staff stated that, based on RG 1.132, excavation made during construction provides opportunities for obtaining additional geologic and geotechnical data. SER at 2-165. Therefore, the Staff found that it is necessary to perform geologic mapping of future excavation for safety-related structures,

evaluate any unforeseen geologic features that are encountered, and notify the NRC no later than 30 days before any excavations for safety-related structures are open for NRC's examination and evaluation. SER at 2-165. The Staff proposed establishing this as Permit Condition 3. SER at 2-165. Finally, the Staff found that the effects of human activity (e.g., ground water withdrawal or mining activity) have no potential to compromise the safety of the site. SER at 2-165.

154. Based on the facts and reasoning set forth above, the Staff concluded that the Applicant properly characterized the site lithology, stratigraphy, geological history, structural geology, and the characteristics of subsurface soils and rocks. SER at 2-165. Accordingly, the Staff concluded that the Applicant identified and appropriately characterized all the seismic sources significant for determining the safe-shutdown earthquake ("SSE") for the ESP site, in accordance with RG 1.165 and Section 2.5.1 of NUREG-0800, and therefore satisfied the associated requirements of 10 C.F.R. § 100.23(c) and GDC 2. Therefore, the Staff concluded that the proposed ESP site is acceptable from a geological and seismological standpoint and meets the requirements of 10 C.F.R. § 100.23. SER at 2-165.

v-b. Vibratory Ground Motion

155. The Applicant described the regional and local geology and structural background and outlined the major seismotectonic sources and materials in the site region. SER at 2-165. The Applicant described (1) its determination of the ground motions at the ESP site resulting from possible earthquakes inside or even outside the site region; (2) the characteristics of seismic sources used in the ESP site seismic hazard calculation; (3) the procedure for the probabilistic seismic hazard analysis ("PSHA") and its results; (4) site characteristics in seismic wave transmission; and (5) site responses at the ESP site. SER at 2-166. The Applicant then summarized the development of the SSE and operating-basis earthquake (OBE) ground motion for the ESP site. SER at 2-166.



156. With respect to seismic source characterization, the Applicant described the characteristics of all seismic sources in the ESP site region. SER at 2-166. The Applicant reviewed the original 1986 EPRI earthquake source model related to the ESP site and found that the model adequately captures the regional earthquake source characteristics and the uncertainty associated with the source model at the time when the model was developed. SER at 2-166. The Applicant also addressed two new seismic sources and their associated parameters resulting from the recent studies. SER at 2-166. The Applicant summarized the EPRI seismic source model, and the seismic source information for the seismic sources in the site region. SER at 2-166. This source information includes the maximum magnitude, closest distance to the ESP site, probability of activity, and an indication as to whether new information regarding the seismic source has been identified since the original EPRI seismic hazard analyses. SER at 2-166, 2-167. The Applicant presented detailed characterizations of the New Madrid Seismic Zone (“NMSZ”) and the Saline River Source Zone (“SRSZ”). SER at 2-167, 2-168. Finally, the Applicant described the effect of updating the earthquake catalog on the EPRI-Seismicity Owners Group (“SOG”) seismicity parameters. SER at 2-169, 2-170.

157. In its review, the Staff considered the regulatory requirements of 10 C.F.R. § 52.17(a)(1)(vi) and 10 C.F.R. § 100.23(c) and (d), which require that an applicant for an ESP describe the seismic and geologic characteristics of the proposed site. SER at 2-180. In particular, 10 C.F.R. § 100.23(c) requires that an ESP applicant investigate the geological, seismological, and engineering characteristics of the proposed site and its environs with sufficient scope and detail to support estimates of the SSE and to permit adequate engineering solutions to actual or potential geologic and seismic effects at the proposed site. SER at 2-180. In addition, 10 C.F.R. §100.23(d) states that the SSE for a site is characterized by both horizontal and vertical free-field ground motion response spectra at the free ground surface. Section 2.5.2 of NUREG-0800 provides guidance concerning the evaluation of the proposed

SSE, and RG 1.165 provides guidance regarding the use of PSHA to address the uncertainties inherent in estimating ground motion at the ESP site.

158. First, the Staff found that the Applicant adequately characterized the overall seismic sources at the ESP site. SER at 2-183. The Staff also concluded that the Applicant's descriptions of the NMSZ and the SRSZ are accurate and sufficient in addressing the need for calculating the SSE for the ESP site. SER at 2-183. In addition, the Staff concurred with the Applicant's decision to use the original EPRI seismicity parameters based on its comparison of the updated seismic catalog with the original EPRI catalog. SER at 2-183.

159. Second, the Staff concluded that the Applicant's description of the PSHA parameters and procedures for the ESP site, as clarified through several RAI responses, is reasonably accurate and adequate. SER at 2-188. The Staff concurred with the Applicant on its conservative approaches in overlapping the new characteristic NMSZ onto the original EPRI source model, and in using only attenuation relationships for the midcontinent to estimate ground motion, although the ESP site is located in the extended Mississippi embayment. SER at 2-188.

160. Third, the Staff concluded that the Applicant generally used an acceptable approach to characterize the site shear wave properties to the appropriate depth required by the reference rock used in the EPRI ground motion attenuation relationships in order to obtain the site-specific seismic wave responses. SER at 2-188. Therefore, the Staff found SERI's description of the site-specific seismic wave transmission characteristics to be adequate and acceptable. SER at 2-188.

161. Fourth, the Staff found that because of the narrow range in the magnitudes of the controlling earthquakes, it was appropriate to use the Applicant's chosen approach, and it concluded that SERI's description of the site responses and its approach in deriving the site response are reasonably accurate and adequate. SER at 2-188.

162. Finally, the Staff considered the SSE developed for the ESP site to be consistent with Appendix S to 10 C.F.R. Part 50, which defines the SSE as the “vibratory ground motion for which certain structures, systems and components must be designed to remain functional.” The Staff concluded that the Applicant’s approach to calculating the SSE for the ESP site is also consistent with the requirements of 10 C.F.R. §§ 100.23(c) and (d) and RG 1.165, and that the Applicant’s description of the SSE and the subsequent operating-basis earthquake (“OBE”) is accurate and adequate. SER at 2-189.

163. Based on the facts and reasoning set forth above with respect to vibratory ground motion, the Staff found as follows: The Applicant provided a thorough characterization of the seismic sources surrounding the site, as required by 10 C.F.R. § 100.23. SER at 2-189. In addition, the Applicant has adequately addressed the uncertainties inherent in the characterization of these seismic sources through a PSHA, and this PSHA follows the guidance provided in RG 1.165. SER at 2-189. The Staff concluded that the controlling earthquakes and associated ground motion derived from the Applicant’s PSHA are generally consistent with the seismogenic region surrounding the ESP site. SER at 2-189. In addition, the Staff found that the Applicant’s SSE was determined in accordance with RG 1.165 and Section 2.5.2 of NUREG-0800. SER at 2-189. Accordingly, the Staff concluded that the proposed ESP site is acceptable from a geological and seismological standpoint and meets the requirements of 10 C.F.R. § 100.23. SER at 2-189.

v-c. Surface Faulting

164. The Applicant described the potential for tectonic fault rupture at the ESP site. SER at 2-189. The Applicant performed the following investigations to assess the potential for surface faulting at and within a 5-mile radius of the ESP site:

- compilation and review of existing data
- interpretation of aerial photography
- discussions with current researchers in the area
- review of seismicity
- field reconnaissance

SER at 2-190. The Applicant stated that a wealth of information is available for the site regarding the surface faulting studies. The information comes from three primary sources: (1) previous research for the existing GGNS; (2) published and unpublished geologic maps from USGS, the State of Mississippi, and the University of Memphis; and (3) seismicity data compiled from published journal articles and evaluated as part of the Applicant's study. SER at 2-190. The Applicant performed aerial and field reconnaissance investigations within a 5-mile radius of the ESP site. SER at 2-190. In particular, the Applicant prepared an updated map of surficial deposits and geomorphology for the site location. SER at 2-190. The Applicant also stated that it used the new map in combination with other preexisting maps to verify the absence of subsurface faulting or other forms of tectonic and nontectonic deformation by showing the surface of buried stratigraphic layers. SER at 2-190.

165. The Staff and its USGS advisors visited the ESP site and met with the Applicant to assist in confirming its interpretations, assumptions, and conclusions concerning potential surface deformation. SER at 2-192. Specific areas of the Staff's review included the geological, seismological, and geophysical investigations, previous investigations, geological evidence or absence of evidence of surface deformation, correlation of an earthquake with capable tectonic sources, characterization of capable tectonic sources, zones of Quaternary

deformation requiring detailed fault investigation, and the potential for surface tectonic deformation at the site. SER at 2-193.

166. The Staff focused its review on the adequacy of the Applicant's investigations to ascertain the potential for surface deformation that could affect the site. SER at 2-193. The Staff reviewed the Applicant's summary of previous site investigations recorded in the updated final safety analysis report ("UFSAR") and the recent investigations, and concluded that the Applicant adequately investigated the potential for surface deformation in the site area. SER at 2-193. The Staff and its USGS consultants also visited the site area and did not observe any evidence for Quaternary tectonic activity near the site. SER at 2-193. The Staff concluded that the Applicant adequately investigated the potential for surface deformation as required by 10 C.F.R. § 100.23, and it concurred with the Applicant's conclusion that no evidence of Quaternary folding or faulting can be associated with these local faults. SER at 2-193.

167. In its review of the geological and seismological aspects of the ESP site, the Staff considered the pertinent information gathered by the Applicant during the regional and site-specific geological, seismological, and geophysical investigations. SER at 2-193. The Staff concluded that the Applicant performed its investigations in accordance with 10 C.F.R. § 100.23 and RG 1.165 and provided an adequate basis to establish that no capable tectonic sources exist in the site vicinity that would cause surface deformation in the site area. SER at 2-193. The Staff concluded that the site is suitable from the perspective of tectonic surface deformation and meets the requirements of 10 C.F.R. § 100.23. In addition, the Staff found that the Applicant appropriately considered the most severe surface deformation historically reported for the site and surrounding area, with sufficient margin for uncertainties, and that the application satisfies GDC 2 in that respect. SER at 2-193.

v-d. Stability of Subsurface Materials and Foundations

168. The Applicant described the characteristics of the subsurface materials and foundations at the ESP site. SER at 2-193. Specifically, the Applicant described the geotechnical characteristics of the site and the investigative programs conducted to support this characterization; site ground water conditions; the soil response to dynamic loading and the evaluation of liquefaction potential at the ESP site; and the static stability conditions at the site, including an evaluation of bearing capacity and settlement. SER at 2-193. Finally, the Applicant briefly described the geotechnical design criteria. SER at 2-193. Throughout the Applicant's discussion, it referred to Engineering Report ER-02, "Geologic, Geotechnical and Geophysical Field Exploration and Laboratory Testing," for details of the site's geotechnical characteristics. SER at 2-193, 2-194.

169. In characterizing the subsurface materials and foundations at the site, the Applicant described the static and dynamic engineering properties of the subsurface materials (between the surface and a depth of 200 feet) at the ESP site. SER at 2-194. The Applicant also presented the laboratory testing program used to obtain the engineering characteristics of the subsurface materials. SER at 2-194. In this context, the Applicant discussed six topics: (1) description of subsurface materials; (2) geophysical properties; (3) cone penetrometer testing; (4) static laboratory testing; (5) dynamic laboratory testing; and (6) engineering properties. SER at 2-194, 2-202, 2-204, 2-215.

170. The Staff considered the regulatory requirements in 10 C.F.R. § 100.23(c) and 10 C.F.R. § 100.23(d)(4). SER at 2-231. Pursuant to 10 C.F.R. § 100.23(c), the engineering characteristics of a site and its environs must be investigated in sufficient scope and detail to permit an adequate evaluation of the proposed site, while 10 C.F.R. § 100.23(d)(4) requires evaluation of siting factors such as soil and rock stability, liquefaction potential, and natural and artificial slope stability. Section 2.5.4 of RS-002 provides specific guidance concerning the

evaluation of information characterizing the stability of subsurface materials, including the need for geotechnical field and laboratory tests as well as the geophysical investigations. SER at 2-231.

171. The Staff evaluated the geotechnical investigations conducted by the Applicant to determine the static and dynamic engineering properties of the materials that underlie the Grand Gulf ESP site. SER at 2-231. In order to evaluate the Applicant's surface faulting investigations, the Staff sought the assistance of a contractor from the Brookhaven National Laboratory. SER at 2-231. The Staff and its advisor from the laboratory visited the ESP site and met with the Applicant to assist in confirming the interpretations, assumptions, and conclusions it presented regarding the characteristics of the subsurface materials and potential foundation layers. SER at 2-231. In addition, the Staff and its advisor observed soil samples taken from the field explorations. SER at 2-231.

172. First, with respect to the properties of subsurface materials, the Staff focused its review on the Applicant's investigation results for subsurface materials, field investigations, laboratory testing, and engineering soil properties (static and dynamic) of the ESP site subsurface materials. SER at 2-232. For most aspects of this portion of the application, the Staff concluded that the methods used by the Applicant for the exploration of subsurface materials, field investigations, laboratory testing, and determination of the engineering soil properties (static and dynamic) meet the guidelines of RS-002, and the results obtained are reasonable. SER at 2-232. This finding is based, in part, on the Staff findings that to the effect that the Applicant had satisfactorily resolved all Staff RAIs. SER at 2-232 through 2-237.

173. Specifically, while the Staff's review found that the construction techniques committed to by the Applicant meet the industry standard, the Applicant committed to use excavation walls (or a combination of ground improvement with tied-back walls) and control the ground water during the excavations at the COL stage, as documented in COL Action

Item 2.5-1. SER at 2-232. The Staff also noted the Applicant's commitment to conduct detailed studies of the fill material and the required treatment, as documented in COL Action Item 2.5-2. SER at 2-233. COL Action Item 2.5-3 provides that if the investigations to be performed during the COL stage indicate differences in material properties which may significantly impact on design ground motions, the COL applicant will evaluate the need to perform additional site response analyses with the updated properties to develop updated design motions. SER at 2-233. Furthermore, the Applicant committed to perform geotechnical investigations during the COL stage, because they will provide additional verification regarding the soil properties of this zone with rise and fall of P-wave velocity, as set forth in COL Action Item 2.5-4. SER at 2-237.

174. With respect to the Applicant's description of subsurface materials overall, the Staff found that the Applicant provided a sufficient description of the subsurface material properties to support its ESP application. SER at 2-237. Accordingly, the Staff concluded that the subsurface materials presented are acceptable. SER at 2-237.

175. Second, with respect to the relationship of foundations and underlying materials, the Staff concluded that the Applicant's description was consistent with the approach taken by industry and is acceptable. SER at 2-238. In order for a COL applicant to ensure that its foundation design assumptions contain an adequate margin of safety, the COL applicant will correlate the plot plans and profiles of each seismic Category I facility with the subsurface profile and material properties to ascertain the sufficiency of selected borings to represent the spectrum of soil variations under each structure, as documented in COL Action Item 2.5-5. SER at 2-238.

176. Third, with respect to site excavation and backfill, the Applicant has not selected a reactor design or location within the ESP site, and it has not provided detailed excavation and backfill plans or plot plans and profiles. SER at 2-238. Therefore, the Staff cannot adequately



evaluate the Applicant's excavation and backfill plans until an applicant submits these plans as part of a COL or CP application. SER at 2-238. In addition, such excavation and backfill, if deep, can pose special concerns near the bluff at the edges of the ESP site. SER at 2-238. Therefore, the Staff noted that a COL applicant should evaluate potential excavation procedures that may be used, as well as the impact of the adjacent bluff on temporary support conditions and on standoff distance in the ESP area, as documented in COL Action Item 2.5-6. SER at 2-238.

177. Fourth, with respect to ground water conditions, the Applicant has not selected a reactor design or location within the ESP site and did not provide an evaluation of ground water conditions as they affect the foundation stability or detailed dewatering plans. SER at 2-238. Therefore, the Staff could not evaluate the ground water conditions as they affect the loading and stability of foundation materials, the Applicant's procedure for dewatering during construction, and ground water control throughout the life of the plant. SER at 2-238. Consequently, the Staff established COL Action Item 2.5-7, which provides that a COL or CP applicant should provide a detailed dewatering plan for evaluating the ground water conditions (procedure for dewatering during construction, and ground water control throughout the life of the plant) regarding their effects on the foundation stability. SER at 2-238, A-8.

178. Fifth, with respect to the response of soil to dynamic loading, the Staff primarily focused on the low-strain shear wave velocity profiles used to determine the response of the soil and rock underlying the ESP site to dynamic loading. SER at 2-238. In addition, the Staff reviewed the Applicant's nonlinear soil models used to incorporate the variation of soil shear modulus and damping with cyclic shear strain. SER at 2-238. Finally, the Staff reviewed the Applicant's site dynamic response, which it based on a soil amplification/attenuation analysis using a single base case site profile. SER at 2-238. The Staff questioned certain aspects relating to mean site amplification factors, and ultimately found that the selected values of

1 sigma used for the profile randomization process are appropriate, since the range of selected values plays a secondary role in generating mean site amplification factors, in view other information provided in the Applicant's response to RAI 2.5.4-5. SER at 2-239. In addition, the Staff concluded that karst formations are probably not of concern in the calcareous clays and limestone deposits at the site. SER at 2-240. In order to further address karst formation, the Staff established COL Action Item 2.5-8, which provides that a COL or CP applicant should perform additional site investigations during the COL stage, including deep borings in the footprint of the powerblock structures to evaluate the potential for karst formation. SER at 2-240, A-8. In view of the above, the Staff concluded that the Applicant provided sufficient and acceptable information for it to perform dynamic response analyses for the ESP site, and that the Applicant's discussion of soil responses to dynamic loading is acceptable. SER at 2-240.

179. Sixth, with respect to liquefaction potential and seismic site stability, the Staff found that the soil deposits underneath the ESP range in age from Miocene (Catahoula formation) to Pleistocene (loess). SER at 2-240. The Staff also found that these deposits all appear to be overconsolidated. SER at 2-240. The Staff indicated that the Applicant does not expect to encounter any Holocene materials or relatively loose sands or silts that may be susceptible to liquefaction at the ESP site location. SER at 2-240. The Staff also stated that the Applicant did not find any reported paleoliquefaction features in the ESP site vicinity. SER at 2-240. The Staff stated that soils below the ground water table that are planned to provide foundation support are relatively dense, overconsolidated, and relatively old and thus are not susceptible to liquefaction. SER at 2-240. Accordingly, the Staff concluded that the Applicant's description of the site conditions meets with the RS-002 guidelines and is acceptable. SER at 2-240.

180. Seventh, with respect to static site stability, the Staff focused on the Applicant's evaluation of bearing capacity, potential of settlement, and lateral earth pressure. SER at 2-240. The Staff found, among other things, that the Applicant demonstrated that, assuming that the current GGNS powerblock structures are far enough from the ESP site, no other facilities (such as piping or conduit) exist in the ESP area that may be influenced by applicable surface movements. SER at 2-240. Accordingly, the Staff concluded that the Applicant's evaluation of bearing capacity, potential of settlement, and lateral earth pressure for the ESP site meets the RS-002 guidelines, and is, therefore, acceptable. SER at 2-241.

181. Eighth, with respect to design criteria, specific design criteria will be developed during the COL stage when the specific characteristics of the operating system are known. SER at 2-241. Accordingly, the Staff established COL Action Item 2.5-9, which provides that a COL or CP applicant should develop specific design criteria (such as potential wall rotations, facility sliding, and overturning) during the COL stage when the specific characteristics of the operating system are known. SER at 2-241, A-8.

182. Finally, based on its review of SSAR Section 2.5.4, the Staff identified a shear wave velocity site characteristic, namely 1000 feet per second, that it determined should be included in any ESP that might be issued for the proposed site. SER at 2-241.

183. With respect to stability of subsurface materials and foundations overall, the Staff concluded that the Applicant adequately determined the engineering properties of the soil encountered during its field and laboratory investigations, and that the Applicant provided sufficient technical information in the geotechnical area to demonstrate the suitability of the ESP site for building a new nuclear power plant. SER at 2-241. The Staff found that the Applicant used the latest field and laboratory methods, in accordance with RGs 1.132, 1.138, and 1.198, "Procedures and Criteria for Assessing Seismic Soil Liquefaction at Nuclear Power Plant Sites," issued November 2003, to determine these properties. SER at 2-241. With

respect to field investigations and laboratory testing necessary for the design of safety-related structures, however, the Staff also concludes that the applicant did not perform activities sufficient to adequately define the overall subsurface profile, as well as the potential variability of the properties of the soil underlying the ESP site; the Staff therefore noted the Applicant's commitment to perform additional field investigations, once it has selected the locations and facilities for safety-related structures at the COL stage. SER at 2-241. In this regard, the COL action items included in SER Appendix A that relate to the stability of subsurface materials and foundations will prompt an applicant for a COL or CP to demonstrate the adequacy of the design of structures that would be built if a COL or CP were later granted.<sup>14</sup>

v-e. Stability of Slopes

184. The Applicant described the ESP site, and stated that it is relatively flat, and will not be subject to large-scale landslides or slope failures. SER at 2-241. The Applicant identified a 22-foot high 3:1 (20-degree slope) cut-slope in loess soils on the site, as well as a 60-70 foot escarpment that bounds the west side of the proposed site. SER at 2-242. In response to a Staff RAI, the Applicant showed the spatial relationships among the PPBA, a loess bluff, and a postulated shallow slump in the bluff near the west boundary of the ESP site. SER at 2-242. Based on a qualitative stability assessment, the Applicant concluded that the hazard to the ESP site from possible future movements in the loess bluff is very low to none and does not require additional analysis at this ESP stage, and that an exclusionary zone between the top of the bluff and ESP PPBA is not necessary. SER at 2-243.

185. With respect to stability of slopes, the Staff questioned the potential impact of differences in elevations on soil-structure interaction ("SSI"). SER at 2-243. To address this

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<sup>14</sup> While not all the information in this paragraph is explicitly stated in the SER as it is here, the Staff intends to provide testimony to this effect with its prefiled written testimony answering Board questions.

matter, the Staff established COL Action Item 2.5-10, which provides that a COL or CP applicant should incorporate the effects resulting from the local topography or possible changes in topography in the future SSI analyses. SER at 2-243, A-8. Further, the Staff found that the Applicant provided sufficient description of the stability of slopes in the area to support its application for the ESP, and the Staff concluded that the slope stability assessment presented is acceptable.

v-f. Embankments and Dams

186. The Applicant indicated that, within the ESP site area, no earth or rock fill embankments are used for flood protection or impounding the cooling water. SER at 2-246. In addition, the Applicant stated that no impoundment structures within the ESP site area exist that could pose a hazard to the proposed future facility. SER at 2-246. Therefore, the Applicant concluded that no significant hazards may be posed by inundation from such facilities. SER at 2-246. The Applicant also did not find any indication of any influence of flooding from the Mississippi River and its potential to further erode the loess bluff. SER at 2-246.

187. The Staff found that no impoundment structures lie within the ESP area. SER at 2-246. The Staff also found that the Applicant provided sufficient descriptions of the embankments and dams in the site vicinity to support its ESP application. SER at 2-246. The Staff, in SER §§ 2.4.4 and 2.5.5, discussed all other issues relevant to dams and embankments, respectively.<sup>15</sup> Since the Applicant did not evaluate the effect of potential flooding of the Mississippi River and possible future erosion of the bluff, the Staff established COL Action Item 2.5-11, which provides that a COL or CP applicant should evaluate the effect of potential flooding of the Mississippi River and possible future erosion of the bluff, including their impacts on SSI effects of the plant. SER at 2-246, A-8. On this basis, the staff concludes

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<sup>15</sup> While this is not explicitly stated in the SER, the Staff intends to provide testimony to this effect with its prefiled written testimony answering Board questions.

that the assessment of embankments and dams presented in this SSAR section is acceptable for the ESP application. SER at 2-246.

188. We find that the facts described in § 2.5 of the Staff's SER include all factors relevant to the geology, seismology, and geotechnical engineering for the proposed Grand Gulf ESP site.

189. Further, we find that the Staff evaluation documented in SER § 2.5, as described above, is based on these facts, and provides reasonable support in logic to support the Staff findings in SER § 2.5.

190. Accordingly, we find that the Staff's review of these matters was adequate.

c. SER, Chapter 3, "Site Safety Assessment"

191. As set forth below, in Chapter 3 of the SER, the Staff evaluated the Applicant's site safety assessment. However, because many elements of the site safety assessment are analyzed in other portions of the SER, they are only briefly referenced in Chapter 3. These portions include discussion of the exclusion area and low-population zone; population center distance; site atmospheric dispersion characteristics and dispersion parameters; physical site characteristics including meteorology, geology, seismology, and hydrology; potential offsite hazards; security plans; emergency plans; population density; gaseous effluent release dose consequences from normal operations; postulated accidents and accident dose consequences; and most geologic and seismic siting criteria. SER at 3-1, 3-2.

192. However, Chapter 3 does include the Staff's analysis of the application with respect to aircraft hazards, to ensure that the risks associated with aircraft hazards are sufficiently low. SER at 3-2. The Staff reviewed the Applicant's aircraft hazard analysis using the procedures set forth in RS-002, Section 3.5.1.6. SER at 3-4. In particular, the Staff reviewed the Applicant's assessment of aircraft hazards at the ESP site that result in a

probability less than about  $1 \times 10^{-7}$  per year for an accident having the potential for radiological consequences greater than the exposure guidelines in 10 C.F.R. § 50.34(a)(1). SER at 3-4.

193. As the Staff did not identify any private airfields within 16 kilometers (10 miles) of the site, and because existing protection requirements against tornado missiles sufficiently protect safety-related plant SSCs against the impact effects of aircraft of the size and type that generally use private fields, the Staff concluded that a detailed analysis of the risk to a nuclear power plant(s) at the proposed ESP site from operations at private fields was not necessary for it to make a site suitability finding. SER at 3-3.

194. The Staff performed an independent assessment of the risks associated with the 12 public airports identified by SERI, as well as an additional 4 airports between 50 and 61 miles from the proposed ESP site. SER at 3-4. For all airports, the Staff found the number of operations per year to be a small fraction (less than one tenth) of the criterion limit, and it concluded that aircraft operations currently associated with these airports do not pose a significant risk at the proposed ESP site. SER at 3-4. The Staff further found that air traffic along the closest low-altitude airway does not pose a significant risk to the proposed ESP site and that military aircraft operations do not pose a significant risk to the proposed ESP site. SER at 3-4.

195. Based on the information submitted in the application as well as on its own independent analyses, the Staff concluded that aircraft hazards at the proposed ESP site pose no undue risk to the health and safety of the public. SER at 3-4.

196. We find that the facts described in Chapter 3 of the Staff's SER include all factors relevant to the site safety assessment for the proposed Grand Gulf ESP site.

197. Further, we find that the Staff evaluation documented in SER Chapter 3, as described above, is based on these facts, and provides reasonable support in logic to support the Staff findings in SER Chapter 3.

198. Accordingly, we find that the Staff's review of these matters was adequate.

d. SER, Chapter 11, "Radioactive Effluent Dose Consequences from Normal Operations"

199. As set forth below, the application describes the radioactive gaseous and liquid effluents and solid radioactive waste material that would be generated as a normal byproduct of nuclear power operations at a future facility at the Grand Gulf ESP site. SER at 11-1.

200. In Chapter 11 of the SER, the Staff reviewed the information in the application concerning radiological effluents and solid radioactive waste, to determine whether site characteristics are such that the radiation dose to members of the public would be within regulatory requirements. SER at 11-1. The licensee submitted that the proposed facility will have the ability to handle these radiological effluents and solid waste materials in a manner that minimizes radioactive releases to the environment and maintains exposure to the public and plant personnel during normal plant operation and maintenance at levels that are as low as reasonably achievable ("ALARA"). SER at 11-1.

201. The Staff evaluated the application to determine whether it adequately addressed anticipated radiological effluents according to 10 C.F.R. § 52.17(a)(1)(iv), which states that an ESP application should describe the anticipated maximum levels of radiological effluents that each facility will produce, and 10 C.F.R. § 100.21(c)(1), which requires that radiological effluent release limits associated with normal operation from the type of facility proposed for the site be met for any individual located off site. SER at 11-1.

202. With respect to gaseous effluents, the application included an estimate of the bounding quantity of radioactive gaseous effluents that may be released from the gaseous waste management and the building ventilation systems; SERI also provided bounding gaseous effluent release data to support compliance with the gaseous effluent release concentration limits in Table 2 of Appendix B, "Annual Limits on Intakes (ALIs) and Derived Air Concentrations



(DACs) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage,” to 10 C.F.R. Part 20. SER at 11-1 to 11-2. The Applicant also included dose estimates to a hypothetical maximally exposed member of the public from the gaseous effluents using radiological exposure models based on RG 1.111, “Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors,” and the GASPAR II program (NUREG/CR-4653, “GASPAR II—Technical Reference and User Guide.”). SER at 11-2.

203. With respect to liquid effluents, the Applicant provided a bounding assessment to demonstrate its capability to comply with the regulatory requirements in 10 C.F.R. Part 20 and Appendix I to 10 C.F.R. Part 50, and calculated the estimated dose to a hypothetical maximally exposed member of the public from the liquid effluents using radiological exposure models based on RG 1.109, “Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 C.F.R. Part 50, Appendix I,” and the LADTAP II program (NUREG/CR-4013, “LADTAP II—Technical Reference and User Guide.”). SER at 11-2 to 11-3.

204. Finally, with respect to solid waste, SERI estimated that it would generate an average of 18,646 cubic feet (ft<sup>3</sup>) of radioactive waste each year, with a maximum curie content at 5400 curies. SER at 11-3. SERI also noted it would periodically ship solid radioactive waste material from the ESP site to the permanent waste disposal facility, and would package and ship the waste in accordance with 10 C.F.R. Part 71, “Packaging and Transportation of Radioactive Material,” and 49 C.F.R. Part 173, “Shippers—General Requirements for Shipments and Packagings.” SER at 11-3. However, SERI did not provide details regarding its solid waste management system, because the NRC will evaluate that issue at the CP or COL stage. SER at 11-3.

205. Based on this information, the Staff concluded that the Applicant provided adequate information to give reasonable assurance that it will control, monitor, and maintain radioactive gaseous and liquid effluents from the ESP facility within the regulatory limits specified in 10 C.F.R. Part 20, 10 C.F.R. Part 71, and 49 C.F.R. Part 173, as well as maintain them at ALARA levels, in accordance with the effluent design objectives contained in Appendix I to 10 C.F.R. Part 50. SER at 11-3. However, the Staff noted that an eventual COL applicant that references an ESP for the site should verify that the calculated radiological doses to members of the public from radioactive gaseous and liquid effluents for any facility to be built on the site are bounded by the radiological doses included in the SSAR for the ESP application and reviewed by the NRC Staff. SER at 11-4. In addition, the Staff determined that a COL applicant will need to provide detailed information on the solid waste management system used to process the radioactive gaseous and liquid effluents. SER at 11-4.

206. The Staff therefore concluded that radiological doses to members of the public from radioactive gaseous and liquid effluents resulting from the normal operation of one or more new nuclear power plants that might be constructed on the proposed ESP site do not present an undue risk to the health and safety of the public; that, with respect to radiological effluent release dose consequences, the proposed site is acceptable for constructing a plant falling within the Applicant's PPE; and that the site meets the relevant requirements of 10 C.F.R. Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants," and 10 C.F.R. Part 100, "Reactor Site Criteria." SER at 11-4.

207. We find that the facts described in Chapter 11 of the Staff's SER include all factors relevant to radioactive effluent dose consequences from normal operations for the proposed Grand Gulf ESP site.

208. Further, we find that the Staff evaluation documented in SER Chapter 11, as described above, is based on these facts, and provides reasonable support in logic to support the Staff findings in SER Chapter 11.

209. Accordingly, we find that the Staff's review of these matters was adequate.

e. SER, Chapter 13, "Conduct of Operations"

210. As set forth below, the application states that no physical characteristics unique to the existing GGNS Unit 1 site would pose a significant impediment to the development of emergency plans for the proposed reactor(s) pursuant to 10 C.F.R. § 52.17(b)(1), describes the major features of SERI's proposed emergency plan pursuant to 10 C.F.R. § 52.17(b)(2)(i), and addresses whether site characteristics are such that the Applicant can develop adequate security plans and measures. SER at 13-1, 13-4, 13-115.

i. Emergency Planning

211. The Staff evaluates emergency plans to determine whether there is reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency. SER at 13-1. An early site permit application, pursuant to 10 C.F.R. § 52.17(b), must identify any physical characteristics unique to the proposed site that could pose a significant impediment to the development of emergency plans. SER at 13-1. The application must also describe the contacts and arrangements that the applicant has made with Federal, State, and local government agencies with emergency response planning responsibilities. SER at 13-1. In addition, the application may propose major features of the emergency plans, as described in Supplement 2 to NUREG-0654/FEMA-REP-1, Revision 1, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants—Criteria for Emergency Planning in an Early Site Permit Application—Draft Report for Comment" (hereafter referred to as Supplement 2), issued April 1996, or may propose complete and integrated emergency plans. SER at 13-1.

212. SERI's ESP application takes advantage of the emergency planning resources, capabilities, and organization that currently exist at the GGNS Unit 1 site. SER at 13-1. However, the Applicant indicated that it did not intend to develop a complete and integrated emergency plan until it is necessary to do so, such as at the COL phase. SER at 13-1.

213. Because the Applicant elected to present and seek NRC acceptance of the major features of the emergency plans, the Staff's evaluation addressed the three aspects of such a submission, in the following order:

- (1) identify physical characteristics that could pose a significant impediment to the development of emergency plans
- (2) describe contacts and arrangements made with Federal, State, and local governmental agencies with emergency planning responsibilities
- (3) propose major features of the emergency plans

SER at 13-3. Although the Applicant identified Appendix E, "Emergency Planning and Preparedness for Production and Utilization Facilities," to 10 C.F.R. Part 50, "Domestic Licensing of Production and Utilization Facilities," as applicable to the major features it proposed, the Staff noted that its findings are limited to those particular portions of Appendix E that the Staff considered during its review of a particular major feature. SER at 13-3.

214. Also, notwithstanding any Staff approval of a proposed major feature, the Staff stated its intent to review all features of the emergency plan requiring description pursuant to Appendix E, but which are not described in the ESP application, in the context of a COL or operating license ("OL") application. SER at 13-3. The Staff indicated it would review the complete and integrated emergency plans submitted in the COL or OL application to determine whether they comply with such requirements, as well as with the requirements of 10 C.F.R. § 50.47, "Emergency Plans." SER at 13-3.

i-a. Significant Impediments to the Development of Emergency Plans

215. The Applicant provided a preliminary analysis of the time required to evacuate transient and permanent populations from various sectors and distances within the 10-mile plume exposure pathway emergency planning zone ("EPZ"). SER at 13-3. The Applicant also indicated that a detailed evacuation time estimate ("ETE") performed in March 1986 for the plume exposure pathway EPZ shows that the maximum evacuation time for the affected area is approximately 3 hours. SER at 13-3 to 13-4. The Applicant further noted that a detailed evaluation of the original 1986 ETE undertaken in May 2003 ("2003 ETE") more fully considered the impact of historical population growth and transportation system improvements. SER at 13-4.

216. Based on the general guidance for updating ETEs contained in NUREG/CR-4831, the Staff concluded that the ETE is up to date for ESP purposes with respect to the guidance in RS-002. SER at 13-10. The Staff noted that because the proposed ESP site is adjacent to GGNS Unit 1, which is an operating nuclear power plant with integrated onsite and offsite radiological emergency plans, no significant impediments exist to the development of an emergency plan for the proposed ESP site. SER at 13-10.

217. Given the current socioeconomic status of the site vicinity, in concert with the modest population growth projected through 2030 (based on projections in Part 3 of the application) and both ongoing and scheduled improvements to major roadways currently used for evacuation, the Staff agreed with the Applicant that changes in demography, topography, land characteristics (and use), road networks, and jurisdictional boundaries are not expected to impact the plume exposure pathway EPZ and protection action area ("PAA") boundaries as defined for GGNS Unit 1 and as proposed for the new facility. SER at 13-10. In addition, based on the changes to the assumptions and data inputs implemented under Revision 1 to the 2003 ETE study and Revision 2 to Part 4 of the application, the Staff considered the ETE

preliminary analysis, contained in Section 2.2 of Part 4, and Revision 1 to the 2003 ETE study to be up to date for ESP purposes, in light of current population distributions and roadway improvements, using the guidance in Appendix 4 to NUREG-0654/FEMA-REP-1. SER at 13-10.

218. The Staff concluded that the Applicant showed through use of the ETE that no physical characteristics unique to the proposed ESP site could pose a significant impediment to the development of emergency plans. SER at 13-10. The Staff determined that the information the Applicant provided is consistent with the guidelines in RS-002 and Supplement 2 and meets the requirements of 10 C.F.R. § 52.17(b)(1) and 10 C.F.R. § 52.18. SER at 13-10.

i-b. Contacts and Arrangements with Local, State, and Federal Agencies

219. In its review of the application, the Staff considered the regulatory requirements in 10 C.F.R. § 52.17(b)(3), which mandate, in part, that an ESP application describe the contacts and arrangements made with Federal, State, and local government agencies with emergency planning responsibilities. SER at 13-13. The Staff found acceptable the Applicant's listing of letters of agreement ("LOAs"), which described the names and locations of the organizations contacted and the titles and/or positions of the persons reached, referenced Appendix D, "Letters of Agreement," to the existing emergency plan for GGNS Unit 1 for a description of the arrangements with the respective government agencies, and provided a statement of their willingness to enter into discussions to address future emergency preparedness needs based on construction of the proposed new facility. SER at 13-13. The Staff found that the application also sufficiently described other relevant contacts and arrangements for support. SER at 13-13.

220. The Staff found, therefore, that the Applicant provided an acceptable description of contacts and arrangements made with Federal, State, and local governmental agencies with emergency response planning responsibilities. SER at 13-14. The Staff concluded that the

information is consistent with the guidelines in RS-002 and Supplement 2 and meets the requirements of 10 C.F.R. § 52.17(b)(3). SER at 13-14.

i-c. Major Features of the Emergency Plans

\_\_\_\_\_221. Emergency Planning Zones: The Staff determined that the Applicant proposed a plume exposure pathway (10-mile) EPZ and an ingestion pathway (50-mile) EPZ, both of which reflect local emergency response needs and capabilities, including conditions such as demography, topography, land characteristics, access routes, and jurisdictional boundaries. SER at 13-17. The Staff also noted that the proposed ESP site currently has an operating reactor with integrated onsite and offsite radiological emergency plans and that the proposed new facility will use the existing GGNS 10-mile and 50-mile EPZs (operating plant). SER at 13-17. The Staff concluded that the proposed major feature, which addresses the size and configuration of the EPZs, is consistent with the guidelines in RS-002 and Supplement 2, and thus meets the requirements of 10 C.F.R. § 50.33(g), 10 C.F.R. § 50.47(c)(2), 10 C.F.R. § 52.17(b)(2)(i), 10 C.F.R. § 52.18, and Sections I, III, and IV of Appendix E to 10 C.F.R. Part 50, insofar as it describes the essential elements of advanced planning that have been considered for the emergency planning zones. SER at 13-17.

222. Assignment of Responsibility (Organization Control) (Major Feature A): The Staff found that the Applicant identified the emergency response organizations (“EROs”), including the functions and responsibilities for major elements of response, and (by reference to specific acts, codes, or statutes) the legal bases for State and local authorities. SER at 13-23. The Staff found sufficient descriptions of key EROs including Federal, State, local, and private sector organizations (as well as utilities) that are intended to be part of the overall response organization for EPZs. SER at 13-23. It also found sufficient description of key functions and responsibilities including command and control, alerting and notification, communications, public information, accident assessment, public health and sanitation, social services, fire and

rescue, traffic control, emergency medical services, law enforcement, transportation, protective response, and radiological exposure control. SER at 13-23. The Staff also determined that the Applicant described contacts and arrangements among the agencies and other support organizations having a response role within the EPZ. SER at 13-23.

223. The Staff concluded that proposed major feature A is consistent with the guidelines in RS-002 and Supplement 2 and meets the requirements of 10 C.F.R. § 52.17(b)(2)(i), 10 C.F.R. § 52.18, and Sections III and IV.A of Appendix E to 10 C.F.R. Part 50, insofar as it describes the essential elements of advanced planning that have been considered for organization control. SER at 13-23.

224. Onsite Emergency Organizations (Major Feature B): The Staff found that the Applicant identified the interfaces between and among the onsite functional areas of emergency activity, local services support, and State and local government response organizations for the ESP site. SER at 3-27. The Staff also determined that the Applicant identified the services and described the arrangements to be provided by various local agencies (such as training, treatment, transportation, and equipment provision by police, ambulance, medical, hospital, and firefighting organizations), and provided adequate letters of agreement. SER at 3-24 to 13-27. The Staff concluded that proposed major feature B is consistent with the guidelines in RS-002 and Supplement 2 and meets the requirements of 10 C.F.R. § 52.17(b)(2)(i), 10 C.F.R. § 52.18, and Sections III and IV.A of Appendix E to 10 C.F.R. Part 50, insofar as it describes the essential elements of advanced planning that have been considered for the onsite ERO. SER at 3-27.

225. Emergency Response Support and Resources (Major Feature C): The Staff found that the Applicant adequately described provisions for requesting Federal assistance and identified nuclear and other facilities and organizations that it can rely on for assistance in an emergency, including the general capabilities and availability of radiological laboratories. The



Staff likewise found that the Applicant described the contacts and arrangements made with the various response organizations. SER at 13-32. These included provisions and contacts with the NRC, Department of Energy, National Weather Service, U.S. Coast Guard, U.S. Army Corps of Engineers, States of Mississippi and Louisiana, and various volunteer organizations. SER at 13-28 to 13-31. The Staff therefore concluded that proposed major feature C is consistent with the guidelines in RS-002 and Supplement 2 and meets the requirements of 10 C.F.R. § 52.17(b)(2)(i), 10 C.F.R. § 52.18, and Sections III, IV.A, IV.B, IV.C, IV.D, and IV.E of Appendix E to 10 C.F.R. Part 50, insofar as it describes the essential elements of advanced planning that have been considered for emergency planning support and resources. SER at 13-32.

226. Emergency Classification System (Major Feature D): The Staff found that the Applicant specified a standard emergency classification scheme that is consistent with that set forth in Appendix 1 to NUREG-0654/FEMA-REP-1 and with those established by the State and local EROs. SER at 13-35. The Staff found this scheme included (1) notification of unusual event, (2) alert, (3) site area emergency, and (4) general emergency. SER at 13-33. The Staff therefore concluded that proposed major feature D is consistent with the guidelines in RS-002 and Supplement 2 and meets the requirements of 10 C.F.R. § 52.17(b)(2)(i), 10 C.F.R. § 52.18, and Sections III and IV.C of Appendix E to 10 C.F.R. Part 50, insofar as it describes the essential elements of advanced planning that have been considered for the emergency classification scheme. SER at 13-35.

227. Notification Methods and Procedures (Major Feature E): The Staff found that the Applicant described the mutually agreeable basis for notifying response organizations, which is consistent with that set forth in Appendix 1 to NUREG-0654/FEMA-REP-1, and includes the method for alerting, notifying, and mobilizing personnel. SER at 13-40. The Staff found that the Applicant identified the persons responsible for notification, described both primary and

secondary contacts, and described the relevant communications systems. SER at 13-35 to 13-37. The Staff also found that the Applicant described the administrative and physical means for notifying and promptly instructing the public within the plume exposure pathway EPZ. SER at 13-40. The Staff found that the Applicant's description discussed the applicable Alert Notification System, including the use of sirens and tone activated receivers (tone alerts), as well as mobile systems for backup notification. SER at 13-38 to 13-39. The Staff concluded that proposed major feature E is consistent with the guidelines in RS-002 and Supplement 2 and meets the requirements of 10 C.F.R. § 52.17(b)(2)(i), 10 C.F.R. § 52.18, and Sections III and IV.D of Appendix E to 10 C.F.R. Part 50, insofar as it describes the essential elements of advanced planning that have been considered for notification and procedures. SER at 13-40.

228. Emergency Communications (Major Feature F): The Staff found that the Applicant adequately identified communications provisions with State and local governments within the EPZs, with Federal EROs, and with fixed and mobile medical support facilities. SER at 13-45. The Staff also found that the Applicant described provisions for alerting and activating emergency personnel. SER at 13-45. The Staff found that these descriptions addressed the use of high-reliability telephones and dedicated lines for communications between the control room, key support centers and with State and local governments, including the UHF and satellite radio systems as backup; as well as fixed and mobile communications for coordination with medical services. SER at 13-40 to 13-44.

229. The Staff concluded that the proposed major feature F is consistent with the guidelines in RS-002 and Supplement 2 and meets the requirements of 10 C.F.R. § 52.17(b)(2)(i), 10 C.F.R. § 52.18, and Sections III, IV.D, and IV.E of Appendix E to 10 C.F.R. Part 50, insofar as it describes the essential elements of advanced planning that have been considered for emergency communications. SER at 13-45, 13-46. However, the Staff noted that some arrangements, such as a description of the NRC ERDS and requirements for its

activation, and communications arrangements with fixed and mobile medical support for the State of Mississippi and with mobile medical support in Claiborne County, would need to be expanded in an eventual COL or OL application to incorporate relevant aspects of a proposed new reactor design. SER at 13-45, 13-46.

230. Public Education and Information (Major Feature G): The Staff found that the Applicant described a program to provide information to the public and news media on a periodic basis and which addresses public notification and emergency actions. SER at 13-49. The Staff noted that the Applicant's intended dissemination of information to the general public, in conjunction with State and local agencies, would include educational information on radiation, personnel to contact for further information, protective measures (e.g., evacuation routes, relocation centers, and shelter), respiratory protection and radioprotective drugs, and special needs of the handicapped. SER at 13-46. The Staff concluded that the proposed major feature G is consistent with the guidelines in RS-002 and Supplement 2 and meets the requirements of 10 C.F.R. § 52.17(b)(2)(i), 10 C.F.R. § 52.18, and Sections III, IV.B, IV.D, IV.E, and IV.F of Appendix E to 10 C.F.R. Part 50, insofar as it describes the essential elements of advanced planning that have been considered for public education and information. SER at 13-49.

231. However, the Staff noted that, with respect to the Mississippi Radiological Emergency Preparedness Plan ("MREPP") and the Port Gibson / Claiborne County Radiological Emergency Preparedness Plan ("PGCCREPP") concerning the mechanism for the periodic dissemination of information regarding the special needs for the handicapped in the State of Mississippi, to the extent that the description would need to be expanded to incorporate relevant aspects of a proposed new reactor design in a COL or OL application, the Staff will determine the adequacy of such incorporation in this area during a COL or OL review. SER at 13-49.

232. Emergency Facilities and Equipment (Major Feature H): The Staff found that the Applicant described the emergency operation centers (“EOCs”) for the States of Mississippi and Louisiana, Claiborne County, and Tensas parish for use in directing and controlling response actions, consistent with the guidance in RS-002 and Supplement 2 (Evaluation Criterion H.3). SER 13-53. However, the Staff found that the Applicant has not described in sufficient detail the emergency facilities and related equipment for the technical support center (“TSC”), operational support center (“OSC”), and emergency operations facility (“EOF”), consistent with the guidance in RS-002 and Supplement 2 (Evaluation Criteria H.1 and H.2). Therefore, the Staff concluded that the proposed major feature H is unacceptable. SER 13-53. Because the emergency response facility guidance in NUREG-0696 will be applied during the emergency plan review at the COL stage, the Staff will determine the adequacy of such incorporation in this area during a COL or OL review.

233. Accident Assessment (Major Feature I): The Staff found that the Applicant adequately described the contacts and arrangements made with offsite organizations (i.e., the National Weather Service or the U.S. Army Corps of Engineers) for acquiring and evaluating meteorological information and described its plan for making suitable meteorological data available to the affected States. SER at 13-53, 13-56.

234. The Staff found that the application described the contacts and arrangements made for field monitoring within the plume exposure pathway and described the contacts and arrangements to locate and track the airborne radioactive plume, using Federal and/or State resources, including the resources and/or response teams of the Department of Energy, Mississippi, and Louisiana. SER at 13-55, 13-56. The Staff also noted the Applicant’s environmental monitoring program, the offsite measurement of ambient radiation by thermoluminescent dosimeters and other devices, as well as the capabilities of the Applicant’s offsite monitoring teams. SER at 13-53, 13-54. The Staff concluded that proposed major

feature I is consistent with the guidelines in RS-002 and Supplement 2 and meets the requirements of 10 C.F.R. § 52.17(b)(2)(i), 10 C.F.R. § 52.18, and Sections III, IV.A, IV.B, IV.C, IV.D, and IV.E of Appendix E to 10 C.F.R. Part 50, insofar as it describes the essential elements of advanced planning that have been considered for accident assessment. SER at 13-56.

235. Protective Response (Major Feature J): The Staff found that the Applicant adequately described a range of protective actions for the plume exposure pathway EPZ for the public and emergency workers, including guidelines for the choice of protective actions that are consistent with Federal guidance, and protective actions for the ingestion exposure pathway EPZ. SER at 13-92.

236. The Staff considered the Applicant's responses to a number of RAIs – in particular, several concerning the 2003 ETE study and its consistency with regulatory guidance such as NUREG/CR-4831 – and determined them to be acceptable. Based on the changes to the assumptions and data inputs implemented under Revision 1 to the 2003 ETE study and Revision 2 to Part 4 of the application, the Staff found that the ETE preliminary analysis, contained in Section 2.2 of Part 4, and Revision 1 to the 2003 ETE study adequately describe the current population distributions and roadway improvements, using the guidance in Appendix 4 to NUREG-0654/FEMA-REP-1. SER at 13-90. The Staff also found that the results of the 2003 ETE study were subsequently reviewed and concurred on by the appropriate State officials. SER at 13-90.

237. The Staff further determined, again after analysis of various RAI responses from the Applicant, the acceptability of various aspects of the Applicant's discussion, including the provision of maps showing the population distribution around the site based on sectors or designated evacuation areas; the proposed means for notifying all segments of the transient and resident populations; the availability and capacity of school buses or other transportation

methods; proposed means for protecting those persons whose mobility may be impaired; control of access to evacuated areas and organizational responsibilities for such control; identification of and the means for dealing with potential impediments (e.g., seasonal impassability of roads) to the use of evacuation routes, as well as contingency measures; and registering and monitoring evacuees at reception centers. SER at 13-88 to 13-92.

238. Furthermore, the Staff agreed with the Applicant that some elements of the protective response, such as aspects of the evacuation routes and transportation for onsite individuals to suitable locations, including alternatives for inclement weather, high traffic density, and specific radiological conditions, and the methods for notification and accountability of site personnel, are outside the scope of the ESP application review, and will be addressed at the COL stage. SER at 13-88 to 13-90.

239. However, with respect to description in the ETE analysis of the current population distributions and roadway improvements – including the availability and capacity of school buses or other transportation methods, the availability of drivers, and the process for mobilizing them during an evacuation for the transport of students, residents, transients, and special needs populations in Claiborne County and Tensas Parish – the Staff noted that to the extent that the arrangements would need to be expanded to incorporate relevant aspects of a proposed new reactor design in a COL or OL application, the Staff will determine the adequacy of such incorporation during a COL or OL review. SER at 13-90.

240. Similarly, while the Staff determined that the Applicant's maps showing evacuation routes, evacuation/shelter areas, and relocation centers were acceptable for an ESP application, it again noted that to the extent that the arrangements would need to be expanded to incorporate relevant aspects of a proposed new reactor design in a COL or OL application, the Staff intends to determine the adequacy of such incorporation during a COL or OL review. SER at 13-90, 13-91. The Staff reached a similar conclusion with respect to the

means for using radioprotective drugs for emergency workers and institutionalized persons within the plume exposure pathway EPZ in the States of Louisiana and Mississippi, and with respect to describe shelter facility capabilities based on any anticipated population increase within the plume exposure pathway EPZ. SER at 13-91.

241. In light of the considerations discussed above, the Staff concluded that the proposed major feature J is consistent with the guidelines in RS-002 and Supplement 2 and meets the requirements of 10 C.F.R. § 52.17(b)(2)(i), 10 C.F.R. § 52.18, and Sections III, IV.A, IV.B, IV.D, and IV.E of Appendix E to 10 C.F.R. Part 50, insofar as it describes the essential elements of advanced planning that have been considered for accident assessment. SER at 13-92.

242. Radiological Exposure Control (Major Feature K): The Staff found that the Applicant adequately described the means for controlling radiological exposures to emergency workers in an emergency. SER at 13-100. The Staff determined the acceptability of various aspects of the application, including its discussions of how the Applicant and State and local agencies will determine the doses received by emergency personnel, including volunteers, involved in any nuclear accident; of how the Applicant and State and local agencies will acquire and distribute dosimeters; of the decision chain for authorizing emergency workers to incur exposures in excess of the EPA dose limits for workers performing emergency services; of specific action levels, as applicable, for determining the need for the decontamination of emergency workers, equipment and vehicles, and members of the general public and their possessions; and of an appropriate means for radiological decontamination of emergency personnel wounds, supplies, instruments, and equipment. SER at 13-99 to 13-100.

243. However, with respect to the Applicant's description of guidance established in the PGCCREPP related to bioassay or whole body counting for determination of offsite emergency worker dose due to uptake of radioactive material, the Staff found the description

acceptable for an ESP application, except to the extent that the arrangements would need to be expanded to incorporate relevant aspects of a proposed new reactor design in a COL or OL application, the Staff will determine the adequacy of such incorporation during a COL or OL review. SER at 13-100.

244. The Staff therefore concluded that the proposed major feature K is consistent with the guidance in RS-002 and Supplement 2 and meets the requirements of 10 C.F.R. § 52.17(b)(2)(i), 10 C.F.R. § 52.18, and Sections III, IV.A, IV.B, and IV.E of Appendix E to 10 C.F.R. Part 50, insofar as it describes the essential elements of advanced planning that have been considered for radiological exposure control. SER at 13-100.

245. Medical and Public Health Support (Major Feature L): The Staff found that the Applicant adequately described the contacts and arrangements for medical services capable of evaluating radiation exposure and uptake. SER at 13-103. The application identified which facilities in both Mississippi and Louisiana will have primary and backup responsibilities for accepting victims of radiation-related accidents, their capabilities, and what emergency training the staff at each facility will have. SER at 13-101 to 13-102. The Staff concluded that the proposed major feature K is consistent with the guidance in RS-002 and Supplement 2 and meets the requirements of 10 C.F.R. § 52.17(b)(2)(i), 10 C.F.R. § 52.18, and Sections III, IV.A, IV.C, and IV.E of Appendix E to 10 C.F.R. Part 50, insofar as it describes the essential elements of advanced planning that have been considered for medical and public health support. SER at 13-103.

246. However, with respect to the description of certain contacts and arrangements for local and backup hospital services in the State of Louisiana, and with respect to special radiological capabilities for hospitals listed in the Louisiana Peacetime Radiological Response Plan ("LPRRP"), Chapter 10, the Staff found the description acceptable for an ESP application, except to the extent that the arrangements would need to be expanded to incorporate relevant



aspects of a proposed new reactor design in a COL or OL application, the Staff will determine the adequacy of such incorporation during a COL or OL review. SER at 13-103.

247. Radiological Emergency Response Training (Major Feature O): The Staff found that the Applicant described a radiological emergency response training program for those who may be called on to assist in an emergency, including a training program for instructing and qualifying personnel who would implement the radiological emergency response plans. SER at 13-109. The Staff also found that the Applicant adequately described specialized initial training and periodic training. SER at 13-109.

248. The Staff agreed that the application sufficiently described a training program for instructing and qualifying personnel who will implement radiological response plans. The Staff found that the program confirms that the Applicant and responsible State and local agencies/organizations will provide specialized initial training and periodic retraining for several categories of personnel, as applicable, including directors or coordinators of the response organizations; personnel responsible for accident assessment; radiological monitoring teams and radiological analysis personnel; police, security, and firefighting personnel; first aid and rescue personnel; local support services personnel, including civil defense/emergency services personnel; medical support personnel; and personnel responsible for transmission of emergency information and instructions. SER at 13-108 to 13-109.

249. The Staff concluded that proposed major feature O is consistent with the guidelines in RS-002 and Supplement 2 and meets the requirements of 10 C.F.R. § 52.17(b)(2)(i), 10 C.F.R. § 52.18, and Sections III, IV.A, and IV.F of Appendix E to 10 C.F.R. Part 50, insofar as it describes the essential elements of advanced planning that have been considered for radiological emergency response training. SER at 13-109.

250. Responsibility for the Planning Effort: Development, Periodic Review, and Distribution of Emergency Plans (Supplement 2, Major Feature P): The Staff found that the Applicant described the responsibilities for plan development and review and for distributing and updating emergency plans. SER at 13-115. The Staff also found that the Applicant identified those responsible for the planning effort – noting their title, jurisdiction, and responsibilities -- and described the training that they receive. SER at 13-109 to 13-112, 13-115. The Staff found that this included designation of an emergency planning coordinator with responsibility for the development and update of emergency plans and the coordination of these plans with other response organizations. SER at 13-115.

251. The Staff concluded that proposed major feature P is consistent with the guidelines in RS-002 and Supplement 2 and meets the requirements of 10 C.F.R. § 52.17(b)(2)(i), 10 C.F.R. § 52.18, and Sections III, IV.A, IV.F, and IV.G of Appendix E to 10 C.F.R. Part 50, insofar as it describes the essential elements of advanced planning that have been considered for the development, periodic review, and distribution of emergency plans. SER at 13-115.

ii. Site Characteristics–Security Systems

252. In addition to examining emergency planning for the proposed Grand Gulf ESP site, the Staff also examined the proposed site characteristics with respect to their potential to affect the establishment of adequate security plans and measures. SER at 13-115. In its review, the Staff conducted a site visit as well as examining the application and RAI responses. SER at 13-116.

253. The Staff noted that NRC regulations require that ESP applicants address characteristics of the proposed site that could affect security, and that specifically, 10 C.F.R. § 52.17 requires that site characteristics comply with 10 C.F.R. Part 100, and 10 C.F.R. § 100.21(f) indicates that site characteristics must be such that applicants can develop

adequate security plans and measures. SER at 13-116. The Staff also found that RG 4.7 both provides amplifying guidance and noted that 10 C.F.R. § 73.55 describes physical protection requirements for nuclear power plants. SER at 13-116.

254. The Staff examined pedestrian, vehicle, and water approaches, including existing culverts, nearby railroad lines, nearby hazardous materials facilities, nearby pipelines, and other transportation routes, as well as terrain features. SER at 13-116. From its site visit and examination of site features, the Staff concluded that the distance from the planned locations of vital equipment and structures (because a design is not specified at the ESP stage, these might be located anywhere in the proposed power block) to the planned protected area boundary can be made large enough that holders of a COL or construction permit (CP) could appropriately locate delay barriers, isolation zones, detection equipment, and vehicle barriers to protect vital equipment and structures. SER at 13-117. The Staff also noted that vital equipment for the existing GGNS unit is sufficiently far from the Mississippi River that restrictions to river access are not required. SER at 13-117.

255. The Staff further concluded that the location of existing roads and site terrain features do not preclude the establishment of adequate vehicle control measures to (1) prevent the use of a land vehicle to gain unauthorized proximity to vital areas, and (2) protect against a vehicle bomb. SER at 13-117. The Staff found that the location of the existing vehicle checkpoint has adequate standoff distance from the proposed power block to mitigate vehicle-bomb overpressure effects. SER at 13-117. Further, the Staff confirmed during a site visit that the terrain features on all borders of the site are amenable to the implementation of a vehicle barrier system. SER at 13-117.

256. Also, the Staff examined the overall site terrain with respect to features (including existing manmade features, such as culverts, as well as natural features) that potential adversaries could use to their advantage. SER at 13-118. The Staff found that no site

terrain features would preclude the establishment of adequate security plans and measures, and that with respect to nearby hazardous material facilities and nearby pipelines, distances to those facilities and the associated hazardous materials identified did not pose an impediment to the development of adequate security plans or measures. SER at 13-118.

257. However, because the exact locations and design of barriers are not known at the ESP stage, the Staff determined that the eventual COL or CP applicant should provide specific designs for protected area barriers to support the security response strategy timelines. SER at 13-118.

258. In light of the considerations discussed above, the Staff concluded that the ESP site characteristics would allow an applicant for a COL or CP to develop adequate security plans and measures for reactor(s) that it might construct and operate on the ESP site. SER at 13-118.

259. We find that the facts described in Chapter 13 of the Staff's SER include all factors relevant to whether there is any significant impediment to the development of emergency plans, whether the Applicant has made contacts and arrangements with Federal, State, and local government agencies with emergency response planning responsibilities, whether major features of the emergency plan can be approved, and whether site characteristics are such that the Applicant can develop adequate security plans and measures for the proposed Grand Gulf ESP site.

260. Further, we find that the Staff evaluation documented in SER Chapter 13, as described above, is based on these facts, and provides reasonable support in logic to support the Staff findings in SER Chapter 13.

261. Accordingly, we find that the Staff's review of these matters was adequate.

f. SER, Chapter 15, "Postulated Accidents and Accident Dose Consequences"

262. As set forth below, the application analyzed and provided the radiological consequences of design-basis accidents ("DBAs") to demonstrate that a new nuclear unit(s) could be sited at the proposed ESP site without undue risk to the health and safety of the public, in compliance with the requirements of 10 C.F.R. § 52.17, "Contents of Applications," and 10 C.F.R. Part 100, "Reactor Site Criteria." SER at 15-1. The regulations at 10 C.F.R. § 52.17(a)(1) require that ESP applications contain an analysis and evaluation of the major structures, systems, and components of the facility that bear significantly on the acceptability of the site under the radiological consequence evaluation factors identified in 10 C.F.R. § 50.34(a)(1). SER at 15-4.

263. The Applicant did not identify a particular reactor design to be considered for the proposed ESP site. Instead, SERI developed a set of reactor DBA source term parameters using surrogate reactor characteristics. SER at 15-1. The Applicant used these source term parameters, in conjunction with site characteristics for accident analysis purposes, to assess the suitability of the proposed ESP site. SER at 15-1. These plant parameters collectively constitute a plant parameter envelope ("PPE"). SER at 15-1. The PPE was developed using seven reactor designs—five water-cooled reactors and two gas-cooled reactors<sup>16</sup> – though the Applicant used source terms for only three of these designs as inputs to its DBA analyses. SER at 15-1.

264. Using source terms developed primarily from two light-water reactors designs, the certified Advanced Boiling Water Reactor ("ABWR") and a version of the Advanced

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<sup>16</sup> The five light water reactor ("LWR") designs SERI considered are the Advanced Canada Deuterium Uranium Reactor ("ACR-700"); the Advanced Boiling Water Reactor ("ABWR"); the Advanced Pressurized Water Reactor ("AP1000"); the Economic Simplified Boiling Water Reactor ("ESBWR"), and the International Reactor Innovative and Secure ("IRIS") next-generation pressurized water reactor ("PWR"). The two gas-cooled designs SERI considered are the Gas Turbine Modular Helium Reactor ("GT-MHR") and the Pebble Bed Modular Reactor ("PBMR").

Pressurized Water Reactor ("AP1000"), the Applicant performed and provided radiological consequence analyses for a number of DBAs. SER at 15-1. These included the pressurized-water reactor ("PWR") main steamline break, PWR feedwater system pipe break, locked rotor accident, reactor coolant pump shaft break, PWR rod ejection accident, boiling-water reactor ("BWR") control rod drop accident, failure of small lines carrying primary coolant outside containment, PWR steam generator tube failure, BWR main steamline break, PWR and BWR loss-of-coolant accidents ("LOCAs"), and fuel-handling accident. SER at 15-1, 15-2.

265. As discussed in Review Standard (RS)-002, the Staff considers the PPE approach to be an acceptable method for assessing site suitability. For the purposes of this analysis, the Applicant proposed a fission product release from the ESP footprint to the environment; the Staff reviewed the Applicant's dose evaluation based on this release. SER at 15-4.

266. Selection of DBAs: First, the Staff found that the Applicant selected DBAs that are consistent with the DBAs listed and analyzed in the SRP and in RG 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Plants," issued July 2000. SER at 15-4 to 15-5. The Staff also indicated that conclusions drawn regarding the site's acceptability based on the AP1000 and ABWR designs are likely to be valid for the other reactor designs the Applicant is considering, although whether those designs are bounded will be evaluated at the time of a CP or COL application. SER at 15-5. Therefore, the Staff found that the Applicant provided an acceptable DBA selection for evaluating the compliance of the proposed ESP site with the dose consequence evaluation factors specified in 10 C.F.R. § 50.34(a)(1). SER at 15-4 to 15-5.

267. Design-Specific (Assumed)  $\chi/Q$  Values: Second, although Westinghouse revised the  $\chi/Q$  (atmospheric dispersion factor) values in the AP1000 DCD subsequent to the Applicant's use of the  $\chi/Q$  values in the proposed AP1000 DCD that were under Staff review at

the time the ESP application was submitted, the Staff determined that the PPE values for the assumed  $\chi/Q$  values associated with the AP1000 design used by the Applicant in its accident analyses are reasonable and, therefore, are adequate for the purpose of demonstrating that a reactor with design characteristics similar to an AP1000 could be sited at the proposed ESP site. SER at 15-5.

268. Site-Specific  $\chi/Q$ s: Third, the Staff reviewed the Applicant's site-specific  $\chi/Q$  values and performed an independent evaluation of atmospheric dispersion per the guidance provided in Section 2.3.4 of RS-002. The Staff found the  $\chi/Q$  values acceptable. SER at 15-6.

269. Source Terms and Radiological Consequence Evaluations: The Staff found that the certified ABWR and the proposed AP1000 designs met the radiological consequence evaluation factors identified in 10 C.F.R. § 50.34(a)(1) with their postulated  $\chi/Q$  values. SER at 15-7. The Staff therefore determined that the resulting DBA radiological consequence doses at the proposed site are lower than those provided in the SSAR/ABWR and AP1000 DCD and, therefore, meet the requirements of 10 C.F.R. § 50.34. SER at 15-7.

270. The Staff further commented that the radiological consequences of the DBAs at the proposed site based on the AP1000 and ABWR designs are likely to be valid for the other reactor designs the Applicant is considering, though whether or not the final reactor design the Applicant selects for use at the Grand Gulf ESP site is in fact bounded by the ESP evaluation would be subject to review during the Staff's consideration of any COL or CP application. SER at 15-7. The Staff subsequently found the source terms from the PPE (i.e., the ESP footprint) themselves to be reasonable and acceptable, and stated that the Applicant correctly concluded that the dose consequences for the chosen surrogate designs comply with the dose consequence evaluation factors of 10 C.F.R. § 50.34(a)(1). SER at 15-6, 15-7.

271. In sum, the Staff found that the Applicant submitted its radiological consequence analyses using the site-specific  $\chi/Q$  values and PPE source term values and concluded that the

proposed site meets the radiological consequence evaluation factors identified in 10 C.F.R. § 50.34(a)(1). SER at 15-8. The Staff found that the Applicant's PPE values for source terms included as inputs to the radiological consequence analyses are reasonable. SER at 15-8. Further, the Staff found that the Applicant's site-specific  $\chi/Q$  values and dose consequence evaluation methodology are acceptable. SER at 15-8.

272. The Staff concluded that the proposed distances to the EAB and the LPZ outer boundary of the proposed ESP site, in conjunction with the fission product release rates to the environment provided by the Applicant as PPE values, are adequate to provide reasonable assurance that the radiological consequences of the DBAs will be within the dose consequence evaluation factors set forth at 10 C.F.R. § 50.34(a)(1) for the proposed ESP site. SER at 15-8. The Staff noted that this conclusion is subject to confirmation at the COL or CP stage that the design of the facility specified by the COL or CP applicant falls within the ESP PPE values. SER at 15-8.

273. The Staff further concluded that (1) the Applicant demonstrated that the proposed ESP site is suitable for power reactors with source term characteristics bounded by those of the ABWR and AP1000 without undue risk to the health and safety of the public, and (2) the Applicant complies with the requirements of 10 C.F.R. § 52.17 and 10 C.F.R. Part 100. SER at 15-8.

274. We find that the facts described in Chapter 15 of the Staff's SER include all factors relevant to postulated accidents and accident dose consequences for the proposed Grand Gulf ESP site.

275. Further, we find that the Staff evaluation documented in SER Chapter 15, as described above, is based on these facts, and provides reasonable support in logic to support the Staff findings in SER Chapter 15.

276. Accordingly, we find that the Staff's review of these matters was adequate.



g. SER, Chapter 17, "Early Site Permit Quality Assurance Measures"

277. As set forth below, in Chapter 17 of the SER the Staff evaluated the quality assurance ("QA") measures employed by the Applicant and its contractors in preparing its ESP application.

278. Current NRC regulations do not require ESP holders or applicants to implement a QA program compliant with the requirements of Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 C.F.R. Part 50. SER at 17-1. However, the Applicant is expected to implement QA measures equivalent in substance to the measures described in Appendix B to 10 C.F.R. Part 50, in order to provide reasonable assurance that any information derived from ESP activities which could be used in the design and/or construction of SSCs important to safety will support satisfactory performance of such SSCs once they are in service. SER at 17-1.

279. Thus, although the Applicant chose not to supply information on the QA measures it employed for ESP activities in its application, the Staff evaluated quality measures for those activities associated with the Applicant's generation of site-related information that could be used as input to the design of future SSCs to ensure that these measures can provide reasonable assurance of the integrity and reliability of the information, assuming that the Applicant's QA measures are equivalent in substance to the criteria of Appendix B to 10 C.F.R. Part 50. SER at 17-1.

280. The Staff's review focused on the Applicant and its primary contractor, Enercon, although the SER also addressed the adequacy of the QA measures applied by certain subcontractors. SER at 17-2. The Staff conducted an inspection of the Applicant's QA measures from February 9–13, 2004. SER at 17-1. Subsequently, the Staff performed an in-office technical review to evaluate whether the Applicant and its principal subcontractors had applied adequate QA measures. SER at 17-1. The Staff also conducted a review to determine

whether SERI adequately applied the guidance in Section 17.1.1 of Review Standard (RS)-002, “Processing Applications for Early Site Permits,” to demonstrate the integrity and reliability of the data obtained during ESP activities. SER at 17-1.

281. Because the Staff determined that conformance to the quality measures described in RS-002, Section 17.1.1, provides reasonable assurance that the Applicant used adequate QA measures to support its ESP application, the Staff focused its review on whether the Applicant’s QA measures adequately address the guidance for each relevant element (as determined by the Applicant). SER at 17-1. For any element that the Applicant determined not to be relevant, the Staff verified that the ESP activities did not rely on QA measures associated with that element. SER at 17-1.

282. The Staff noted that the “Quality Assurance Project Planning Document for Entergy Nuclear Potomac Early Site Permitting Project, Grand Gulf Nuclear Station Site,” Project No. ENTO-002, Revision 5, dated October 6, 2003 (“QAPPD”), describes the QA measures for ESP activities and identifies certain criteria in Appendix B to 10 C.F.R. Part 50 that contain elements associated with the control of ESP activities. SER at 17-2. The Staff further noted that Enercon applied elements from these criteria or verified that the controls used for ESP activities reflect the elements from these criteria, as outlined in the Enercon Services Quality Assurance Program Manual, Revision 8 (“QAPM”). SER at 17-2. Finally, the Staff noted that because Enercon wrote the QAPM to comply with the requirements of Appendix B to 10 C.F.R. Part 50, it contains QA policies corresponding to each of the Appendix B criteria. SER at 17-2.

i. Introduction (Organization)

283. The Staff reviewed the QA measures employed by the Applicant and its primary contractor and concluded that they have implemented an acceptable organization meeting the guidance in Section 17.1.1 of RS-002. SER at 17-4. An acceptable organizational description

includes (1) an organization description and charts of the lines, interrelationships, and areas of responsibility and authority for all organizations performing quality-related activities, including the Applicant's organization and principal subcontractors, (2) the relative location of the QA organization, degree of independence from the organization performing ESP activities, and authority of the individuals assigned the responsibility for performing QA functions, and (3) the organizational provisions that exist for ensuring the proper implementation of QA controls. SER at 17-3. The Staff found reasonable assurance that any information derived from ESP activities that could be used in the design and/or construction of SSCs important to safety will support satisfactory performance of such SSCs once they are in service. SER at 17-4.

284. The Staff noted that SERI, a subsidiary of Entergy Corporation, authorized Entergy Nuclear Potomac Company to prepare the ESP application, and that Entergy Nuclear Potomac Company in turn selected Enercon to perform the actual preparation of the ESP application and delegated ESP QA organizational responsibilities to Enercon. SER at 17-3. The Staff found that Enercon's QAPM conforms to the requirements of Appendix B to 10 C.F.R. Part 50. SER 17-3.

ii. Quality Assurance Program

285. The Staff reviewed the QA measures implemented by the Applicant and its primary contractor. The Staff concluded that they have implemented an acceptable QA program which meets the guidance in Section 17.1.1 of RS-002. SER at 17-7. Such a QA program should include (1) a scope of QA controls adequate to ensure that appropriate quality controls are applied to all site characterization data that relate to the design and analysis of SSCs important to safety that might be constructed on the proposed site, (2) provisions to ensure proper definition of QA controls, and (3) provisions to ensure adequacy of personnel qualifications. SER at 17-5. The Staff found reasonable assurance that any information derived from ESP activities that could be used in the design and/or construction of SSCs

important to safety will support satisfactory performance of such SSCs once they are in service. SER at 17-7.

286. As part of its review, the Staff examined the QAPPD, which Enercon developed to implement its QA program for specific activities related to the ESP application. The Staff noted that the QAPPD, intended to provide a detailed description of the total scope of work and tasks necessary to produce the ESP application, identifies hydrological and meteorological activities that fall within the Enercon QA program, as well as oversight of seismic and geotechnical work performed by Entergy Nuclear Potomac Company's subcontractor, William Lettis & Associates ("WLA"). SER at 17-6. The Staff verified that calculations associated with the determination of atmospheric dispersion factors were performed with QA program controls within the scope of meteorological activities, and the Staff confirmed calculations to determine that population projections were developed with adequate quality measures. SER at 17-6.

iii. Design Control

287. The Staff reviewed the QA control measures employed by the primary contractor and its subcontractors and concluded that they implemented acceptable design controls which meet the guidance in Section 17.1.1 of RS-002. SER at 17-10. Such acceptable design controls should include (1) the scope of activities that could affect design and construction activities for SSCs important to safety that might be constructed on the site, (2) definition of the organizational structure, activity, and responsibility of the positions or groups responsible for design activities important to safety (if any), (3) provisions to carry out design activities important to safety in a planned, controlled, and orderly manner, (4) provisions for interface control between functional units of the applicant's organization, (5) provisions to verify the technical adequacy of design documents applicable to ESP activities that could affect SSCs important to safety, and (6) provisions to control design changes applicable to ESP activities that could affect SSCs important to safety. SER at 17-8. The Staff found reasonable

assurance that any information derived from ESP activities that could be used in the design and/or construction of SSCs important to safety will support satisfactory performance of such SSCs once they are in service. SER at 17-10.

288. The Staff determined that the Applicant provided adequate QA measures to authenticate and verify data retrieved from Internet Web sites that support information in the SSAR that could affect the design, construction, or operation of SSCs important to safety. SER at 17-9. The Staff also noted that the QAPM provides guidelines for QA controls in the areas of design input, verification, change control, and corrective actions; the Staff found that the QAPM also provides the guidelines for design process, interface control, and document control and references other Enercon QA procedures for document control and corrective actions. SER at 17-9. As a result, the Staff found that the QA design control measures described in Enercon's QAPPD and other Enercon procedures and documents are equivalent in substance to the requirements of Appendix B to 10 C.F.R. Part 50 and the guidance contained in Section 17.1.1 of RS-002 regarding ESP design control activities. SER at 17-9. The Staff reached a similar conclusion with respect to the QA design control measures for the work performed by WLA. SER at 17-10.

iv. Procurement Document Control

289. The Staff reviewed the QA measures employed by the primary contractor and its subcontractors and concluded that they have implemented an acceptable level of procurement document control which meets the guidance in Section 17.1.1 of RS-002. SER at 17-13. Acceptable procurement document controls should include (1) provisions to ensure that procurement documents related to ESP activities that could affect SSCs important to safety include or reference the applicable technical requirements and QA controls, and (2) provisions for the review and approval of procurement documents for ESP activities that could affect SSCs important to safety. SER at 17-11.

290. The Staff found reasonable assurance that any information derived from ESP activities that could be used in the design and/or construction of SSCs important to safety will support the satisfactory performance of such SSCs once they are in service. SER at 17-13. As part of its review, the Staff found that the procurement document controls, with respect to both Enercon and WLA, are equivalent in substance to the requirements of Appendix B to 10 C.F.R. Part 50 and meet the guidance contained in Section 17.1.1 of RS-002. SER at 17-13.

v. Instructions, Procedures, and Drawings

291. The Staff reviewed the QA measures employed by the primary subcontractors and concluded that they have implemented an acceptable level of control for instructions, procedures, and drawings which meets the guidance in Section 17.1.1 of RS-002. SER at 17-16. Acceptable controls for instructions, procedures, and drawings should include (1) provisions for ensuring that ESP activities that could affect SSCs important to safety are prescribed by and accomplished in accordance with instructions, procedures, and drawings, and (2) provisions for incorporating quantitative and qualitative acceptance criteria in instructions, procedures, and drawings related to ESP activities that could affect SSCs important to safety. SER at 17-14.

292. The Staff found reasonable assurance that any information derived from ESP activities that could be used in the design and/or construction of SSCs important to safety will support the satisfactory performance of such SSCs once they are in service. SER at 17-16. As part of its review, the Staff found that the instruction, procedure, and drawing controls applied to the work performed by six subcontractors (University of Texas, Eustis, GEOVision, Pacific Engineering, Jack Benjamin & Associates, and Omega Technical Services) in support of the ESP project are equivalent in substance to the requirements of Appendix B to 10 C.F.R. Part 50 and the guidance contained in Section 17.1.1 of RS-002 regarding ESP design control activities. SER at 17-14 to 17-16.

vi. Document Control

293. The Staff reviewed the QA measures employed by the primary contractor and concluded that it implemented acceptable document controls which meet the guidance in Section 17.1.1 of RS-002. SER at 17-18. Acceptable document controls should include provisions to ensure that documents related to ESP activities that could affect SSCs important to safety, including changes, are reviewed for adequacy, approved for release by authorized personnel, and distributed and used at the location where the prescribed activity is performed. SER at 17-17.

294. The Staff found reasonable assurance that any information derived from ESP activities that could be used in the design and/or construction of SSCs important to safety will support the satisfactory performance of such SSCs once they are in service. SER at 17-18. As part of its review, the Staff found that the primary contractor adequately controlled the distribution of the copies of the QAPM and corporate standard procedures ("CSPs"), identified authorized users of the procedures, and maintained a record of distribution and properly incorporated revisions into applicable documents. SER at 17-18.

vii. Control of Purchased Material, Equipment, and Services

295. The Staff reviewed the QA measures employed by the primary subcontractors and concluded that they have implemented acceptable controls for purchased material, equipment, and services which meet the guidance in Section 17.1.1 of RS-002. SER at 17-23. Acceptable controls should include (1) provisions for the control of purchased material, equipment, and services related to ESP activities that could affect SSCs important to safety that apply to selecting suppliers, as well as to assessing the adequacy of quality, and (2) provisions to ensure that documented evidence of the conformance to procurement specifications of material and equipment related to ESP activities that could affect SSCs important to safety are available at the site before installation or use. SER at 17-19.

296. The Staff found reasonable assurance that any information derived from ESP activities that could be used in the design and/or construction of SSCs important to safety will support the satisfactory performance of such SSCs once they are in service. SER at 17-23. As part of its review, the Staff found that the procurement document controls, with respect to seven subcontractors (Omega Technical Services, Black Diamond Consultants, Eustis, GEOVision, University of Texas, Jack Benjamin & Associates, and Pacific Engineering), are equivalent in substance to the requirements of Appendix B to 10 C.F.R. Part 50 and meet the guidance contained in Section 17.1.1 of RS-002. SER at 17-20 to 17-23. With respect to subcontractor Eustis, the Staff also found acceptable an alternative method that the Applicant proposed to address a lack of 10 C.F.R. Part 21 requirements. SER at 17-20 to 17-21.

viii. Identification and Control of Materials, Parts, and Components

297. The Staff noted that in general, according to NRC guidance, an acceptable QA level of identification and control of materials, parts, and components should include (1) provisions to identify and control materials, parts, and components related to ESP activities that could affect SSCs important to safety, and (2) provisions to ensure that incorrect or defective items are not used in ESP activities that could affect SSCs important to safety. SER at 17-24. However, the Staff reviewed the need for QA measures by the Applicant and its primary contractor and concluded that the scope of work for the ESP project does not require the identification and control of materials, parts, and components; the Staff determined that the Applicant and Enercon did not conduct activities important to safety that require the identification and control of materials, parts, and components. SER at 17-24.

ix. Control of Special Processes

298. The Staff noted that in general, according to NRC guidance, acceptable QA control of control of special processes should include (1) provisions to ensure the acceptability of special processes used for ESP activities that could affect SSCs important to safety, and



(2) provisions to ensure that special processes related to ESP activities that could affect SSCs important to safety are performed by qualified personnel using qualified procedures and equipment. SER at 17-25. However, the Staff reviewed the need for QA measures by the Applicant and its primary contractor and concluded that, based on the scope of work for the ESP project, control of special processes is not required; the Staff determined that the Applicant and Enercon did not conduct activities important to safety that require control of special processes. SER at 17-26.

x. Inspection

299. The Staff noted that in general, according to NRC guidance, an acceptable level of QA inspection control includes (1) provisions for the inspection of activities affecting the quality of ESP activities that could affect SSCs important to safety, in addition to the items and activities to be covered, (2) establishment of organizational responsibilities and qualifications for individuals or groups performing inspection of ESP activities that could affect SSCs important to safety, and (3) provisions for inspection personnel to be independent of the performance of the activity being inspected. SER at 17-27. However, the Staff reviewed the need for QA measures by the Applicant and its primary contractor and concluded that, based on the scope of work for the ESP project, inspection is not required; the Staff determined that the Applicant and Enercon did not conduct activities important to safety that require inspection. SER at 17-27.

xi. Test Control

300. The Staff reviewed the QA measures employed by the Applicant and the primary contractor and its subcontractors, concluding that they have implemented acceptable test controls which meet the guidance in Section 17.1.1 of RS-002. SER at 17-30. Acceptable test controls should include (1) provisions ensuring that tests related to ESP activities that could affect SSCs important to safety are appropriately controlled to provide confidence that these

SSCs would perform adequately in service, and (2) provisions ensuring that prerequisites are provided in written test procedures and that test results are documented and evaluated for activities related to ESP activities that could affect SSCs important to safety. SER at 17-28.

301. The Staff found reasonable assurance that any information derived from ESP activities that could be used in the design and/or construction of SSCs important to safety will support satisfactory performance of such SSCs once they are in service. SER at 17-30. The Staff considered the surveillances that QA personnel conducted to be an appropriate indicator of acceptable test controls in place for ESP activities. SER at 17-29. Consequently, the Staff reviewed the Enercon QA manager's performance of two surveillances at the ESP site and one surveillance at subcontractor University of Texas, as well as an independent subcontractor's surveillances of activities at WLA. SER at 17-29 to 17-30. The Staff found that the test controls for the ESP site evaluation activities and for material testing activities are equivalent in substance to the requirements of Appendix B to 10 C.F.R. Part 50 and meet the guidance contained in Section 17.1.1 of RS-002, as are the test controls for activities conducted by subcontractor WLA. SER at 17-29 to 17-30.

xii. Control of Measuring and Test Equipment (M&TE)

302. The Staff reviewed the QA measures employed by the primary subcontractors (here, WLA, University of Texas, Eustis, and GEOVision) and concluded that they implemented acceptable controls for M&TE that meet the guidance in Section 17.1.1 of RS-002. SER at 17-32. Acceptable control of M&TE should include (1) provisions to ensure that tools, gauges, instruments, and other measuring and testing devices are properly identified and controlled, and (2) provisions to ensure that those tools and devices are calibrated and adjusted at specified intervals. SER at 17-31. In conducting its review, the Staff reviewed the completed M&TE calibration data sheets, reviewed engineering report results and instrumentation calibration reports, and ensured that calibration standards used were traceable to the National

Institute of Standards and Technology. SER at 17-31 to 17-32. The Staff found reasonable assurance that any information derived from ESP activities that could be used in the design and/or construction of SSCs important to safety will support satisfactory performance of such SSCs once they are in service. SER at 17-32.

xiii. Handling, Storage, and Shipping

303. The Staff reviewed the QA measures employed by the primary contractor and concluded that it implemented acceptable controls for handling, storage, and shipping which meet the guidance in Section 17.1.1 of RS-002. SER at 17-34. Acceptable controls should include provisions to control the handling, storage, shipping, cleaning, and preservation of items related to ESP activities that could affect SSCs important to safety in accordance with work and inspection instructions to prevent damage, loss, and deterioration by environmental conditions, such as temperature or humidity. SER at 17-33. In addition to reviewing the provisions of the QAPPD, as part of its review, the Staff observed a specific example of Enercon's controls for handling, storage, and shipping, and detailed the results in a site visit report. SER at 17-33 to 17-34. The Staff found reasonable assurance that any information derived from ESP activities that could be used in the design and/or construction of SSCs important to safety will support satisfactory performance of such SSCs once they are in service. SER at 17-34.

xiv. Inspection, Test, and Operating Status

304. The Staff noted that in general, according to NRC guidance, acceptable QA controls should include provisions to indicate the inspection, test, and operating status of items related to ESP activities that could affect SSCs important to safety in order to prevent inadvertent use or bypassing of inspection and tests. SER at 17-35. However, the Staff reviewed the need for QA measures by the Applicant and its primary contractor and concluded that, based on the scope of work for the ESP project, inspection, test, and operating status is

not required; the Staff determined that the Applicant and Enercon did not conduct activities important to safety that require control of inspection, test, and operating status. SER at 17-35.

xv. Nonconforming Materials, Parts, or Components

305. The Staff noted that in general, according to NRC guidance, acceptable QA controls should include provisions to control the use or disposition of nonconforming materials, parts, or components related to ESP activities that could affect SSCs important to safety. SER at 17-36. However, the Staff reviewed the need for QA measures by the Applicant and its primary contractor and concluded that the scope of work for the ESP project does not require the identification and control of nonconforming materials, parts, or components; the Staff determined that the Applicant and Enercon did not conduct activities important to safety that require identification and control of nonconforming materials, parts, or components.

SER at 17-37.

xvi. Corrective Action

306. The Staff reviewed the QA measures employed by the primary contractor and its subcontractors (here, WLA) and concluded that they implemented an acceptable corrective action program that meets the guidance in Section 17.1.1 of RS-002. SER at 17-39. An acceptable corrective action program should include provisions to ensure that conditions adverse to quality are promptly identified and corrected and, for significant conditions adverse to quality, such provisions should preclude recurrence. SER at 17-38.

307. The Staff determined that the applicable CSP on corrective action provides adequate guidance for the conduct of a corrective action program. SER at 17-38. Also, while the Staff identified that neither the QAPM nor the CSP define a condition adverse to quality, the Staff found that the threshold at which the primary contractor documented CARs and took corrective action was appropriate for ESP activities. SER at 17-38. Similarly, the Staff determined that corrective actions identified in WLA's internal QA surveillances had been

adequately addressed. SER at 17-39. The Staff found reasonable assurance that any information derived from ESP activities that could be used in the design and/or construction of SSCs important to safety will support satisfactory performance of such SSCs once they are in service. SER at 17-39.

xvii. Quality Assurance Records

308. The Staff reviewed the QA measures employed by the primary contractors and concluded that they have implemented an acceptable level of control for QA records which meets the guidance in Section 17.1.1 of RS-002. SER at 17-41. Acceptable control of QA records should include provisions for the identification, retention, retrieval, and maintenance of quality records. SER at 17-41. In its review of test records produced by WLA and Eustis, audits and surveillances of the Enercon subcontractors, and surveillances performed at WLA, the Staff noted that the subcontractors maintained all of the records in accordance with the QAPM. SER at 17-41. The Staff found reasonable assurance that any information derived from ESP activities that could be used in the design and/or construction of SSCs important to safety will support satisfactory performance of such SSCs once they are in service. SER at 17-41.

xviii. Audits

309. The Staff reviewed the QA measures employed by the primary contractor and concluded that it implemented acceptable audit controls that meet the guidance in Section 17.1.1 of RS- 002. SER at 17-44. Acceptable audits should include (1) provisions for audits to verify compliance with all aspects of QA controls and to determine the effectiveness of the QA controls, and (2) detailed responsibilities and procedures for conducting, documenting, and reviewing the results of audits, including the designation of management levels to review and assess audit results. SER at 17-42. The Staff found that primary contractor Enercon performed audits, including of subcontractor Eustis and of Enercon's offices, that are equivalent

in substance to the requirements of Appendix B to 10 C.F.R. Part 50 and meet the guidance contained in Section 17.1.1 of RS-002. SER at 17-44. The Staff found reasonable assurance that any information derived from ESP activities that could be used in the design and/or construction of SSCs important to safety will support satisfactory performance of such SSCs once they are in service. SER at 17-44.

310. Based on its analysis of all of the application's QA measures, the Staff concluded that the organizations and persons performing QA functions have the independence and authority necessary to effectively carry out QA measures without undue influence from those directly responsible for costs and schedules. SER at 17-44. The Staff also found that the QA procedures and measures, when properly implemented, are equivalent in substance to the criteria of Appendix B to 10 C.F.R. Part 50 and conform to the guidance in RS-002, Section 17.1.1. SER at 17-44. Finally, the Staff concluded that the Applicant applied QA measures to all ESP activities that established information regarding (1) the design and construction of SSCs important to safety which might be constructed on the proposed site, or (2) the establishment of site characteristics for comparison to the values of site parameters postulated in a certified design or to serve as design inputs for a custom design. SER at 17-44. The Staff determined that the measures provide adequate confidence that information provided in the ESP application and accepted by the NRC is reliable and, when used as input for the design or construction of SSCs important to safety, would not adversely impact their ability to perform satisfactorily in service. SER at 17-44. The Staff therefore found the Applicant's QA provisions to be acceptable for conducting ESP activities. SER at 17-44.

311. We find that the facts described in Chapter 17 of the Staff's SER include all factors relevant to the QA measures employed by the Applicant and its contractors in preparing its ESP application for the proposed Grand Gulf ESP site.

312. Further, we find that the Staff evaluation documented in SER Chapter 17, as described above, is based on these facts, and provides reasonable support in logic to support the Staff findings in SER Chapter 17.

313. Accordingly, we find that the Staff's review of these matters was adequate.

h. Review by the Advisory Committee on Reactor Safeguards

314. The Advisory Committee on Reactor Safeguards ("ACRS") completed its review of the application and of the Staff's draft safety evaluation report ("DSER") for the ESP application. SER at 18-1. The ACRS ESP subcommittee began a detailed review of the application and DSER in April 2005, and the ACRS ESP subcommittee met with representatives from SERI and the NRC Staff on May 16, 2005. SER at 18-1.

315. The ACRS held its full committee meeting on the Grand Gulf ESP DSER on June 2, 2005. SER at 18-1. The discussions during these meetings focused on the open items identified in the DSER. SER at 18-1. On the basis of its review, the ACRS issued an interim letter report, dated June 14, 2005, which addresses the portions of the Grand Gulf ESP application that concern safety. SER at 18-1. The Staff responded to the interim letter report in its letter dated August 12, 2005. SER at 18-1. The final SER documents the actions the Staff took in response to the comments and recommendations the ACRS identified in its interim report of June 14, 2005, as described in the Staff's response letter of August 15, 2005. SER at 18-1. The Staff issued its final SER after the resolution of open items discussed in the DSER and after receiving the ACRS interim letter report to the Commission related to its review. SER at 18-1.

316. During its meeting with the ACRS on December 8, 2005, the Staff discussed the resolution of open items and responses to ACRS comments on the major elements of the ESP review. SER at 18-1. At the 528<sup>th</sup> meeting of the ACRS, the full committee considered the Staff's FSER, as well as the application, and issued its final letter report to the NRC Executive

Director for Operations (“EDO”) on December 23, 2005. SER at 18-1. In this letter, ACRS concluded that the safety evaluation report should be issued once the Staff has made more explicit its analysis of the hazards posed to the proposed site by explosions in transportation accidents on the Mississippi River. SER at 18-1. By memorandum dated March 27, 2006, the Staff addressed the ACRS’ comments, and the changes are reflected in the final SER. SER at 18-1. On April 14, 2006, the ACRS found acceptable the changes the Staff had made to its SER in response to earlier ACRS comments [ADAMS Accession No. ML061060003].

317. Based upon our review of the SER and the record of this proceeding, the Board is satisfied that by either (1) adhering to the relevant guidance and acceptance criteria of RS-002, the SRP, and other identified regulatory guidance documents or (2) where deviations from or alternatives to that guidance proved necessary, ensuring that those deviations or alternatives were adequately justified, the Staff utilized a reasonable and logical approach to reviewing the application. In sum, the Staff had a reasonable basis for its findings (i.e., those findings were, factually speaking, adequately supported and logically flowed from those facts) with respect to its safety review.

#### B. Review of NEPA-Related Matters

318. With respect to environmental matters, i.e., matters stemming from the agency’s NEPA obligations, the Commission’s January 2004 notice of hearing required the Board to determine “whether the review conducted by the Commission pursuant to NEPA has been adequate.” Hearing Notice at 2636; see *also* 10 C.F.R. § 2.104(b)(2)(ii). The Staff’s final environmental impact statement (“FEIS”) addresses (1) the results of the NRC Staff’s analyses, which consider and weigh the environmental effects of the proposed action (issuance of the



ESP) and of constructing and operating one or more new nuclear units at the ESP site, (2) mitigation measures for reducing or avoiding adverse effects, (3) the environmental impacts of alternatives to the proposed action, and (4) the NRC Staff's recommendation regarding the proposed action based on its environmental review. FEIS at xxvii.

#### 1. Applicable Regulatory Guidance

319. The NRC standards for review of an ESP application are outlined in 10 C.F.R. § 52.18. The NRC Staff conducts its reviews of ESP applications in accordance with guidance set forth in review standard RS-002. That review standard draws from the previously published NUREG-0800, *Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants*, as well as from NUREG-1555, *Standard Review Plans for Environmental Reviews for Nuclear Power Plants* (hereafter "ESRP"). FEIS at 1-3. As provided in 10 C.F.R. Part 51, Subpart A, Appendix A, the techniques of tiering and incorporation by reference were used to aid in the presentation of issues, eliminate repetition, and reduce the size of the EIS; for example, the Staff also considered the information and analyses provided in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (NUREG-1437) in its review. FEIS at 1-3, 1-4.

320. The Staff's FEIS focused on the environmental effects of construction and operation of reactors with characteristics that fall within the plant parameter envelope ("PPE") developed by SERI and included an evaluation of alternative sites to determine whether there is an obviously superior alternative to the proposed Grand Gulf ESP site. FEIS at 1-3. An ESP environmental report is not required to include an assessment of the benefits (for example, the need for power) (10 C.F.R. § 52.17) or a discussion of energy alternatives; these may be deferred to the CP or COL application. FEIS at 1-3. However, the SERI environmental report did address energy alternatives; therefore, the FEIS included an assessment of energy alternatives, but did not evaluate the need for power. FEIS at 1-3.

## 2. Overall Environmental Review Findings

### a. Introduction and Background

321. On December 31, 2003, the NRC Staff published a notice in the *Federal Register* (68 FR 75656) stating its intent to prepare an EIS, conduct scoping, and publish a draft EIS (“DEIS”) for public comment as required by 10 C.F.R. § 51.26. FEIS at 1-1. A public scoping meeting was held on January 21, 2004, in Port Gibson, Mississippi to obtain public input on the scope of the environmental review. FEIS at 1-5. NRC issued a notice on April 28, 2005 (70 FR 22155) announcing the availability of the DEIS and the time and place of a public meeting to receive comments on the DEIS. FEIS at 1-1. The Staff considered these comments while developing its FEIS. FEIS at 1-5.

322. Following requirements set forth in 10 C.F.R. Part 51 and the guidance in RS-002, the NRC environmental staff (and its technical experts from the Pacific Northwest National Laboratory retained to assist the Staff) visited the Grand Gulf ESP site and alternative sites in July 2003 and during January, April, June, and July 2004 to gather information and to become familiar with the sites and their environs. FEIS at 1-5. During these site visits, the Staff and its contractor personnel met with the Applicant’s staff, public officials, Federal and State regulators, and the public. FEIS at 1-5. To guide its assessment of environmental impacts of a proposed action or alternative actions, the NRC established a standard for quantifying environmental impacts using the Council on Environmental Quality guidance (40 C.F.R. § 1508.27). FEIS at 1-5, 1-6. Using this approach, the NRC established three

significance levels -- SMALL, MODERATE, or LARGE<sup>17</sup> – that the Staff applied to its findings throughout the FEIS. FEIS at 1-5, 1-6.

323. In conducting its review, the Staff evaluated environmental impacts based on the bounding parameter values SERI submitted as part of its application; as discussed above with respect to the safety review, these values constitute the PPE for the Grand Gulf ESP site and represent the “footprint” for a future facility. A list of these values is reproduced in Appendix I to the FEIS. In any COL or CP application referencing a Grand Gulf ESP, the Staff would review the actual design selected to determine whether the design fits within these bounding parameter values.

b. FEIS Chapter 2, “Affected Environment”

324. As set forth below, in FEIS Chapter 2 the Staff reviewed the Application’s description of the affected environment and provided the Staff’s characterization of the site conditions. FEIS at 2-1.

325. The Grand Gulf ESP site is 162 ha (400 ac) located on a portion of the Grand Gulf site within Claiborne County, Mississippi, approximately 10 km (6 mi) northwest of Port Gibson, the county seat. FEIS at 2-3. Claiborne County lies in southwest Mississippi and is bordered on the west by the Mississippi River and Tensas Parish, Louisiana, on the north by Warren County, on the east by Hinds and Copiah counties, and on the south by Jefferson County. FEIS at 2-3. Approximately 162 ha (400 ac) of the 850 ha (2100 ac) Grand Gulf site would be directly affected by construction on the Grand Gulf ESP site. FEIS at 2-3.

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<sup>17</sup> The NRC Staff’s definitions of these significance levels are as follows:

SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

LARGE – Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

326. The land use in the vicinity of the site includes primarily agricultural and undeveloped lands. FEIS at 2-3. The nearest incorporated community is the town of Port Gibson, about 10 km (6 mi) southeast of the site. FEIS at 2-3. The small community of Grand Gulf lies about 2.6 km (1.6 mi) north of the Grand Gulf ESP site. FEIS at 2-3. The nearest river port facility is Port Claiborne at River Mile 404.8. FEIS at 2-8.

327. The Grand Gulf site is located in rural Claiborne County and is accessible by both river and road. FEIS at 2-1. The Grand Gulf ESP site consists primarily of woodlands and former farms as well as two lakes, Hamilton Lake and Gin Lake. FEIS at 2-1. These lakes were once in the channel of the Mississippi River and have an average depth of 2 to 3 m (8 to 10 ft). FEIS at 2-1. The land in the vicinity of the Grand Gulf site is mostly rural. FEIS at 2-1. The western half of the site is the Mississippi Alluvial Valley, consisting of materials deposited by the Mississippi River and extending eastward from the river about 1.3 km (0.8 mi). FEIS at 2-3. The area is generally at elevations of 17 to 23 m (55 to 75 ft) above mean sea level (MSL). FEIS at 2-3. The eastern half of the site is rough and irregular with steep slopes and deeply cut stream valleys and drainage courses. FEIS at 2-3. Ground elevations in this portion of the Grand Gulf ESP site range from 24.4 m (80 ft) above MSL to more than 61 m (200 ft) above MSL inland. FEIS at 2-3. Elevations of about 122 m (400 ft) above MSL occur on the hilltops east and northeast of the site. FEIS at 2-3. Grade elevation for the existing GGNS facility structures is 40.4 m (132.5 ft) above MSL. FEIS at 2-3. About 18 km (11 mi) of the Mississippi River courses through the 10-km (6-mi) vicinity. FEIS at 2-4.

328. SERI has acquired and will maintain surface ownership of all the land within the Grand Gulf site property boundary with three limited exceptions. FEIS at 2-5. Although SERI and its affiliates do not legally own all of the subsurface rights on the Grand Gulf ESP site and the associated exclusion area, the Staff found, as part of its safety review, that they effectively

control the ability to exercise these rights and to preclude the exercising of these rights by others. FEIS at 2-5, 2-6.

329. No active railroads or navigable waterways traverse the Grand Gulf ESP site. FEIS at 2-6. With the exception of three roads, two transmission lines, and one abandoned railroad spur, no other industrial, commercial, institutional, or residential structures are on the Grand Gulf site other than a private hunting lodge on the extreme southwest corner. FEIS at 2-6. No coastal zones or wild and scenic rivers were identified in or around the area that may be used for construction. FEIS at 2-7.

330. SERI chose not to include a site redress plan in its ESP application and, therefore, would not be permitted to undertake site preparation activities, including work on transmission line rights-of-way. FEIS at 2-7. Once an ESP holder has chosen a specific facility design and has applied to the Federal Energy Regulatory Commission ("FERC") for large-generator interconnection (most likely at the COL stage), a FERC transmission analysis would be required (18 C.F.R. Part 35). FEIS at 2-7. This process would determine the optimal routing of any new transmission service by requiring studies of feasibility, impact, and facilities associated with the transmission request. FEIS at 2-7. Land use within the existing transmission line right-of-way consists of agricultural and undeveloped lands. FEIS at 2-7.

331. The dominant air mass in the region during most of the year is a maritime tropical air mass originating in the Gulf of Mexico. FEIS at 2-12. As a result, the climate of the region is humid most of the year. FEIS at 2-12. The winters are relatively short and mild with occasional brief cold periods associated with outbreaks of continental polar air, and these cold periods rarely last more than three or four days. FEIS at 2-12. Summers are long and warm; however, temperatures above 38°C (100°F) are infrequent and long periods of very hot weather are rare. FEIS at 2-12.

332. Winds at the Grand Gulf ESP site are relatively light. FEIS at 2-12. The average wind speed for the Grand Gulf site during the period from 2001 through 2003 is 1.9 m/s (4.2 mph), significantly lower than average wind speeds at Vicksburg and Jackson, Mississippi. FEIS at 2-12. More than 99 percent of the time, the wind speed at the Grand Gulf ESP site is less than 5.8 m/s (13 mph). FEIS at 2-12.

333. Data for 2002 and 2003 from the GGNS meteorological monitoring system indicate that on average the atmospheric stability is “neutral” about 35 percent of the time. FEIS at 2-13. About 47 percent of the time, the atmospheric stability is slightly to extremely stable, and the remaining 18 percent of the time, the atmospheric stability is slightly to extremely unstable. FEIS at 2-13.

334. Average temperatures range from 8.4°C (47.2°F) in January to 27.7°C (81.9°F) in July. FEIS at 2-14. During the year, the normal (based on data for 1971 through 2000) number of days with minimum temperatures of 0°C (32°F) and below is 46, while the normal number of days with maximum temperatures of 0°C (32°F) and below is less than 2. FEIS at 2-14. The lowest temperature at the current and comparable measurement locations, based on a 63-yr period of record, is -17°C (2°F). FEIS at 2-14. Temperatures below -18°C (0°F) have been observed in the area. FEIS at 2-14. In contrast, the normal number of days with maximum temperatures of 32°C (90°F) and above is 84, and the highest temperature on record is 42°C (107°F). FEIS at 2-14.

335. Precipitation averages about 142 cm (56 in.) per year and is uniformly distributed throughout the year. FEIS at 2-14. The maximum precipitation in a 24-hour period was 22 cm (8.5 in.) in April 2003, and on average, about one third of the days each month experience measurable precipitation. FEIS at 2-14. Typically, snow falls almost every year, but only about 4 years in 10 have measurable snowfall. FEIS at 2-14.

336. The Grand Gulf ESP site can experience severe weather in the form of thunderstorms, snow, ice, tornadoes, and hurricanes. FEIS at 2-15. Meteorological records for Jackson, Mississippi, indicate that thunderstorms can be expected on about 68 days per year. FEIS at 2-15. On average, hurricanes strike the Gulf Coast along the Louisiana and Mississippi coastlines several times a decade; however, the Grand Gulf ESP site is sufficiently far inland that the strength of storms generally diminish to less than hurricane strength by the time they reach the vicinity of the site. FEIS at 2-15.

337. The NRC Staff has conducted an independent assessment of tornadoes in the vicinity of the Grand Gulf ESP site using National Climatic Data Center data for 1950 through August 2003, over which time period there were 592 tornado events within the two-degree box centered on the Grand Gulf ESP site. FEIS at 2-15. The Staff estimated that the expected probability of a tornado striking the site is approximately  $7.4 \times 10^{-4} \text{ yr}^{-1}$  with 95 percent confidence that the strike probability is less than  $9.4 \times 10^{-4} \text{ yr}^{-1}$ . FEIS at 2-15, 2-16.

338. Air quality monitoring results for Vicksburg, Mississippi (the closest monitoring site to the Grand Gulf site), for 2001, 2002, and 2003 demonstrate that concentrations of ozone and particulate matter smaller than 2.5 micrometers are well below National and Mississippi Ambient Air Quality Standards; more extensive monitoring is conducted in Jackson, Mississippi, with similar results. FEIS at 2-16.

339. Entergy Operations, Inc. and its predecessors have had a meteorological monitoring program at the Grand Gulf site since March 1972. FEIS at 2-17. The meteorological monitoring system consists of a 50-m (162-ft) tower, meteorological instrumentation at the 10-m (33-ft) and 50-m (162-ft) levels of the tower, surface meteorological instrumentation, and data collection and processing equipment. FEIS at 2-17. Instrumentation at the 10-m (33-ft) level of the tower measures wind direction, wind speed, temperature, and relative humidity, while instrumentation at the 50-m (162-ft) level measures wind direction, wind

speed, and temperature. FEIS at 2-17. The temperature difference between the two levels is also determined. FEIS at 2-17. A tipping-bucket rain gauge is located near the base of the tower, and a 10-m (33-ft) backup meteorological tower measures wind direction, wind speed, and temperature at the 10-m (33-ft) level. FEIS at 2-17.

340. The Staff viewed the meteorological site and instrumentation, reviewed the available information on the meteorological measurement program, and evaluated data collection under the Entergy Operations, Inc. program. FEIS at 2-17. Based on this information, the Staff concluded that the program provides data that represent the onsite meteorological characteristics as required by 10 C.F.R. § 100.20(c); Staff also found that the data provide an acceptable basis for making estimates of atmospheric dispersion for the evaluation of the consequences of routine and accidental releases required by 10 C.F.R. § 50.34(a)(1) and 10 C.F.R. Part 50, Appendix I. FEIS at 2-17, 2-18.

341. The Grand Gulf ESP site lies within the Mississippi Alluvial Plain Section of the Coastal Plain Physiographic Province. FEIS at 2-18. It is within the very northern extent of the Coastal Lowlands Aquifer system and in the center of the Mississippi Embayment Aquifer system. FEIS at 2-18. The bluffs at the site delineate a change in the upper stratigraphy. The upland plain, east of the bluffs, is a Pleistocene terrace rising to an elevation of about 46 m (150 ft) above MSL. FEIS at 2-18. The surface of the upper plain is about 23 m (75 ft) of loess overlaying about 12 m (40 ft) coarse-grained alluvial sand and gravel deposits of the Upland Complex. FEIS at 2-18. The lowland, west of the bluffs, at an elevation of about 21 m (70 ft) above MSL consists of a layer of Holocene alluvium over 30 m (100 ft) in thickness including backswamp areas and meander belts of the Mississippi River. FEIS at 2-18, 2-19. The Catahoula formation underlies both the terrace deposits in the uplands and the alluvium in the lowlands. FEIS at 2-19. The ESP facility would be located in the uplands portion of the site. FEIS at 2-19. No activity involving exploration, drilling, or otherwise extracting minerals occurs



at the Grand Gulf site. FEIS at 2-19. Past unsuccessful exploratory activities on or near the Grand Gulf site and the geological character of the subsurface structure in the vicinity of the Grand Gulf site indicate that commercial mineral production appears unlikely in the foreseeable future. FEIS at 2-19.

342. A radiological environmental monitoring program (REMP) has been conducted around the Grand Gulf site since 1978. FEIS at 2-19. The REMP has indicator and control locations within a 29-km (18-mi) radius of the site. FEIS at 2-19. Annual radioactive effluent release reports for calendar years 2001, 2002, and 2003 showed that doses to the maximally exposed individuals around GGNS were a small fraction of the limits specified in Federal environmental radiation standards. FEIS at 2-19.

343. The site has three primary hydrological areas. The first is the Mississippi River, the dominant hydrological feature of the vicinity. The second is the lowlands between the bluffs and the Mississippi River. The third is the uplands area east of the bluffs, where the ESP site would be located. FEIS at 2-19, 2-20. The western boundary of the Grand Gulf site is defined by the Mississippi River's eastern bank. At the site, the Mississippi River is about 0.8 km (0.5 mi) wide at low flow and about 2.3 km (1.4 mi) during a typical annual high flow period. FEIS at 2-20. The bluffs at the Grand Gulf site represent a natural levee and have confined the river, even during pre-channelization times, to stay to the west of the Grand Gulf ESP site. FEIS at 2-22.

344. Total annual water withdrawals for the existing unit from radial wells adjacent to the Mississippi River, dewatering wells, and wells in the Catahoula formation for potable water supplies are reported to the Mississippi Department of Environmental Quality ("MDEQ"). FEIS at 2-25. The Staff reviewed annual water use reports obtained from MDEQ for 2000 and 2002 and found that the radial wells and potable wells were operating well below their rated

capacities and the dewatering wells were not being used at all during these two years. FEIS at 2-25.

345. Although the hydraulic conductivity information from various permeability tests reported by SERI for the Catahoula formation (which underlies terrace deposits in the uplands and alluvium in the lowlands, see FEIS at 2-19) is currently inadequate to provide a reliable basis to estimate the groundwater drawdowns associated with withdrawals from this formation, continuation of the existing monitoring program would, with that exception, provide an adequate hydrological monitoring program. FEIS at 2-26.

346. Water in the vicinity satisfies a variety of purposes including domestic, industrial, and agricultural uses, with groundwater withdrawn from the various aquifers and surface water withdrawn from the Mississippi River. Total estimated water use in Claiborne County in 2000 was 130,000 m<sup>3</sup>/d (34.3 MGD), all but 1600 m<sup>3</sup>/d (0.4 MGD) from groundwater. FEIS at 2-26.

347. The massive nature of the Mississippi River makes the discharges from the GGNS facility undetectable within the overall flow regime, and any changes in the quality are small and localized compared to the overall width of the river. FEIS at 2-28. The water quality of the Mississippi is monitored by the U.S. Army Corps of Engineers at Vicksburg, Mississippi upstream of the Grand Gulf ESP site. FEIS at 2-28. Temperatures in the Mississippi River vary seasonally with maximum and minimum temperatures reported as 32°C (90°F) and 1.5°C (35°F), respectively. FEIS at 2-28. The Mississippi River water is generally hard to very hard and, therefore, requires softening to avoid scale formation when heated. FEIS at 2-28.

348. At the Grand Gulf site, the water quality of two streams is affected by the GGNS facility. The first stream is generally unaffected by the GGNS facility until it reaches a sedimentation basin, where discharges include storm water runoff, standby service water leakage, treated sanitary waste water, and miscellaneous waste water from the GGNS Energy Services Center, including water softener backwash and air-conditioning cooling tower

blowdown. FEIS at 2-28. These sources contribute nutrients, chlorine, and sediment to the basin. FEIS at 2-28. In compliance with its NPDES permit, Entergy Operations, Inc. is required to monitor these constituents. FEIS at 2-28. The maximum monthly average nutrient concentration of the sanitary waste treatment system reported by SERI, expressed in terms of biological oxygen demand, for 2000 and 2001 was 25 mg/L, while the maximum total suspended solids from the combined outflow from the first sedimentation basin reported by SERI for 1999, 2000, and 2001 was 97 ppm. FEIS at 2-28.

349. The watershed and channel for the second stream were nearly entirely modified as a result of the construction of the GGNS facility, and the water quality of the second stream has been altered by the loss of vegetation and soil cover. FEIS at 2-28. The normal nutrient and sediment load from a forested watershed have been reduced by the loss of the canopy and changes of the surface runoff conditions. FEIS at 2-28. The second sedimentation basin also receives standby service water leakage, intermittent circulating water basin overflows, storm water runoff, and water from a variety of building drains. FEIS at 2-28, 2-29. Entergy Operations, Inc. is required by its NPDES permit to monitor these sources. The maximum amount of total suspended solids in the combined outflow from the second sedimentation basin reported by SERI for 1999, 2000, and 2001 was 26 ppm. FEIS at 2-28, 2-29.

350. The site is roughly bisected by a north-south line of bluffs located parallel to and east of the Mississippi River. FEIS at 2-30. The Grand Gulf site consists of seasonally inundated bottomland west of the bluffs along the river and uplands atop the bluffs. FEIS at 2-30. About one-half of the site is bottomland, including forested, shrub, and emergent marsh wetlands, while the other half of the site supports upland habitat, including forests, fields, and small wetlands, in areas that were not cleared during construction of GGNS Unit 1. FEIS at 2-30. The Grand Gulf ESP site consists primarily of upland hardwood forest and bottomland forested wetlands. FEIS at 2-30. Generally, wildlife species found on the Grand Gulf site are

representative of those commonly found in central Mississippi and northern Louisiana along the Mississippi River. FEIS at 2-30.

351. Terrestrial habitats at the Grand Gulf site can now, as in the 1970s, generally be classified as upland and bottomland forest, upland and bottomland clearings, and upland and bottomland wetlands. FEIS at 2-34. There apparently have been no noteworthy environmental alterations on the Grand Gulf site since construction of GGNS Unit 1 that contribute significantly to the existing patterns of plant and animal communities. FEIS at 2-54.

352. The aquatic resources in the vicinity of the proposed Grand Gulf ESP site are associated with the major aquatic features of the Grand Gulf site: the Mississippi River and two onsite oxbow lakes, Hamilton and Gin. FEIS at 2-55. Also associated with the Grand Gulf site are a flooded, fabricated borrow pit, three small ponds, and two perennial streams. FEIS at 2-55, 2-56. In addition, ephemeral drainages and wetlands are found around the site. FEIS at 2-55, 2-56. Because the most recent information on aquatic resources is over 30 years old, the Staff determined it would obtain a recent description of the aquatic biota in the vicinity of the site and transmission line rights-of-way prior to or during the CP or COL phase. FEIS at 2-57.

353. Population data for the area surrounding the Grand Gulf ESP site indicate low population densities and a rural setting. The nearest population center is Port Gibson, Mississippi, located approximately 10 km (6 mi) to the southeast with a population of 1840 based on the 2000 U.S. Census. FEIS at 2-65. The majority of the population in this area is African American. FEIS at 2-65. Four larger towns are located within 80 km (50 mi) of the Grand Gulf ESP site. FEIS at 2-65. Vicksburg, Mississippi, located 40 km (25 mi) to the north-northeast, had a 2000 U.S. Census population of 26,407. FEIS at 2-65, 2-67. Clinton, Mississippi, located to the northeast, and Natchez, Mississippi, located to the southwest, had 2000 U.S. Census populations of 23,347 and 18,464, respectively. FEIS at 2-67. Jackson,

Mississippi, the largest nearby metropolitan area, located about 88 km (55 mi) northeast of the site, had a 2000 U.S. Census population of 184,256. FEIS at 2-67.

354. The estimated population for 2002 and the projected populations for 2030 (the projected first year of operation) and for each decade for five decades through the year 2070 (the projected end of the initial facility license term) are based on the 2000 U.S. Census. FEIS at 2-67, H-1 (Appendix H, Table H-1). The estimated transient population is about 10,700 within 16 km (10 mi) of GGNS for 2002. FEIS at 2-70. Between 16 and 48 km (10 and 30 mi), SERI estimated the weighted transient population for 2002 at about 14,800. FEIS at 2-70. SERI estimated the total population (transient plus resident population) to 48 km (30 mi) at 128,300; this is projected to increase to 137,800 by 2030 and to 152,200 by 2070. FEIS at 2-70. In 2030, transient population for 0 to 48 km (0 to 30 mi) is projected at 29,800. FEIS at 2-70. By 2070, it is projected at 33,000 (vs. 25,500 in 2002). FEIS at 2-70. The Staff noted that it considered both the estimate for 2002 and the projections to be overestimates, because much of the projected increase is actually double-counted resident population. FEIS at 2-70.

355. Approximately 750 people work at GGNS Unit 1, with up to 970 personnel onsite during outages, making Entergy one of the large, stable employers in the four-county region. FEIS at 2-70. About 46 percent of the employees lived in Warren County (Vicksburg), about 18 percent in Claiborne County, 15 percent in Hinds County, almost 6 percent in Jefferson County, over 4 percent each in Copiah and Franklin counties, almost 3 percent in Lincoln County, and the rest scattered. FEIS at 2-70. There were 226,000 occupied housing units reported in the 2000 U.S. Census for the counties that currently supply workers to the GGNS. FEIS at 2-77; Table 2-15. U.S. Census data for 2000 indicates 567 vacant housing units are located within Claiborne County, representing 13 percent of the total housing in the county; in

the ten-county area, 21,760 housing units were reported as vacant for the 2000 U.S. Census. FEIS at 2-77.

356. The annual 2004 county labor force data show that Claiborne County had an unemployment rate of 10.1 percent as compared to the surrounding four contiguous counties in Mississippi (Copiah, Hinds, Jefferson, and Warren) and Tensas Parish, Louisiana. FEIS at 2-72. These surrounding counties had an average unemployment rate of 6.0 percent, and the state of Mississippi had an unemployment rate of 6.2 percent. FEIS at 2-72.

357. GGNS is taxed by the State for a sum equal to 2 percent of the assessed value but not less than \$20 million annually. FEIS at 2-74. At least \$7.8 million goes to Claiborne County, although of this amount, \$3 million is allocated contingent upon Claiborne County upholding its commitment to the GGNS offsite emergency plan. FEIS at 2-74. The \$7.8 million represents roughly 83 percent of all Claiborne County revenues. FEIS at 2-74. The Mississippi State Tax Commission transfers \$160,000 annually to the town of Port Gibson provided that the city maintains its commitment to the GGNS offsite emergency plan. FEIS at 2-74. Ten percent of the remainder of the payments are transferred from the Mississippi State Tax Commission to the General Fund of the State. FEIS at 2-74. The balance of the tax revenue from the GGNS site is transferred to the counties and municipalities in the state of Mississippi where electric service is provided. FEIS at 2-74.

358. The GGNS site is visible from the adjacent Grand Gulf Military Park, and the existing natural draft cooling tower is visible from the Mississippi River. FEIS at 2-77. Otherwise, the site is well screened by topography and forested areas surrounding it. FEIS at 2-77.

359. To meet consultation requirements found in the National Historic Preservation Act of 1966, as amended, and NEPA, the NRC Staff elected to integrate its compliance with the

National Historic Preservation Act with its NEPA review, in accordance with 36 C.F.R. § 800.8. FEIS at 2-83. The NRC Staff informed the public about the ESP application and consulted with various entities. None of the organizations identified deficiencies in the NRC Staff's identification and assessment of the effects of the proposed action on any historic or cultural resources. FEIS at 2-83.

360. Although it is not subject to Executive Order 12898 (59 FR 7629), which directs Federal executive agencies to consider environmental justice under NEPA, the Commission has voluntarily committed to undertake environmental justice reviews. FEIS at 2-84.

(Environmental justice refers to a Federal policy under which each executive agency identifies and addresses, as appropriate, disproportionately high and adverse impacts on human health or environmental effects of its programs, policies, and activities on minority or low-income populations.)

361. We find that the facts described and referenced in Chapter 2 of the Staff's FEIS include all factors relevant to the Staff's characterization of the affected environment at the proposed Grand Gulf ESP site.

362. Further, we find that the Staff characterization of the site documented in FEIS Chapter 2, as described above, is based on these facts, and provides reasonable support in logic to support the Staff findings in later chapters of the FEIS.

363. Accordingly, we find that the Staff's review of these matters was adequate.

c. FEIS Chapter 3, "Site Layout and Plant Parameter Envelope"

364. As set forth below, in FEIS Chapter 3 the Staff reviewed the Application's description of the site layout and provided the Staff's characterization of the plant parameter envelope.

365. The existing reactor unit at the GGNS (Unit 1) is a boiling-water reactor that went online in 1985. FEIS at 3-1. The reactor unit generates 3898 MW(t) (or 1353 MW(e)). FEIS

at 3-1. It is cooled by a natural draft cooling tower and auxiliary mechanical draft tower located to the southwest of the containment and powerblock buildings. FEIS at 3-1. Makeup water for the cooling system is brought from radial wells along the Mississippi River via underground pipeline; discharge water is also piped to the Mississippi River via underground pipeline. FEIS at 3-1. The switchyard, which was originally constructed to support power from two units, lies to the east of the containment and powerblock buildings. FEIS at 3-1.

366. In its ESP application, SERI used a composite of values from seven reactor designs to develop the bounds of its PPE. FEIS at 3-3. These reactor designs include five light water reactors: the Advanced Canada Deuterium Uranium Reactor ("ACR-700"); the Advanced Boiling Water Reactor ("ABWR"); the Advanced Pressurized Water Reactor ("AP1000"); the Economic Simplified Boiling Water Reactor ("ESBWR"), and the International Reactor Innovative and Secure ("IRIS") next-generation pressurized water reactor ("PWR"). FEIS at 3-3, 3-4. The designs SERI used also include two gas-cooled reactor types, the Gas Turbine Modular Helium Reactor ("GT-MHR") and the Pebble Bed Modular Reactor ("PBMR"). FEIS at 3-4.

367. The Staff noted that because PPE values were to be used as a surrogate for design-specific values, the Staff expected SERI to provide sufficient information for the Staff to develop a reasonable independent assessment of potential impacts to specific environmental resources. FEIS at 3-4. In some cases, the Staff found that the design-specific information called for in the ESRP were not provided in the SERI ESP application because it did not exist or was not available, and as a result, the NRC Staff could not fully apply the ESRP guidance in those review areas. FEIS at 3-4. In accordance with RS-002, in those cases, the Staff used its experience and judgment to adapt the review guidance in the ESRP and to develop assumptions necessary to evaluate impacts to certain environmental resources to account for



missing information. The Staff identified these assumptions in the appropriate sections of the FEIS, as well as in Appendix J. FEIS at 3-4, Appx J.

368. The Staff noted that, pursuant to RS-002, it did not review the PPE values for correctness. However, the Staff determined that SERI's application was sufficient to enable the Staff to conduct its required environmental review and that the PPE values are not unreasonable for consideration by the Staff when making its finding on the application in accordance with 10 C.F.R. § 52.18. FEIS at 3-5. During its environmental review, the Staff used its judgment to determine whether SERI provided sufficient information for the Staff to perform its independent assessment of the environmental impacts of construction and operation of a new nuclear unit or units. FEIS at 3-5. The Staff considered the PPE values to be bounding parameters. FEIS at 3-5. Therefore, for environmental issues that could be resolved, the Staff's evaluation serves as a bounding estimate of the potential environmental impacts resulting from constructing and operating one or more new nuclear units at the ESP site. FEIS at 3-5. However, the Staff reiterated that environmental impacts not considered or not bounded at the ESP stage would be assessed at the CP or COL stage. FEIS at 3-6.

i. Facility Water Use

369. The dominant water use for the proposed site is makeup water for the normal heat sink ("NHS"). FEIS at 3-7. That makeup water replaces water lost by evaporation, drift, and blowdown. FEIS at 3-7. The PPE lists the average makeup water flow as 3020 L/s (47,900 gpm) and the maximum makeup water flow as 4920 L/s (78,000 gpm). FEIS at 3-7. Average and maximum blowdown are listed as 807 L/s (12,800 gpm) and 2500 L/s (39,000 gpm). FEIS at 3-7.

370. The water supply system would provide water for the circulating water system, NHS, service water system ("SWS"), UHS, demineralized water system, fire protection system, and other miscellaneous raw water supply needs. FEIS at 3-7. The Applicant indicated that the

sources of water for the Grand Gulf ESP facility would be a new well in the Catahoula aquifer and a new intake on the Mississippi River. FEIS at 3-7. Discharge of chemical effluents from water treatment processes would be limited by a National Pollutant Discharge Elimination System ("NPDES") permit issued by the MDEQ. FEIS at 3-8.

ii. Cooling System

371. The Grand Gulf ESP facility would have several different cooling systems. The largest heat load would be dissipated by the NHS. FEIS at 3-8. The SWS would have a far smaller heat rejection load, and the UHS designed heat rejection load is only required to safely shut down the facility. FEIS at 3-8. Although SERI has not yet finalized a detailed design for the cooling water systems, it considered the potential for three cooling system designs for the NHS: mechanical draft, natural draft, and a wet-dry hybrid design. FEIS at 3-8. While a wet-dry hybrid system would have lower water demands than a natural draft or mechanical draft tower, wet-dry hybrid towers were not included in the PPE and were not considered further in the Staff's review. FEIS at 3-8.

372. The NHS comprises a closed-loop circulating water system, pumps, water basin, and cooling towers. The main condenser for each unit of a new facility would reject heat to the atmosphere at a rate of 3140 MW(t) ( $10.7 \times 10^9$  Btu/hr) during normal full-power operation, according to the PPE. FEIS at 3-8.

373. SERI provided bounding values for water and energy fluxes for the NHS. Maximum blowdown flow would be 2500 L/s (39,000 gpm), maximum blowdown temperature would be 38°C (100°F), maximum evaporation rate would be 2500 L/s (39,000 gpm), and maximum makeup flow value would be 5000 L/s (78,000 gpm). FEIS at 3-8, 3-9.

374. The Applicant has proposed a closed-loop UHS for the Grand Gulf ESP facility. The UHS system would comprise pumps, heat exchangers, a dedicated water basin, and cooling towers. FEIS at 3-9. The basin would be required to maintain an adequate supply of

water for 30 days of emergency operation. FEIS at 3-9. SERI provided bounding values for water and energy fluxes for the UHS: the maximum blowdown flow would be 110 L/s (1700 gpm), maximum blowdown temperature would be 35°C (95°F), and maximum evaporation rate would be 110 L/s (1700 gpm). FEIS at 3-9.

375. Intake: Water would be withdrawn from the Mississippi River through a proposed intake structure on the river shore, at or near the GGNS barge slip location. FEIS at 3-9. Water would be withdrawn from an embayment via piping connected to pumps and equipment housed in an intake pumping station in the vicinity of the embayment. FEIS at 3-9. To minimize erosion by river currents and to protect the integrity of the embayment, the slopes would be covered by riprap or other similar means. FEIS at 3-9. Screens would be mounted at the entrance to each suction pipeline to minimize uptake of aquatic biota and river debris; these screens would be designed so that the average velocity at the screens would be less than 0.15 m/s (0.5 ft/s), as required by 40 C.F.R. § 125.84, to limit organism mortality from impingement and entrainment. FEIS at 3-9.

376. Discharge System: Effluent from the Grand Gulf ESP facility (including blowdown, excess service water, sanitary waste, filter process waste, radwaste effluent, and miscellaneous drain effluent) would be combined with the existing discharges from GGNS Unit 1 facility downstream from the embayment and intake. FEIS at 3-10. An outfall diffuser, located on the shoreline, would be used to enhance distribution and cooling of the effluent, thereby limiting thermal impact in the area of the discharge. FEIS at 3-10. The effluent discharge outfall would be located approximately 150 to 180 m (500 to 600 ft) downstream of the intake screens, and at approximately 9 m (30 ft) above the low water reference plane for the Mississippi River. FEIS at 3-10. The maximum discharge from all sources would be 2630 L/s (41,700 gpm). FEIS at 3-10. The NHS cooling tower blowdown would be the major contributor to the total discharge flow; its return temperature is estimated at 38°C. FEIS at 3-10.

377. Heat Dissipation: Heat dissipation from the NHS, SWS, and UHS would occur through the use of cooling towers with blowdown to the Mississippi River. FEIS at 3-10. The Applicant proposed wet cooling towers for the NHS and UHS. The SWS heat dissipation was incorporated into the NHS. FEIS at 3-10. Two different options for NHS cooling towers were evaluated for the Grand Gulf ESP facility; the first consisted of four natural draft cooling towers and the second used four 20-cell linear mechanical draft cooling towers. FEIS at 3-10. In both cases, the total heat rejection rate and the bounding values of blowdown flow rate and blowdown water temperature are defined in the PPE. FEIS at 3-10.

#### iii. Radioactive Waste Management System

378. The SERI ESP application did not identify specific radioactive waste management systems for new facilities constructed at the Grand Gulf ESP site. However, the PPE concept was used to provide an upper bound on liquid radioactive effluents, gaseous radioactive effluents, and solid radioactive waste releases. The bounding releases for gaseous and liquid effluents are found in the Grand Gulf ESP environmental report. The total annual volume of solid radioactive waste is estimated at  $540 \text{ m}^3/\text{yr}$  ( $1.9 \times 10^4 \text{ ft}^3/\text{yr}$ ) with a bounding total amount of radioactive material of  $2 \times 10^{14} \text{ Bq/yr}$  ( $5400 \text{ Ci/yr}$ ) as found in the PPE. FEIS at 3-11.

#### iv. Nonradioactive Waste Management

379. The Staff noted that the Applicant has not yet finalized design of nonradioactive waste management systems. FEIS at 3-11. The relevant systems include cooling water and auxiliary boiler blowdown that may contain water-treatment chemicals or biocides, water-treatment wastes, floor and equipment drain effluent, storm water runoff, laboratory waste, trash, hazardous waste, effluent from the sanitary sewer system, miscellaneous gaseous emissions, and liquid and solid effluent. FEIS at 3-11. However, nonradioactive liquid

waste effluents would be regulated under the NPDES permit process and would require a permit from the MDEQ. FEIS at 3-11.

v. Transmission System

380. The Grand Gulf site is linked to load centers by a system of transmission lines in the Entergy Mississippi, Inc. ("EMI") electric system, which consists of hydro, fossil-fuel, and nuclear power plants interconnected by a 500/230/115 kV transmission system. FEIS at 3-12. EMI owns the GGNS switchyard where the GGNS Unit 1 facility is connected to two transmission lines, one 40.3-km (25.2-mi) long, single-circuit 500-kV line that connects to the Baxter-Wilson Extra High Voltage Substation, and one 69.8-km (43.6-mi) long, single-circuit 500-kV line that connects to the Franklin Extra High Voltage Substation. FEIS at 3-12.

381. If 3000 MW(e) generating capacity were installed, the existing transmission lines would have to be upgraded or additional transmission lines would be required. FEIS at 3-13. The process for obtaining any additional transmission services required presumably would be completed prior to submission of an application for construction and operation of a new facility at the Grand Gulf ESP site. FEIS at 3-14. Although it can be assumed that the Grand Gulf ESP facility connection with the transmission system would be similar to the GGNS Unit 1 facility connection and would make use of existing transmission line rights-of-way to the extent possible, additional land might be required, to widen existing rights-of-way or to establish new rights-of-way. FEIS at 3-13, 3-14.

382. We find that the facts described and referenced in Chapter 3 of the Staff's FEIS are adequate to support the Staff's characterization of the site layout and plant parameter envelope for the proposed Grand Gulf ESP site.

383. Further, we find that the Staff characterization documented in FEIS Chapter 3, as described above, is based on these facts, and provides reasonable support in logic to support the Staff findings in FEIS Chapter 3.

384. Accordingly, we find that the Staff's review of these matters was adequate.

d. FEIS Chapter 4, "Construction Impacts at the Proposed Site"

385. As set forth below, in Chapter 4 of the FEIS, the Staff analyzed the potential impacts of construction on land use, air quality, water, ecosystems, socioeconomics, historic and cultural resources, and environmental justice, as well as nonradiological and radiological health effects. Where possible, the Staff assigned a single significance level of potential impact – SMALL, MODERATE, or LARGE – to each issue, in accordance with 10 C.F.R. Part 51. FEIS at 4-1.

i. Land Use Impacts

386. The principal impacts during site preparation and construction of a new nuclear reactor at the Grand Gulf ESP site would include clearing, dredging, grading, excavation, spoil deposition, and dewatering. FEIS at 4-2. An estimated 162 ha (400 ac) of the 850-ha (2100-ac) Grand Gulf site would be affected by construction of a new facility, though the Staff estimates that only about 30 percent, about 49 ha (120 ac), of the proposed construction footprint for the Grand Gulf ESP facility would affect areas of the site that were not previously affected during the GGNS construction. FEIS at 4-2.

387. The magnitude of the impact from local or onsite use of dredged material, construction, or other excavated spoils cannot be determined until a facility design is submitted at the CP or COL stage. The Staff determined that the impact level could be either SMALL or MODERATE, depending on whether the disposition of dredge spoils and the use of borrow affect areas outside the proposed ESP facility construction footprint, and whether best management practices are used. FEIS at 4-3. The Staff concluded that an applicant for a CP or COL referencing an ESP for the Grand Gulf ESP site would need to provide additional information on the planned disposition of dredge spoils and the use of borrow in order for the Staff to make a significance determination regarding the impacts of construction on land use at

the site and vicinity. FEIS at 4-3. The Staff's conclusions also were based on the potential need to reestablish rail service to the site using 18.2 miles of currently abandoned railway. FEIS at 4-3. Were an applicant referencing the ESP at the CP or COL stage to determine that rail service would be needed, some determination of the scope of the railway upgrading would be necessary to determine the level of land use impacts. FEIS at 4-3. The issue is therefore unresolved. FEIS at 4-3.

388. With respect to transmission lines, the Staff estimated that the land-use impact of doubling the width of the current rights-of-way would include conversion of as much as 524 ha (1296 ac) of currently undeveloped forested land to vegetation-managed land along the widened portions of the rights-of-way. FEIS at 4-4. The Staff determined that the impact from new or upgraded transmission lines could be either SMALL or MODERATE, depending on the transmission improvements chosen. FEIS at 4-5. The issue of offsite land use impacts is therefore unresolved until further information is available at the COL stage. FEIS at 4-5.

ii. Meteorological and Air Quality Impacts

389. The Staff found that the primary impacts of construction of the Grand Gulf ESP facility on local meteorology and air quality would be dust from construction activities, smoke and other pollutants from open burning, emissions from equipment and machinery used in construction, concrete batch plant operations, and emissions from vehicles used to transport workers and materials to and from the site. FEIS at 4-5.

390. Because construction activities take place for a limited duration and because of mitigation measures identified by the Applicant (such as wetting roads during dry periods and inspecting equipment to prevent excess exhaust emissions), the Staff concluded that the impacts of construction activities on air quality would be SMALL. FEIS at 4-6. Similarly, because of SERI's proposed mitigation in the timing of construction shift changes and because air quality in Mississippi and nearby counties in Louisiana is consistent with all national

standards, the Staff concluded that the impact on air quality of increased traffic associated with construction would be SMALL. FEIS at 4-6.

iii. Water-Related Impacts

391. With respect to hydrology, the Staff did not identify any significant changes to the local flow patterns or intensities that would occur at the site due to construction. Noting that any increase in runoff intensity would be mitigated using standard engineering storm water management practices, that construction of shoreline intake and discharge structures along the Mississippi River would have minimal impact on the river's flow pattern adjacent to the shoreline, and that dewatering systems during construction would only have localized impact on the groundwater flow patterns, the Staff concluded that the impact of hydrological alterations from construction would be SMALL. FEIS at 4-8.

392. The Staff agreed that the impact of construction dewatering for the new ESP power block excavation would be small, temporary, and localized. FEIS at 4-9. However, the Staff concluded that additional aquifer characterization is needed to determine the impacts on water use of additional groundwater withdrawals from the Catahoula formation for construction water needs. FEIS at 4-8, 4-9. Although the Applicant concluded that additional wells installed there for construction water needs would not significantly affect the groundwater water surface elevation in the vicinity, the Staff found current characterization to be inadequate, given the limited number of borings into the Catahoula formation, limited hydraulic conductivity measurements, and limited long-term pump tests. FEIS at 4-8. The Staff noted that the impact of additional groundwater wells on the Catahoula formation could be SMALL or MODERATE, given the significance of the aquifer for local domestic water supplies and its designation by EPA as a sole-source aquifer. FEIS at 4-8. The issue of water-use impacts is therefore unresolved until further information is available at the COL stage. FEIS at 4-8, 4-9.



393. Likewise, although the Staff concluded most impacts of the likely construction on water quality would be small, it again concluded that additional aquifer characterization is needed to determine the impacts on water quality of additional groundwater withdrawals from the Catahoula formation for construction water needs. The Staff found that impacts on the Catahoula formation could be either SMALL or LARGE, depending on whether the proposed withdrawal were to induce degradation of the water quality of the sole source aquifer. The issue of water-quality impacts is therefore unresolved until further information is available at the COL stage. FEIS at 4-9, 4-10.

iv. Ecological Impacts

394. The Staff concluded, based on estimated locations, quantities, and types of land disturbed for the new facilities, that the impact of construction on wildlife habitat on the Grand Gulf site (including permanent and temporary losses of upland hardwood forest and bottomland forested wetlands) would be minimal. FEIS at 4-11 to 4-13, 4-14 to 4-15. The Staff noted that the combined upland hardwood forest and bottomland forested wetland lost to permanent structures and facilities represents only about 5 percent of the combined total of these available onsite, while other areas to be disturbed for equipment staging and borrow areas are expected to be temporary and eventually restored by SERI. FEIS at 4-15.

395. The Staff also found that the onsite impact on wildlife populations, including State-listed species, would also be minimal, given the relatively small permanent impact on the areas considered most important to animal habitat, the availability of areas for displaced animals to relocate, and SERI's plans to implement management practices (and follow applicable permit conditions) to reduce dust and noise that might disturb animals at critical times. FEIS at 4-15 to 4-18. However, the Staff also concluded that impacts on wildlife habitat and populations associated with the transmission system could be SMALL if additional transmission capacity were to be accommodated within the existing right-of-way, but could be

MODERATE to LARGE if the right-of-way were to be expanded or if new rights-of-way were needed. FEIS at 4-18. Therefore, the Staff concluded that the issue of wildlife habitat impact is not resolved, and an applicant for a CP or COL referencing an ESP for the Grand Gulf ESP site would need to provide additional information on the location and nature of environmental impacts associated with construction of transmission system improvements. FEIS at 4-18.

396. The Staff concluded that the overall impacts of likely construction activities on aquatic ecological resources, including state-listed species, would be SMALL because these activities would take place for a limited time and could be readily mitigated, including by instituting best management practices for erosion control into nearby rivers and streams. FEIS at 4-18 to 4-20. The Staff determined it would verify the necessary construction surveys and monitoring prior to issuance of a CP or COL that references the Grand Gulf ESP. FEIS at 4-20.

397. The Staff concluded that the impacts of construction at the Grand Gulf ESP site on terrestrial and aquatic Federally listed species would be SMALL, and additional mitigation (beyond already identified measures such as advance surveys for habitat, standard construction practices to reduce sedimentation, or restricting the timing of particular construction activities to minimize disruption) would not be warranted. FEIS at 4-28. This conclusion was predicated on certain assumptions, including the current occurrence of Federally listed threatened and endangered species and critical habitat in the project area, the current listing status of such species, and the current designation of critical habitat. FEIS at 4-21 to 4-28.

v. Socioeconomic Impacts

398. Physical Impacts: The Staff noted that the Grand Gulf site is in an area zoned for industrial use, that all construction activities would occur within the Grand Gulf site boundary (and offsite areas supporting construction would be expected to already be permitted and operational), and that impacts from construction dust, and gaseous pollutants would be

mitigated by worker training, protective equipment, and compliance with other permit conditions. FEIS at 4-28, 4-29. The Staff also considered that noise impacts from construction would be mitigated by distance, the rural and wooded setting, and the Applicant's intent to restrict the timing of any particularly noisy activities. FEIS at 4-29, 4-30.

399. The Staff concluded that the overall physical impacts of construction on workers and the local public, buildings, roads, and aesthetics would be SMALL as long as the mitigative actions, such as noise, dust, and traffic control and possible management measures identified by SERI are undertaken. FEIS at 4-32. In reaching its conclusion, the Staff relied on certain assumptions; these included no building of new roads or extension of the former railroad line into the site, as well as various control and mitigation measures identified by the Applicant, such as wetting for dust suppression, maintaining or restoring vegetative cover, properly maintaining vehicles, restricting the hours of certain noise-related construction activities, and keeping noise and pollutant levels within regulatory limits. FEIS at 4-30, 4-31. The Staff also noted other mitigation strategies identified by SERI, including storm water management, and erosion and sediment control. FEIS at 4-31.

400. The Staff also found that because much of the construction activity at the site would be masked by woods and the 20-m (65-ft) bluff to the east of the site, because the Grand Gulf ESP site is already aesthetically altered by the presence of an existing plant with a 158-m cooling tower, and because construction impacts would be temporary, there are no adverse impacts expected on the site or vicinity's visual aesthetics. FEIS at 4-32.

401. Demography: The Staff evaluated SERI's demographic assumptions using occupational statistics and other demographic data for the region surrounding the proposed ESP site. These assumptions included that 50 percent of the workforce would come from the region, that the peak workforce (maintained for much of the construction period) would be 3150 people, and that 6300 people would move into the area within 80 km (50 mi) of the

proposed ESP site, representing approximately 2 percent of the year 2000 population for nearby Adams, Hinds, and Warren counties. FEIS at 4-33. The Staff also evaluated SERI's assumption that the majority of the relocation would be to the larger population centers in the area, rather than to smaller communities. FEIS at 4-33.

402. After assuming that 50 percent of the construction workers would be expected to come from within the region and the number of construction workers who might relocate to the region would be a small percentage of the larger communities' population base, the Staff concluded that the likely impacts of construction on increases in population within most of the region would be SMALL. FEIS at 4-34. However, the Staff acknowledged that it could not at this time dismiss the possibility of a LARGE demographic impact in Claiborne County, where the ESP site would be located, if a larger percentage of workers came from outside the region and a greater proportion relocated to Claiborne County rather than to more populated areas of the region. FEIS at 4-34.

403. Social and Economic: Based on assumptions about the likely workforce employed at the site, the percentage of employment from within the region, and the likely residence of new workers, as well as evaluation of the positive aspects of station construction on the regional economies (mostly in Warren County) and the workforce availability, the Staff concluded that the impacts on the economy are generally beneficial and could reach the MODERATE level in Warren County. FEIS at 4-35, 4-36, 4-37.

404. The Staff found that without knowledge of the specific reactor design to be used and the associated estimates about workforce size and residence, it could not estimate the value of tax revenues or outlays for regional governments. FEIS at 4-35, 4-36. However, assuming no significant changes in Mississippi tax law, especially the terms and conditions for taxability of real property, the Staff concluded that Claiborne County would benefit from an increase of at least \$7.8 million in property tax revenues by the last year of construction. FEIS

at 4-37. The Staff concluded that in combination with the jobs created in the region, the impacts would be LARGE and beneficial. FEIS at 4-37.

405. Infrastructure and Community Services: Based on information in the application, Staff interviews conducted with public officials in affected counties, and Staff review of data concerning local services and current state and local planning, the Staff concluded that the construction impacts on the regional infrastructure and community services would be SMALL in most of the region. FEIS at 4-44. The impact of the estimated workforce of 3150 would be SMALL on the transportation network in the vicinity and region because of several permanent transportation mitigation measures that are being implemented, and the impact on aesthetics and recreation would be SMALL because the site is relatively isolated, industrial in nature, and well masked by forest in most directions. FEIS at 4-44. Finally, impacts on public services and infrastructure would be SMALL throughout the region, unless a substantial share of the in-migrating construction workforce is drawn to Claiborne County, which is not expected; however, if that were the case, the impacts on housing and education in Claiborne County could be MODERATE. FEIS at 4-44.

406. Along with assumptions made earlier with respect to socioeconomics, the Staff also assumed, with respect to education, that the state would provide some financial help if the school system were seriously affected by in-migration. FEIS at 4-44. As before, the Staff would have to confirm these assumptions at the CP or COL stage and determine whether there would be any new and significant information that would change this conclusion. FEIS at 4-44, 4-45.

vi. Historic and Cultural Resource Impacts

407. Because construction, operation, and decommissioning of new nuclear units at the Grand Gulf ESP site could possibly affect either known or potential historic properties, the Staff made a reasonable and good-faith effort to identify historic properties, in order to comply

with the provisions of NEPA and National Historic Preservation Act of 1966 (“NHPA”). FEIS at 4-45, 4-46. The Staff’s analysis included consultation with the State Historic Preservation Officer, American Indian Tribes, interested parties, and the public. FEIS at 4-46, 4-47.

408. The Staff noted that previous cultural resource efforts have identified the presence of several archaeological sites and the potential for additional sites, but none of the known sites are considered significant and most are generally located away from the areas targeted for new construction. FEIS at 4-47. The Staff further relied on SERI’s commitment to develop procedures to provide immediate reaction and notification in the event of inadvertent discovery of cultural resources and to conduct surveys prior to construction of new transmission lines as well as any construction on two areas of the site identified by the Mississippi Department of Archives and History. FEIS at 4-47. Based on its analysis and consultations, the Staff concluded that the potential impacts of the activities contemplated by the ESP application on historic and cultural resources would be SMALL. FEIS at 4-47.

vii. Environmental Justice Impacts

409. The Staff evaluated whether minority and low-income populations could be disproportionately affected by the environmental impacts associated with the construction of new units at the Grand Gulf ESP site. Minority populations are present in all of the counties and parishes within the 80-km (50-mi) radius of the Grand Gulf ESP site; minority populations are primarily concentrated on the Mississippi side of the river in Claiborne and Jefferson counties, and Hinds County has the largest number of minorities. FEIS at 2-85. Claiborne County is entirely composed of minority block groups and contains 10 of the 129 block groups containing exceptionally significant minority populations. FEIS at 2-85. Likewise, most of the area near the proposed site, especially Claiborne and Jefferson counties, has percentages of low-income populations in the range of 20 to 30 percent of the population. The heaviest concentrations of low-income populations are in southern Claiborne County, central Jefferson

County, and eastern Tensas and Concordia parishes. FEIS at 2-85. County poverty estimates from the 2000 U.S. Census indicate that 32.4 percent of individuals are below the poverty level in Claiborne County, compared to the state of Mississippi with 19.9 percent of individuals below the poverty level. FEIS at 2-70.

410. The Staff examined available data for these populations with respect to health status, death statistics (including those for heart disease, cancer, stroke, chronic lung disease, and accidental death), and infant mortality. FEIS at 2-85 to 2-89. The Staff also gathered available data on subsistence hunting and fishing practices. FEIS at 2-88, 2-89. However, the Staff found no unusual resource dependencies or practices through which the populations could be disproportionately affected. FEIS at 4-49. In addition, the Staff did not identify any location-dependent disproportionate impacts affecting these minority and low-income populations. FEIS at 4-49. Assuming no significant demographic changes, the Staff concluded that construction of new units at the Grand Gulf ESP site would not result in disproportionate and adverse offsite environmental impacts on minority and low-income populations. FEIS at 4-49.

411. With respect to socioeconomic impacts, as noted above, the Staff identified a possible LARGE and beneficial impact, principally on Claiborne County through its tax base, and a MODERATE and beneficial impact on the larger Mississippi communities surrounding the site through increased employment opportunities. FEIS at 4-50. However, the Staff also found that if additional tax payments and planned infrastructure improvements are not made to Claiborne County to compensate for the additional burden of construction traffic and possible new residents, the socioeconomic burden on local taxpayers (largely minority, and a majority of whom are low income) may be MODERATE adverse and disproportionate. FEIS at 4-50. In short, the Staff found that the socioeconomic impacts could range from LARGE beneficial to

MODERATE adverse, depending on the level of public sector obligations imposed by new residents and the level of tax revenues provided by the new units. FEIS at 4-50, 4-51.

viii. Nonradiological Health Impacts

412. The Staff posited that construction workers and personnel working onsite could be exposed to fugitive dust, gaseous effluents, and noise resulting from construction activities, as well as the possibility of typical occupational injuries to workers engaged in activities such as construction, maintenance, and excavation. However, noting SERI's operational controls to mitigate dust and emissions, the fact that actual injury and fatality rates at nuclear reactor facilities have been lower than the average U.S. industrial rates, the comparison of expected noise levels with the applicable effective distances and exposure for both workers and the public, and the Staff's assumption of adherence to NRC, OSHA, and State safety standards, practices, and procedures during construction activities, the Staff concluded that nonradiological health impact on the site preparation and construction workers and local population would be SMALL. FEIS at 4-51, 4-52.

ix. Radiological Health Impacts

413. According to the Applicant, all major construction activities are expected to occur outside of the GGNS Unit 1 protected area boundary but inside the restricted site boundary (exclusion area). FEIS at 4-53. The Staff reviewed the proposed construction areas and recent records of dose rates, the locations of the thermoluminescent dosimeters ("TLDs"), and the procedure used for estimating doses to members of the public in controlled areas. FEIS at 4-54. The Staff concluded that the Applicant's method for estimating doses to workers from direct radiation from the existing GGNS Unit 1 would be acceptable. FEIS at 4-54.

414. With respect to analyzing effluent exposures, the Applicant considered that, on an annual basis, the dose to workers from gaseous effluents would be insignificant (approximately 0.001 person-Sv or 0.1 person-rem) with respect to the dose from direct



radiation and that this dose would be accounted for in the protected area-fence TLD readings; SERI assumed a construction workforce of 3150 persons and an occupational exposure period of 2080 hours per year. FEIS at 4-54. Likewise, related to liquid effluents, SERI noted that any of the construction activities for the new facility would be upstream from the release point of the current plant, and it estimated that, on an annual basis, the dose to site preparation and construction workers from liquid effluents also would be insignificant (approximately 0.0006 person-Sv/yr (0.06 person-rem/yr)) with respect to the dose from direct radiation. FEIS at 4-55.

415. The Staff reviewed the data from the 2001 *Annual Radioactive Effluent Release Report* and from more recent years and found that 2001 data were typical of effluents in recent years. The Staff determined that the Applicant's method for estimating dose from gaseous and liquid effluents was acceptable. FEIS at 4-55.

416. The Staff then reviewed the Applicant's calculated estimate of dose to workers during site preparation and construction activities, an annual dose to a construction worker of 0.36 mSv (36 mrem) from the direct radiation pathway. FEIS at 4-55. As the annual dose limit to an individual member of the public is 1 mSv (100 mrem) total effective dose equivalent and less than 0.02 mSv (2 mrem) in any 1 hour, and the annual occupational dose limit is 0.05 Sv (5 rem) total effective dose equivalent, the Staff found the calculated dose estimates for Grand Gulf to be well within NRC exposure limits designed to protect public health, even if workers exceed the 2080 hour per year occupancy factor. FEIS at 4-55, 4-56. Assuming the location of the proposed new nuclear unit or units does not change, the Staff concluded that the impact of radiological exposures to site preparation and construction workers would be SMALL. FEIS at 4-56.

417. We find that the facts described and referenced in Chapter 4 of the Staff's FEIS include all factors relevant to the assessment of environmental impacts of construction at the proposed Grand Gulf ESP site, including those relating to the impacts of land-use, meteorology

and air quality, water, ecology, socioeconomics, historic and cultural resources, environmental justice, and radiological and nonradiological health.

418. Further, we find that the Staff evaluation documented in FEIS Chapter 4, as described above, is based on these facts, and provides reasonable support in logic to support the Staff findings in FEIS Chapter 4.

419. Accordingly, we find that the Staff's review of these matters was adequate.

e. FEIS Chapter 5, "Operation Impacts at the Proposed Site"

420. In Chapter 5 of the FEIS, the Staff analyzed the potential impacts of operation on land use, air quality, water, ecosystems, socioeconomics, historic and cultural resources, and environmental justice, as well as nonradiological and radiological health effects. Where possible, the Staff assigned a single significance level of potential impact – SMALL, MODERATE, or LARGE – to each issue, in accordance with 10 C.F.R. Part 51. FEIS at 5-1.

i. Land Use Impacts

421. The Staff concluded that land-use impacts in the vicinity of the ESP facility due to operations would be SMALL. Using a conservative estimate of 2320 persons as the expected increase in population related to new personnel being employed at the ESP site, the Staff examined data on housing availability and mortgage transactions in the region and concluded that land-use impacts from development of new housing would occur, but would be widely disbursed and would not be concentrated in any one community. FEIS at 5-1, 5-3. The Staff noted that land cover alterations would be minor because of the likely geographically disbursed construction of new housing for ESP facility workers. FEIS at 5-3. The Staff also concluded that the effects of temporary worker increases during outages would be small due to the small incremental number of workers involved (compared to current numbers of outage workers for the existing plant), and that, in light of data from the existing unit and the offsite

location of agricultural land, any effects from salt drift from the operation of cooling towers similarly would be of only minor significance. FEIS at 5-3.

422. Finally, as discussed with respect to Chapter 4 of the FEIS, the Staff concluded that land use impacts from transmission line rights-of-way are expected to be minimal, although the extent of expansion necessary will be determined at the COL stage. FEIS at 5-4.

ii. Meteorological and Air Quality Impacts

423. On the assumption that cooling towers associated with the new nuclear unit or units would be similar to cooling towers at existing nuclear plant sites, including the GGNS, the Staff concluded that the impacts, such as plume visibility and drift, of the cooling towers on air quality would be SMALL. FEIS at 5-4, 5-5.

424. Similarly, because auxiliary systems such as diesel generators and boilers are used on an infrequent basis and no significant industrial source exists within 16 km (10 mi) of the proposed site, the Staff concluded that the impacts of non-cooling system routine releases would be SMALL. FEIS at 5-5. Finally, finding the potential impacts from transmission line gas emissions to be bounded by existing guidance such as that in the NRC's Generic EIS, the Staff concluded that the potential transmission line impacts of operation of the Grand Gulf ESP facility would be SMALL. FEIS at 5-6.

iii. Water-Related Impacts

425. With respect to hydrology, the Staff did not identify any significant changes to the local flow patterns or intensities that would occur at the site due to operation. FEIS at 5-7. Based on the character of the shallow groundwater system, the Staff concluded that any impacts on the groundwater flow pattern would be localized and any change would be unlikely to extend beyond the site boundary. FEIS at 5-7. The Staff thus concluded that the impact of hydrological alterations from operation would be SMALL. FEIS at 5-7.

426. Because the Staff concluded that a new facility would withdraw only a small amount of water relative to the total Mississippi river flow (about 0.2 percent) at even the lowest minimum river discharge conditions recorded for the area, and because of the small area of the river that would be affected by the proposed new facility, the Staff concluded that the intake structure would not affect recreational or commercial fishing operations or otherwise restrict navigation on the Mississippi River. FEIS at 5-8. Because the withdrawal would be small relative to river flow, taking into account withdrawals for both the proposed ESP unit(s) and the existing GGNS Unit 1, the Staff concluded that intake impacts would be small. FEIS at 5-8. The Staff also concluded that employing standard best management practices for storm water management would make the impact on water uses associated with nearby streams insignificant. FEIS at 5-8.

427. In terms of aquifer analysis, because of the limited number of borings, hydraulic conductivity measurements, and long-term pump tests currently available for the Catahoula portion of the aquifer, the Staff was unable to assess reliably the impact of a significant increase in the groundwater withdrawal at the Grand Gulf ESP site. FEIS at 5-8. Because the Staff concluded that the impact on the Catahoula formation could be SMALL if the proposed withdrawal had little effect on the Catahoula formation or MODERATE if the proposed withdrawal were to adversely affect current water withdrawals elsewhere in the aquifer, the Staff determined that additional information would need to be provided at the COL stage; therefore, the issue of water-use impacts resulting from operational activities on groundwater is unresolved. FEIS at 5-8, 5-9.

428. With respect to water quality impacts, although details of the outfall design are not known at the ESP stage, the Staff analyzed the expected outfall plume for the Mississippi River using the Cornell Mixing Zone Expert System ("CORMIX"), version 4.3, and evaluated two assumed river discharges. FEIS at 5-10, 5-11. Based upon PPE values for the Grand Gulf

ESP facility and the 1994 *Updated Final Safety Analysis Report* ("UFSAR") for GGNS Unit 1, the bounding discharge flow rate was assumed to be 3.34 m<sup>3</sup>/s (52,900 gpm) at a temperature of 37.7°C (100°F). FEIS at 5-9. The Staff determined that a shoreline diffuser outfall represents the bounding case, and by comparing the projected bounding plume to the size and variable flow conditions of the river, the Staff concluded that the impact of the thermal plume on the Mississippi River would be small and localized. FEIS at 5-11, 5-12.

429. However, the Staff could not determine the impacts on water quality for the Mississippi River or the two local streams from chemical effluents (other than in blowdown) because the Applicant did not define the bounds of concentrations of chemical effluents for other sources. FEIS at 5-12. Therefore, the impact on water quality from chemical effluent is unresolved for both of these discharge locations and would need to be addressed at the COL stage. FEIS at 5-12.

430. Similarly, the Staff could not determine the impacts on groundwater based on the limited information provided by SERI and its incomplete plans for water withdrawals from the Catahoula formation. FEIS at 5-14. The Staff noted that if very deep groundwater drawdowns were to occur resulting from high groundwater withdrawal rates during operation of the Grand Gulf ESP facility, it is conceivable that lower quality groundwater from deeper aquifers would be induced to flow upward into the Catahoula formation and possibly degrade the quality of water in the Catahoula formation. FEIS at 5-14. The Staff determined that impacts on the Catahoula formation could be SMALL if the proposed withdrawal had little effect on the Catahoula formation or LARGE if the proposed withdrawal were to induce degradation of the water quality of the sole source aquifer. FEIS at 5-14. Therefore, the impact on groundwater is unresolved and would need to be addressed at the COL stage. FEIS at 5-14.

iv. Ecological Impacts

431. The Staff analyzed the potential impacts from operation of the Grand Gulf ESP facility, including transmission lines and associated right-of-way maintenance, to terrestrial ecosystems, aquatic ecosystems, and threatened and endangered species. FEIS at 5-15. First, the Staff noted that because the actual need for and extent of transmission system improvements would be determined prior to or during the CP or COL stage, the magnitude of the environmental impacts will need to be evaluated at that time. FEIS at 5-15, 5-16.

432. Next, the Staff noted that salt drift, icing, fogging, or increased humidity from the operation of cooling towers for the Grand Gulf ESP facility all have the potential to affect crops, ornamental vegetation, and native plants. FEIS at 5-16. However, because the direction of the prevailing winds is away from the nearest agricultural land, the data available from the existing Grand Gulf unit indicates no significant difference between onsite and offsite salt deposition rates, and the analysis of all operating nuclear power plants in the NRC's *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* ("GEIS") found salt drift impact to be of only minor significance for existing nuclear plants (including those with multiple cooling towers), the Staff concluded that these impacts at the proposed site would be minimal. FEIS at 5-16. Similarly, the data available from other cooling tower installations led the Staff to conclude that impact associated with bird collisions with the cooling towers would be minimal, regardless of the type of tower used. FEIS, 5-16, 5-17. The Staff also determined that the noise levels from cooling tower operation would likely have minimal impact on wildlife at the site. FEIS at 5-17.

433. With respect to shoreline habitat, the Staff found that, because of the small quantity of water withdrawn and discharged during operation relative to the flow in the Mississippi River, adverse impacts on the river shoreline from cooling tower operation are unlikely. FEIS at 5-17. As to vegetation management practices for transmission line

rights-of-way, the Staff assumed that existing practices would simply occur along the same rights-of-way, but potentially over twice the area; because existing practices on transmission line rights-of-way of variable widths were found in the GEIS to be of small significance, the Staff concluded that the incremental effects of transmission line right-of-way maintenance posed by increasing the width of the existing rights-of-way for the Grand Gulf ESP facility would be minimal. FEIS at 5-18.

434. The Staff considered a GEIS finding of minimal impact to be similarly dispositive for the Grand Gulf ESP site with respect to the issues of bird collisions with transmission lines; the effect of electromagnetic fields on flora and fauna; and the impact of transmission line right-of-way maintenance on floodplains and wetlands. FEIS at 5-18, 5-19. The Staff further determined that in light of the aforementioned conclusions with respect to the negligible operational impacts from cooling tower operation, transmission line operation, and right-of-way maintenance, any related impacts of operation on state-listed animal and plant species likewise would be minimal. FEIS at 5-19, 5-20.

435. In terms of impact on aquatic ecosystems, the Staff first noted that because the PPE identifies cooling system designs that employ the use of mechanical draft or natural draft cooling systems – both of which are considered a closed-cycle cooling system – the Staff expected that the ESP facilities would meet the performance standards specified in the EPA regulations implementing Section 316(b) of the Clean Water Act. FEIS at 5-21. The Staff noted that losses of fish from impingement and entrainment are significantly less with systems that have cooling towers. FEIS at 5-21.

436. The Staff also analyzed the intake structure for the proposed site, although the design has not yet been finalized. The Staff evaluated potential impingement and entrainment by comparing the available information concerning the proposed intake structure to the performance of the similarly designed structure at the once-through River Bend Nuclear Station

located downstream on the Mississippi River. FEIS at 5-21. According to SERI, the intake structure would be located along the upstream shoreline of the existing barge slip and would consist of screened suction pipes supplying the makeup water pumps. FEIS at 5-21.

Furthermore, the intake screens would be sized so that the average intake velocity through the screen would be less than or equal to 0.12 m/s (0.5 ft/s), and the depth of the intake screens would minimize the uptake of aquatic biota and river debris. FEIS at 5-21. Because the final environmental impact statement for River Bend concluded that impingement of organisms on the intake screens was not likely to be a problem because of low-intake velocities, the Staff concluded that the use of a similar intake structure at the Grand Gulf ESP facility would likely also pose a minimal impact from impingement and entrainment of aquatic organisms in the Mississippi River. FEIS at 5-21, 5-22.

437. The Staff also determined that aquatic thermal impacts would be minimal, both because the use of cooling towers would discharge most waste heat to the atmosphere rather than to the Mississippi River and because the expected thermal plume size is small compared to the river width at the discharge point. FEIS at 5-23. The Staff found that the projected temperature increase in the plume (a 2.8°C (5°F) degree difference in temperature from the ambient water temperature) was not likely to be lethal to aquatic organisms, and noted that cold shock mortalities at U.S. plants are rare, particularly at multiple-unit facilities. FEIS at 5-23, 5-24. The Staff further concluded that the location of the discharge along the bank of the Mississippi River, the buoyant nature of the plume, the large flow of the river, and the stabilization of the river shoreline by concrete mats and riprap would minimize other potential impacts on aquatic organisms from thermal discharge. FEIS at 5-24. Furthermore, the Staff found that any dredging or shoreline stabilization activities could be timed and conducted to have a minimal impact on aquatic resources. FEIS at 5-24.



438. The Staff determined that impacts on the aquatic ecosystem from transmission line right-of-way maintenance would depend on the methods used and that, because a plan has not yet been developed (and it is not clear whether rights-of-way will need to be widened), a COL applicant would need to provide further information. FEIS at 5-24, 5-25. Finally, after its analysis of potentially affected terrestrial and aquatic Federally listed threatened and endangered species, the Staff concluded that the impacts on from operation of the Grand Gulf ESP facility on all of these species would be SMALL, assuming the present occurrence of these species and critical habitat in the project area, the current listing status of such species, and the current designation of critical habitat. FEIS at 5-30, 5-31.

v. Socioeconomic Impacts

439. To assess the potential socioeconomic impacts of operations, the Staff evaluated the physical impacts, population impacts, and impacts on community characteristics. First, the Staff concluded that the physical impacts of operation of the new unit or units at the Grand Gulf ESP site would be SMALL, noting the distance between the site and residential areas (6 miles between the site and Port Gibson), the generally low offsite noise levels characteristic of power plant sites as well as the noise controls to be used at Grand Gulf, the lack of impact on offsite buildings, and the lack of significant aesthetic impacts beyond those already present as a result of the existing unit. FEIS at 5-31 to 5-33.

440. Second, the Staff concluded that the impacts of operation on demographics would be SMALL, based on its determination that there are not likely to be more than 1160 new operations workers at the Grand Gulf ESP site, that not less than 50 percent of the operations workers would come from the region within 80 km (50 mi) of the Grand Gulf site, and that most of the new workers would choose to live in the larger cities of the region. FEIS at 5-34, 5-35. However, the Staff noted that if Port Gibson, Mississippi, were to attract new in-migrating population in the same proportion as existing facility employees, the town would experience an

18 percent population increase; the impact under such circumstances would be LARGE. FEIS at 5-35.

441. For similar reasons, the Staff found that the overall impact on the economy and tax revenues of the region (including Claiborne County and surrounding counties—especially Vicksburg and Warren County) would be positive, as a result of new jobs for residents and demand for commercial retail establishments, expanded property tax payments and other tax revenues. FEIS at 5-35. The Staff found the impact on the economy of most of the region would be SMALL, with a possible MODERATE beneficial impact in Warren County. FEIS at 5-37. The Staff concluded that impacts on the economy and tax revenues in Claiborne County would be LARGE and beneficial, noting that the tax yield would be about \$29 million per year at Claiborne County's current property tax rate, a very significant positive impact. FEIS at 5-36, 5-37. The Staff found that payment in lieu of taxes to Claiborne County would be about \$7.8 million per year even if the new nuclear facility were taxed and the funds distributed in the same manner as with the existing GGNS, which would still be a LARGE effect. FEIS at 5-37.

442. The Staff concluded that the impacts from operation on the regional infrastructure and community services would be SMALL in most of the region. FEIS at 5-42. The Staff noted positive changes to the adequacy of the local transportation network, the GEIS finding of small impacts on tourism and recreation near existing nuclear plants, the anticipated distribution of new workers and their families among various communities in the Grand Gulf site vicinity such that the impact on housing and social services in any one would not likely overburden any one community's capacity, and the ability of anticipated tax revenues to offset potential burdens. FEIS at 5-38 to 5-42. However, the Staff acknowledged that if Claiborne County draws a substantial share of the in-migrating operations workforce, which is not expected, the impacts from operation on housing and education in that county could be

MODERATE. FEIS at 5-40 to 5-42. The Staff's socioeconomic analysis remained dependent on various demographic assumptions identified earlier. FEIS at 5-42.

vi. Historic and Cultural Resources Impacts

443. Because all ground-disturbing activities that could have an impact on historic or archaeological resources would probably occur during the construction phase, the Staff found that there would be limited potential for impacts during operation of one or more additional units at the Grand Gulf ESP site. FEIS at 5-43. Therefore, the Staff concluded that the potential impacts from operation on historic and cultural resources would be SMALL. FEIS at 5-43.

vii. Environmental Justice Impacts

444. The Staff examined air, land, and water resources within about 80 km (50 mi) of the Grand Gulf ESP site for potential environmental impacts that could affect human populations. The Staff concluded that (as with the construction impacts) all physical environmental impacts of operation would be SMALL, and the socioeconomic impacts would vary from LARGE beneficial to MODERATE adverse. FEIS at 5-44. The Staff found only minor offsite impacts on minority and low-income populations, and no disproportionate effects. FEIS at 5-44, 5-45.

445. Relying on the Staff's dose and accident analyses in subsequent sections of FEIS Chapter 5, the Staff determined that operation would result in only slight contributions to radiation dose to members of the public in the site vicinity, far below that associated with natural radiation background levels. FEIS at 5-45. The Staff found the maximum individual dose for critical pathways to be insignificant, well below the regulatory guidelines in Appendix I of 10 C.F.R. Part 50 and the regulatory standards of 10 C.F.R. Part 20, and that the radiological consequences of postulated accidents would meet the site acceptance criteria of 10 C.F.R. § 50.34 and 10 C.F.R. Part 100, adequately protecting public health. FEIS at 5-45.

446. Finally, the Staff concluded that in light of projected tax revenues (namely, that Claiborne County would receive at least \$7.8 million per year if the new nuclear facility were treated in the same manner as the existing GGNS), a LARGE net financial benefit from operation would be realized by Claiborne County residents and taxpayers, most of whom are minority and low-income persons. FEIS at 5-46.

viii. Nonradiological Health Impacts

447. The Staff evaluated nonradiological health impacts on the public as well as on workers. It found that health risks to workers likely would be dominated by occupational injuries, but that nuclear industry trends indicate such injuries occur at rates below the average U.S. industrial rates. FEIS at 5-50. The Staff determined that health impacts from thermophilic microorganisms would be minimal given the size of the Mississippi River, and that noise impacts from operations also would be minimal, given the distances to plant boundaries at the proposed site, sound surveys at the existing unit, and experience at other plants. FEIS at 5-47 to 5-49. Therefore, the Staff concluded that the potential impacts of nonradiological effects from proposed operations would be SMALL. FEIS at 5-50.

448. However, the Staff did not reach a conclusion with respect to either the acute or chronic impacts of electromagnetic fields, because SERI has not asserted (in connection with potential acute impacts) that the existing transmission and distribution system meets National Electric Safety Code criteria for induced currents or that modifications to the existing system would comply with the relevant standards, and conclusive information is not available with respect to chronic effects. FEIS at 5-49, 5-50. Therefore, those issues remain unresolved and will receive additional examination at the COL stage. FEIS at 5-49, 5-50.

ix. Radiological Impacts of Normal Operations

449. Using the PPE, SERI provided a list of fission and activation products that may be released in gaseous emissions and liquid effluents from the new unit(s) at the Grand Gulf

ESP site. The Staff independently assessed the health impacts from potential exposure pathways from routine gaseous and liquid radiological effluent releases and direct radiation. After identifying likely exposure pathways (described in Regulatory Guides 1.109 and 1.111), calculating the dose to a maximally exposed individual and a collective whole body dose for the population within 80 km (50 mi) of the Grand Gulf ESP site, and comparing the calculated doses to regulatory design objectives, the Staff concluded there would be no observable health impacts on the public from normal operation of new nuclear units, and that the health impacts from operation would be SMALL. FEIS at 5-51 to 5-58.

450. The Applicant did not specifically address occupational doses to workers in its environmental report. However, based on a study conducted by Dominion Energy, Inc., the Staff noted that the estimated occupational doses for the possible advanced reactor designs to be used at the Grand Gulf ESP site were slightly less than annual occupational doses for current light water reactors ("LWRs"). FEIS at 5-59. The Staff found that the data on these designs was generically applicable to the SERI application and that the dose estimates were reasonable; therefore, the Staff concluded that impacts from occupational doses from operation can be considered SMALL because worker dose would fall within the 10 C.F.R. Part 20 criteria. FEIS at 5-59.

451. The Staff examined the Applicant's estimated doses to surrogate species for both liquid (using input parameters taken from NUREG/CR-4013) and gaseous effluent pathways. FEIS at 5-59, 5-60. The Staff's independent evaluation of biota doses produced similar results. FEIS at 5-60. The Staff concluded that, although the doses for surrogate species exceeded the regulatory standards for humans, the impacts were sufficiently protective because the cumulative effects of current operating units and proposed unit or units would result in dose rates significantly less than studies by the National Council on Radiation Protection and Measurements ("NCRP") and International Atomic Energy Agency ("IAEA") that

found adequate protection for biota. FEIS at 5-60, 5-61. Therefore, the Staff concluded that the radiological impact on biota other than members of the public from routine operation would be SMALL. FEIS at 5-61.

452. Finally, the Staff reviewed the documentation for the radiological environmental monitoring program ("REMP") (which has been in effect around the Grand Gulf site since 1978), the Grand Gulf Offsite Dose Calculation Manual, and recent monitoring reports from SERI and the state of Mississippi, and determined that the current operational monitoring program is adequate to establish the radiological baseline for comparison with the expected impacts on the environment related to the proposed construction and operation. FEIS at 5-61, 5-62.

x. Environmental Impacts of Postulated Accidents

453. In section 5.10 of the FEIS, the Staff considered the radiological consequences on the human environment of potential accidents at one or more new nuclear units at the Grand Gulf ESP site. In its application, SERI evaluated the potential consequences of postulated accidents, using a set of surrogate design basis accidents ("DBAs") intended to be representative for the range of reactor designs being considered for the ESP site and site-specific meteorological data. FEIS at 5-63. These accidents cover events ranging from relatively high probability of occurrence with relatively low consequences to relatively low probability with high consequences. FEIS at 5-63. The Staff's DBA review focused on two light water reactor designs: the ABWR and the surrogate AP1000. Although DBAs for reactor designs other than light-water designs are not yet resolved, the Staff expects the potential consequences of accidents for such reactor designs to be bounded by those for the ABWR and surrogate AP1000 designs because the source terms for accident analyses are generally proportional to the power level. FEIS at 5-64.

454. The Staff noted that the source terms for the ABWR design are based on TID-14844 guidance, and that guidance on methods for evaluating potential accidents for the

ABWR are set forth in NUREG-0800, Regulatory Guide 1.3, and Regulatory Guide 1.25. FEIS at 5-64. Similarly, the source terms for the surrogate AP1000 reactor and methods for evaluating potential accidents are based on guidance in Regulatory Guide 1.183. FEIS at 5-64. Furthermore, acceptable methods of calculating atmospheric dispersion factors (also referred to as  $\chi/Qs$ ) for DBAs from meteorological data are set forth in Regulatory Guide 1.145. FEIS at 5-64.

455. The Staff reviewed meteorological data from the ESP site for 2002 and 2003 and found them to be representative of the meteorological conditions at the site. FEIS at 5-64. The Staff concluded that the meteorological instrumentation and its maintenance are consistent with Staff guidance, and that the data quality is consistent with standards set forth in that guidance. FEIS at 5-64, 5-65. The Staff also reviewed SERI's procedures for calculating site-specific  $\chi/Q$  values and found them to be consistent with Staff guidance. FEIS at 5-65.

456. However, although the Staff found SERI's derivation process to be consistent with NRC guidance, it found that the  $\chi/Q$  values are not acceptable for use in environmental reviews because they are for adverse meteorological conditions rather than typical conditions. FEIS at 5-65. Instead, using the procedure described in Regulatory Guide 1.145, the Staff estimated site  $\chi/Q$  values for typical meteorological conditions using the EAB and LPZ distances given in the ESP application. FEIS at 5-65. The Staff then concluded that the atmospheric dispersion characteristics of the Grand Gulf ESP site are acceptable with respect to the potential environmental consequences of postulated DBAs for reactor designs with design  $\chi/Q$  values falling within the bounds set by the Staff's site  $\chi/Q$  values. FEIS at 5-66.

457. Subsequently, the Staff estimated the environmental consequences of each DBA in terms of total effective dose equivalent ("TEDE"): the sum of the committed effective dose equivalent ("CEDE") from inhalation and the deep dose equivalent from external exposure. FEIS at 5-66. The Staff used dose conversion factors from Federal Guidance Reports 11

and 12 to calculate the CEDE and the deep dose equivalent, respectively. FEIS at 5-66. The Staff also examined SERI's evaluation of the consequences of a postulated loss-of-coolant accident ("LOCA") for the ACR-700 reactor design and found the TEDE values to be well below the review criteria used in the Staff's safety review of DBA doses for EAB and LPZ. FEIS at 5-66. In all cases, the Staff found the calculated TEDE values to be small – considerably smaller than the TEDE doses used as safety review criteria. FEIS at 5-66.

458. Although the Staff adjusted the results of the SERI analysis to reflect typical meteorological conditions, both the Applicant and Staff analyses indicate that the environmental risks associated with DBAs for an advanced LWR at the Grand Gulf ESP site would be small compared to the TEDE doses used as safety review criteria. FEIS at 5-67. Therefore, the Staff concluded that the consequences of DBAs at the Grand Gulf ESP site are of SMALL significance for advanced LWRs. FEIS at 5-67. However, the Staff noted that the environmental impacts of DBAs have not been explicitly evaluated for gas-cooled reactors and, therefore, the issue remains unresolved and would require additional information at the COL stage. FEIS at 5-67.

459. With respect to the potential environmental consequences of severe accidents, the Applicant based its evaluation on three pathways considered in the GEIS: the atmospheric pathway in which radioactive material is released to the air, the surface water pathway in which airborne radioactive material falls out on open bodies of water, and the groundwater pathway in which groundwater is contaminated by a basemat meltthrough with subsequent contamination of surface water by the groundwater. FEIS at 5-68. The Applicant used the MACCS2 code to evaluate the consequences of atmospheric releases of radioactive material following a severe accident; the Staff conducted its own confirmatory analysis using the code. FEIS at 5-69, 5-78.

460. Air Pathway: First, the MACCS2 code directly estimates consequences associated with releases to the air pathway. FEIS at 5-70. From its own analysis, the Staff



agreed that the probability weighted consequences, i.e., the risks, of severe accidents for an ABWR or a surrogate AP1000 reactor located on the Grand Gulf ESP site, are small for all risk categories considered. FEIS at 5-70. It also determined that the health risks for the ABWR and surrogate AP1000 reactors at the Grand Gulf ESP site are significantly lower than the risks associated with current-generation operating reactors presented in NUREG-1150. FEIS at 5-70.

461. Furthermore, the Staff found that the latent cancer fatality risks calculated for the ABWR and surrogate AP1000 designs at the Grand Gulf ESP site are lower than the risks associated with the current-generation reactors considered in NUREG-1150, and are well below the Commission's safety goals. FEIS at 5-76. The Staff also determined that the core damage frequencies estimated for the ABWR and surrogate AP1000 reactors are significantly lower than those of current-generation reactors, and that the population doses estimated for the advanced reactors at the Grand Gulf ESP site are well below the mean and median values for current generation reactors undergoing license renewal. FEIS at 5-76. After comparing these risk assessments with the Commission's safety goals, and after finding based on preliminary information that the surrogate AP1000 and the ABWR are likely to bound the risk for the IRIS/ACR-700 and ESBWR, respectively, the Staff concluded that the impacts for the proposed Grand Gulf ESP site for the air pathway releases for severe accidents would be small for operation of advanced LWRs. FEIS at 5-77.

462. Surface Water Pathway: The Staff noted that population dose risk from ingestion of surface water is a small fraction of the dose risk from the air pathway. FEIS at 5-77. The Staff found the Applicant's dose estimates to be conservative because actual use of surface water as a source for public water systems is less than assumed in the MACCS2 code, and it also found that exposures from surface water pathways from recreational activities are even lower than those from aquatic ingestion. FEIS at 5-77, 5-78. After considering the surface

water ingestion dose estimates and the GEIS, the Staff concluded that the impacts for the proposed Grand Gulf ESP site from surface water pathway releases for severe accidents are small for operation of ABWR and surrogate AP1000 reactors. FEIS at 5-78. In a similar fashion to the air pathway, the Staff expects the environmental impacts of the surface water pathways for other advanced LWRs to be bounded by the ABWR and the surrogate AP1000. FEIS at 5-78.

463. Groundwater Pathway: Although the MACCS2 code does not evaluate the environmental risks associated with severe accident releases of radioactive material to groundwater, the Staff noted that the pathway has been addressed in the GEIS, which concluded that groundwater generally contributed a small fraction of the risk attributable to the atmospheric pathway. FEIS at 5-78. Although the Staff assumed the probability of a release via the groundwater pathway to be significantly larger than a release via the atmospheric pathway for either the ABWR or the surrogate AP1000, the Staff found that the groundwater pathway affords a greater time for implementing protective actions and, therefore, results in a lower risk to the public. FEIS at 5-78. The Staff thus concluded that the risks associated with releases to groundwater are small for the proposed Grand Gulf ESP site. FEIS at 5-78.

464. We find that the facts described and referenced in Chapter 5 of the Staff's FEIS include all factors relevant to the assessment of environmental impacts of operations at the proposed Grand Gulf ESP site, including those relating to the impacts of land-use, meteorology and air quality, water, ecology, socioeconomics, historic and cultural resources, environmental justice, radiological and nonradiological health, and postulated accidents.

465. Further, we find that the Staff evaluation documented in FEIS Chapter 5, as described above, is based on these facts, and provides reasonable support in logic to support the Staff findings in FEIS Chapter 5.

466. Accordingly, we find that the Staff's review of these matters was adequate.

f. FEIS Chapter 6, “Fuel Cycle, Transportation, and Decommissioning”

467. As set forth below, in FEIS Chapter 6 the Staff evaluated the environmental impacts from (1) the uranium fuel cycle and solid waste management, (2) transportation of radioactive material, and (3) decommissioning for the proposed Grand Gulf early site permit (ESP) site. FEIS at 6-1.

f-i. Fuel Cycle Impacts and Solid Waste Management

468. The Staff first examined the Applicant’s assessment of the environmental impacts from the uranium fuel cycle and solid waste management, for both the advanced light water reactor (“LWR”) designs<sup>18</sup> and gas-cooled reactor designs.<sup>19</sup>

f-i.1. Light-Water Reactors

469. In the Applicant’s analysis of LWR designs, the PPE for the new unit or units at the Grand Gulf ESP site uses the bounding input parameters from several LWR designs, all of which use uranium dioxide fuel. FEIS at 6-2. As a result, the Staff determined that Table S–3 found at 10 C.F.R. § 51.51(b), which states key uranium fuel cycle environmental data calculated by the NRC, can be used to assess environmental impacts. FEIS at 6-2. The Staff is confident that the contemporary fuel cycle impacts weighed in its analysis correspond to those identified in Table S–3. FEIS at 6-7.

470. Although the NRC’s GEIS is specific to the impacts related to license renewal, the information is relevant to this ESP review because the advanced LWR designs considered

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<sup>18</sup> As noted earlier, the five LWR designs SERI considered are the Advanced Canada Deuterium Uranium Reactor (“ACR-700”); the Advanced Boiling Water Reactor (“ABWR”); the Advanced Pressurized Water Reactor (“AP1000”); the Economic Simplified Boiling Water Reactor (“ESBWR”), and the International Reactor Innovative and Secure (“IRIS”) next-generation pressurized water reactor (“PWR”).

<sup>19</sup> As noted earlier, the two gas-cooled designs SERI considered are the Gas Turbine Modular Helium Reactor (“GT-MHR”) and the Pebble Bed Modular Reactor (“PBMR”).

by the Applicant use the same type of fuel; therefore, the Staff summarized and incorporated by reference the analyses from Section 6.2.3 of the GEIS. FEIS at 6-7.

471. Because the fuel cycle impacts in Table S-3 are based on a reference 1000-MW(e) LWR operating at an annual capacity factor of 80 percent for a net electric output of 800 MW(e), the Staff used the stated capacity factor in the SERI PPE of 96 percent with a total net electric output of 3000 MW(e) for the ESP site (referred to by the Staff in its review as “the 1000-MW(e) LWR scaled model”), resulting in approximately four times the impact values in Table S-3. FEIS at 6-7.

472. The Staff then examined the fuel cycle environmental impacts associated with the Table S-3 thresholds to assess the impacts of the proposed ESP site. The Staff determined these impacts to be small for each primary impact area.

473. The Staff’s analysis indicated small impacts with respect to land commitment and disturbance, noting that the total annual land requirement for the fuel cycle supporting the 1000-MW(e) LWR scaled model is about 183 ha (452 ac). FEIS at 6-8. Of that total, approximately 20 ha (52 ac) constitutes permanently committed land, and 162 ha (400 ac) is only temporarily committed, of which 113 ha (280 ac) are undisturbed and 49 ha (120 ac) are disturbed. FEIS at 6-8. The Staff compared this to a coal-fired power plant with the same MW(e) output (and using strip-mined coal), which requires the disturbance of about 324 ha (800 ac) per year for fuel alone. FEIS at 6-8.

474. The Staff likewise found small impacts with respect to water use for thermal loadings and water consumption. The Staff determined that on a thermal effluent basis, annual discharges from the nuclear fuel cycle are about 4 percent of the 1000-MW(e) LWR scaled model using once-through cooling, while consumptive water use is about 2 percent of the 1000-MW(e) LWR scaled model using cooling towers. FEIS at 6-9. The maximum consumptive water use (assuming that all plants supplying electrical energy to the nuclear fuel

cycle use cooling towers) would be about 6 percent of the 1000-MW(e) LWR scaled model using cooling towers. FEIS at 6-9. The Staff concluded that impacts on water use for these combinations of thermal loadings and water consumption would be small relative to the water use and thermal discharges. FEIS at 6-9.

475. The Staff concluded that impacts with respect to fossil fuel impacts from direct and indirect electricity energy consumption would be small relative to the net power production of the proposed project, noting that electric energy associated with the fuel cycle represents only about 5 percent of the annual electric power production of the reference 1000-MW(e) LWR. FEIS at 6-9.

476. The Staff's analysis indicated small impacts with respect to chemical, gaseous, and particulate effluents, in comparison, for example, with the emissions from the stationary fuel combustion and transportation sectors in the U.S.; the Staff noted that fuel cycle emissions constitute about 0.08 percent of the annual national releases for each of these effluents. FEIS at 6-9. The Staff further noted that liquid chemical effluents produced in fuel cycle processes are usually present in dilute concentrations, and that all liquid discharges from fuel cycle plants into the navigable waters of the United States are subject to regulatory agency requirements. FEIS at 6-9.

477. The Staff's analysis indicated small impacts from the fuel cycle with respect to radioactive effluents. Using the data in Table S-3 for the reference reactor, the additional whole body dose commitment to the U.S. population from radioactive gaseous effluent and radioactive liquid effluents from all fuel cycle operations other than reactor operation would be approximately 16 person-Sv (1600 person-rem) and 8 person-Sv (800 person-rem), respectively, per year of operation. FEIS at 6-10. Thus, the estimated 100-year environmental dose commitment to the U.S. population from radioactive gaseous and liquid releases because of these portions of the fuel cycle is approximately 24 person-Sv (2400 person-rem) to the

whole body per reference reactor year. FEIS at 6-10. Because the Table S-3 values do not incorporate the effects of radon-222 and technetium-99, the Staff referred to the GEIS analysis, in which the Staff estimated that for radon-222, the 100-year environmental dose commitment to the whole body from mining, milling, and tailings prior to stabilization for each site year (assuming the 1000-MW(e) LWR scaled model) would be approximately 37 person-Sv (3700 person-rem) for radon-222, and approximately 0.71 person-Sv (71 person-rem) from stabilized tailings piles; the Staff calculated a dose commitment of 4 person-Sv (400 person-rem) from technetium-99. FEIS at 6-11. Finally, the Staff calculated the estimated cancer risk to the public from radiation exposure, using the method contemplated by the National Research Council's 2006 BEIR VII report, and found this risk to be very small compared to the number of fatal cancers, nonfatal cancers, and severe hereditary effects that would be estimated to the U.S. population annually from exposure to natural sources of radiation using the same risk estimation method. FEIS at 6-11, 6-12. From its analyses, the Staff concluded that the environmental impacts of radioactive effluents from the fuel cycle are small.

478. Based on the values in Table S-3 (taking into account low-level, high-level, and transuranic wastes), and in accordance with the Commission's Waste Confidence Decision (10 C.F.R. § 51.23) that a repository can and likely will be developed at some site, which would comply with regulatory limits for offsite releases of radionuclides, with peak doses to virtually all individuals of 1 mSv (100 mrem) per year or less, the Staff concluded that the environmental impacts of radioactive waste disposal would be small. FEIS at 6-12 to 6-14.

479. With respect to occupational dose, the Staff noted from Table S-3 that the annual occupational dose attributable to all phases of the fuel cycle for the 1000-MW(e) LWR scaled model is about 24 person-Sv (2400 person-rem), and it concluded that the environmental impact from this occupational dose can be considered small because the dose to

any individual worker is maintained within the dose limits of 10 C.F.R. Part 20, which is 0.05 Sv/yr (5 rem/yr). FEIS at 6-14.

480. Finally, with respect to transportation, the Staff noted that the Table S-3 values indicate that the transportation dose to workers and the public totals about 0.025 person-Sv (2.5 person-rem) annually for the reference 1000-MW(e) LWR, corresponding to a dose of 0.1 person-Sv (10 person-rem) for the 1000-MW(e) LWR scaled model. FEIS at 6-14, 6-15. Using for comparison that the estimated collective dose from natural background radiation to the population within 80 km (50 mi) of the Grand Gulf ESP site is 1020 person-Sv/yr (102,000 person-rem/yr), the Staff concluded that environmental impacts of transportation would be small. FEIS at 6-15.

#### f-i.2. Gas-Cooled Reactors

481. The Staff considered issues related to reactors based on non-LWR designs, such as gas-cooled reactors, to not be resolved because there is insufficient design information at this time to validate values and impacts. FEIS at 6-15. However, the Staff attempted to estimate the impacts using data provided by the Applicant, with respect to the two potential gas-cooled designs, the Gas Turbine Modular Helium Reactor ("GT-MHR") and the Pebble Bed Modular Reactor ("PBMR"). FEIS at 6-15.

482. SERI sought to demonstrate in its environmental report that the impacts for the gas-cooled reactor designs were comparable to the environmental impacts identified in the technical basis document, WASH-1248, *Environmental Summary of the Uranium Fuel Cycle*, and its Supplement 1 (NUREG-0116) for Table S-3. FEIS at 6-15. Both SERI and the Staff performed this assessment by comparing key parameters – including energy usage, material involved, and number of shipments for each major fuel cycle activity – for the gas-cooled reactor designs to those used to generate the impacts in Table S-3. FEIS at 6-15. As with its evaluation of the LWR designs, the Staff used the 1000-MW(e) LWR scaled model to compare

impacts. It determined that the Applicant could site 3 GT-MHR units or 2 PBMRs to remain close to the site PPE of 3000 MW(e) total net electric output. FEIS at 6-16.

483. With respect to fuel fabrication, the Staff concluded it could not directly compare environmental impacts for uranium dioxide, because there are no currently operating large-scale fuel fabrication facilities producing gas-cooled reactor fuels in the United States. Although the Staff found, based on some small-scale facilities, that the environmental impacts from producing gas-cooled reactor fuel likely would be small in comparison with the fuel fabrication impacts for LWR technologies, it concluded that these impacts would need to be assessed at the CP or COL stage. FEIS at 6-18. Similarly, with respect to enrichment, after evaluating the lower amount of energy required to enrich gas-cooled fuel and the higher amount of uranium hexafluoride needed, the Staff concluded that, on balance, the environmental impacts of enriching gas-cooled fuels by comparison with the impacts of enriching LWR fuel would likely be small, but that the impacts still would need to be assessed at the CP or COL stage. FEIS at 6-18, 6-19.

484. In terms of uranium hexafluoride production, yellowcake milling, and uranium ore mining, because the scaled gas-cooled reactor UF<sub>6</sub>, yellowcake, and ore needs are less than or comparable to those for the scaled LWR model, the Staff concluded that the associated environmental impacts are expected to be less for gas-cooled reactors and therefore would be small. FEIS at 6-19 to 6-20. Similarly, because gas-cooled reactor technologies are projected to generate far smaller amounts of low-level waste scaled annually compared to the amounts for the reference LWR, and because less waste and less heavy metal radioactive waste (because of gas-cooled reactors' higher thermal efficiency and higher fuel burnup) are expected to result in less decontamination and decommissioning waste than for the scaled LWR model, the Staff concluded that the environmental impacts of waste operations, decontamination, and decommissioning would also be small. FEIS at 6-20. However, the Staff noted that the impacts



for decontamination and decommissioning would need to be assessed at the COL stage if a gas-cooled design is chosen. FEIS at 6-20.

f-ii. Transportation of Radioactive Materials

485. The Staff also evaluated the radiological and nonradiological environmental impacts from normal operating and accident conditions resulting from (1) shipment of unirradiated fuel to new nuclear units at the Grand Gulf ESP site, (2) shipment of spent fuel to a monitored retrievable storage facility or a permanent repository, and (3) shipment of low-level radioactive waste and mixed waste to offsite disposal facilities. FEIS at 6-21.

486. Previously in WASH-1238 and NUREG-75/038, the NRC evaluated the environmental effects of transportation of fuel and waste for LWRs and found the impact to be small. FEIS at 6-21. These documents provided the basis for Table S-4 in 10 C.F.R. § 51.52, which summarizes the environmental impacts of transportation of fuel and waste to and from one LWR of 3000 to 5000 megawatts thermal (MW(t))(1000 to 1500 MW(e)) and provides impacts for normal conditions of transport and accidents in transport for a reference 1100-MW(e) LWR. FEIS at 6-21. Dose to transportation workers during normal transportation operations was estimated to result in a collective dose of 0.04 person-Sv (4 person-rem) per reference reactor year, while combined dose to the public along the route and dose to onlookers were estimated to result in a collective dose of 0.03 person-Sv (3 person-rem) per reference reactor year. FEIS at 6-21. Environmental risks (radiological) during accident conditions were determined to be small, while nonradiological impacts during accident conditions were estimated as one fatal injury in 100 reference reactor years and one nonfatal injury in 10 reference reactor years. FEIS at 6-21. At least one subsequent Staff review of transportation impacts concluded that those impacts were bounded by Table S-4. FEIS at 6-21.

487. Although, pursuant to 10 C.F.R. § 51.52(a), a full description and detailed analysis of transportation impacts is not required when licensing an LWR (and impacts are assumed to be bounded by Table S-4) if an LWR meets certain criteria, the Staff determined that none of SERI's proposed designs met all the relevant criteria. FEIS at 6-21, 6-22. Therefore, SERI was required to provide a full transportation description and detailed analysis for each LWR design. FEIS at 6-22. SERI used a sensitivity analysis in order to show that transportation impacts from advanced LWR designs (as well as gas-cooled designs) would be bounded by the criteria identified in Table S-4. FEIS at 6-23.

488. Consequently, the Staff conducted an independent analysis of the impacts under normal operating and accident conditions of transporting unirradiated fuel to advanced reactor sites and spent fuel and wastes from advanced reactor sites to disposal facilities. FEIS at 6-41. In order to make comparisons to the bounding values in Table S-4, the Staff normalized impacts to a reference reactor year. FEIS at 6-41. The Staff determined that because of the conservative approaches and data (with respect to the Table S-4 values) used to calculate doses, actual environmental effects are not likely to exceed those in the Staff's EIS calculations. FEIS at 6-41.

489. With respect to transport of unirradiated fuel under normal conditions, the Staff relied on sufficiently bounding estimates of factors such as the number of truck shipments, shipping mode and truck weight limits, and it found (using the RADTRAN 5 computer code) that radiological risks and dose estimates to both transport workers and the public were bounded by the conditions in Table S-4 and were very small compared to the fatal cancers, nonfatal cancers, and severe hereditary effects that would be expected to occur annually in the same population from exposure to natural sources of radiation. FEIS at 6-24 to 6-27. The Staff also conducted a scenario-based analysis to develop estimates of incident-free radiation doses to maximally exposed individuals ("MEI") under normal transport conditions, and found that in

each case – including for truck crew members, inspectors, residents, individuals stuck in traffic, and persons at truck service stations – the limits were below the applicable dose thresholds.

FEIS at 6-27 to 6-28.

490. With respect to accidents during the transportation of unirradiated fuel, the Staff found that accident frequencies are expected to be lower than those used in the analysis in WASH-1238 because of improvements in highway safety and security and an expected decrease in traffic accident, injury, and fatality rates. FEIS at 6-28. The Staff also found that there is no significant difference in severe accident consequences between advanced LWRs and current-generation LWRs because the fuel form, cladding, and packaging are similar to those analyzed in WASH-1238. FEIS at 6-28. Therefore, the Staff concluded that the impacts of accidents during transport of unirradiated fuel for advanced LWRs to the Grand Gulf ESP site are expected to be smaller than the impacts listed in Table S-4 for current generation LWRs. FEIS at 6-28.

491. With respect to advanced gas-cooled reactors, the Staff found that transport accident rates and frequencies would be expected to follow the same lower trends as for LWRs, but because the consequences of accidents involving gas-cooled reactor unirradiated fuel are less clear, the Staff found this issue to be unresolved, and noted that it would need to be assessed at the CP or COL stage when specific information is available regarding other-than-LWR fuel performance. FEIS at 6-28, 6-29.

492. The Staff also performed an independent review of the environmental impacts of transporting spent fuel from the proposed new nuclear unit or units at the Grand Gulf ESP site to a spent fuel disposal repository, and it considered an estimate of the impacts of the transportation of spent fuel to a possible repository at Yucca Mountain, Nevada, to be a reasonable bounding estimate. FEIS at 6-29. The Staff calculated the environmental impacts of transportation of spent fuel using the RADTRAN 5 computer code, while routing and

population data used in the RADTRAN 5 for truck shipments were obtained from the TRAGIS routing code. FEIS at 6-30. For both normal and accident conditions, the Staff concluded that the overall transportation accident risks associated with advanced LWR reactor spent fuel shipments are small and are consistent with the risks associated with transportation of spent fuel from current-generation reactors presented in Table S-4 of 10 C.F.R. § 51.52. FEIS at 6-29 to 6-39. For both normal and accident conditions, the Staff found the total detriment estimates from the assessed dose to be very small compared to the fatal cancers, nonfatal cancers, and severe hereditary effects that would be expected to occur annually in the same population from exposure to natural sources of radiation. FEIS at 6-34, 6-38, 6-39. However, it found that the fuel performance characteristics, shipping casks, and accident risks for other-than-LWR designs are not resolved and would need to be assessed at the CP or COL stage. FEIS at 6-30, 6-37, 6-39.

493. Finally, with respect to the transport of radioactive waste, the Staff determined that the estimated normalized number of shipments of radioactive waste per year would be well below the reference LWR (46 shipments per year per 1100 MW(e)), and that the sum of the daily shipments of unirradiated fuel, spent fuel, and radioactive waste would be well below the one truck shipment per day condition given in 10 C.F.R. § 51.52, Table S-4 for all reactor types. FEIS at 6-41. However, the Staff considered impacts from non-LWR designs to not be resolved because of the lack of verifiable information. FEIS at 6-41.

494. Thus, the Staff concluded that the environmental impacts of transportation of fuel and radioactive wastes to and from advanced LWR designs would be SMALL, and would be consistent with the risks from current-generation reactors presented in Table S-4. FEIS at 6-41. However, the Staff found that for gas-cooled designs, while the impacts are likely to be small, it could not resolve the issue because verifiable information is not yet available for the designs. FEIS at 6-41. It therefore found that an applicant would need to provide appropriate

data at the COL stage and the Staff would need to validate the assumptions in its EIS. FEIS at 6-41. These validations concerned fuel and cladding integrity following a traffic accident, as well as the bounding of assumptions about shipping cask design, unirradiated fuel initial core/refueling requirements, spent fuel generation rates, radioactive waste generation rates, and shipping cask capacities and accident source terms. FEIS at 6-42.

f-iii. Decommissioning Impacts

495. Finally, with respect to decommissioning impacts, the Staff noted that applicants at the ESP stage are not required to submit information regarding the process of decommissioning. FEIS at 6-42, 6-43. Environmental impacts from the activities associated with the decommissioning of any LWR before or at the end of an initial or renewed license are evaluated in the *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities, Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors*, NUREG-0586 (“DGEIS”), and if impacts from decommissioning are within the bounds described in NUREG-0586, the Staff expects they will be small. FEIS at 6-42, 6-43. As SERI did not provide data on decommissioning in its application, for whatever design ultimately selected, the Staff concluded that the impacts from decommissioning are not resolved and would have to be assessed at the CP or COL stage. FEIS at 6-42, 6-43.

496. We find that the facts described in Chapter 6 of the Staff’s FEIS include all factors relevant to the environmental impacts from (1) the uranium fuel cycle and solid waste management, (2) transportation of radioactive material, and (3) decommissioning for the proposed Grand Gulf early site permit (ESP) site.

497. Further, we find that the Staff evaluation documented in FEIS Chapter 6, as described above, is based on these facts, and provides reasonable support in logic to support the Staff findings in FEIS Chapter 6.

498. Accordingly, we find that the Staff’s review of these matters was adequate.

g. FEIS Chapter 7, "Cumulative Impacts"

499. As set forth below, in FEIS Chapter 7 the Staff evaluated the potential cumulative impacts of constructing and operating one or more nuclear power units at the proposed Grand Gulf ESP site. FEIS at 7-1.

500. To determine cumulative impacts, the Staff examined the impacts of the proposed action in combination with other past, present, and reasonably foreseeable future actions in the vicinity of the Grand Gulf ESP site that would affect the same resources impacted by the current GGNS. FEIS at 7-1. Pursuant to the definition of "cumulative" established in 40 C.F.R. § 1508.7, the Staff assessed these combined impacts, including consideration of individually minor but collectively significant actions taking place over a period of time. FEIS at 7-1.

501. The Staff reviewed the cumulative impacts associated with land use, including possible additional growth and land conversions to accommodate new workers and services. It expected impacts to be minor, because the construction and operations work forces are predicted to be drawn from a much wider area than Claiborne County alone, including larger nearby cities, such that the impact can be more easily absorbed. FEIS at 7-2. However, because at the ESP stage only limited information was available on transmission line improvements and associated changes in rights-of-way, the Staff considered the issue unresolved. FEIS at 7-2.

502. The Staff reviewed the cumulative impacts associated with air quality, including construction effects, operation emissions, and cooling tower plumes. FEIS at 7-2. The Staff noted the limited duration of construction activities and SERI's mitigation controls, as well as the magnitude and intermittent nature of operational emissions (and their similarity to existing emissions from the GGNS). The Staff also considered it unlikely that the impacts of heat, water vapor, and drift plumes from the new cooling towers merging with current GGNS plumes would

be significantly different from the existing impacts. FEIS at 7-2. The Staff therefore concluded that cumulative air quality impacts would be small.

503. The Staff reviewed the cumulative impacts associated with water use and quality, for both surface water and groundwater. The Staff modeled combined discharges of the present and proposed facilities and assumed steady-state conditions into the future, including future groundwater use based on projected population. FEIS at 7-3.

504. With respect to surface water use, the Staff found that nearby watersheds as well as the Mississippi River are not expected to be altered by site activities, and should remain consistent even with alterations in climate patterns or further demands for upstream water. The Staff found that these cumulative impacts would be small. FEIS at 7-3. However, because of inadequate data on the potential incremental drawdown of the groundwater elevation associated with groundwater wells proposed in the Catahoula formation, the Staff was unable to resolve the impacts of groundwater use, so further information would be necessary at the COL stage. FEIS at 7-3.

505. With respect to surface water quality, the Staff noted that changes outside the site are unlikely to alter the quality of onsite watersheds (because existing watersheds are nearly contained within the proposed site, and external drainage areas are not expected to change), and that the water quality of the Mississippi River is expected to be preserved because of its importance as a national resource. FEIS at 7-3, 7-4. However, the Staff was unable to resolve the impacts on surface water quality, because data on possible chemical discharges from the plant are unavailable at the ESP stage, so further evaluation would be necessary in a COL application. FEIS at 7-4. Similarly, the Staff considered impacts on groundwater quality unresolved because of the range of possible impacts on the Catahoula formation (a sole-source aquifer). FEIS at 7-4.

506. The Staff reviewed the cumulative impacts associated with the terrestrial ecosystem, including the effects on plant and animal species and associated habitats from construction, cooling tower operation, transmission line operation, and right-of-way maintenance. FEIS at 7-4.

507. The Staff analyzed the likely construction impacts and found the potential for displacement of animals and destruction of habitat to be low, given the relatively small amount of land expected to be disturbed. FEIS at 7-4, 7-5. Particularly if transmission lines are contained within existing rights-of-way, the Staff concluded that cumulative losses of species and habitat would be small. FEIS at 7-5. However, the Staff noted that if construction required expansion of these rights-of-way or creation of one or more new rights-of-way, cumulative impacts could be moderate. FEIS at 7-5. The Staff also noted that it identified no other present or future actions in the regions that could significantly affect species or habitats. FEIS at 7-5.

508. Similarly, the Staff found no other past, present, or future actions in the region that would have impacts on wildlife or habitat similar to those from the ESP facility's cooling tower operation or transmission line operation and right-of-way maintenance. FEIS at 7-5. Because the Staff determined those operational impacts to be negligible for the site itself, it concluded that the associated cumulative impact would also be negligible. FEIS at 7-5.

509. Therefore, while the Staff found that the cumulative impacts of operation of the proposed ESP facility would be small, uncertainty about the need for and extent of transmission system improvements led the Staff to determine that the issue of construction impacts is unresolved and that further information would be needed at the COL stage. FEIS at 7-5, 7-6.

510. The Staff reviewed the cumulative impacts associated with the aquatic ecosystem, including impacts from construction, water intake, consumption, and discharge. FEIS at 7-6. The Staff found that the construction of the existing GGNS did not change the Mississippi River significantly and that few changes have affected the river habitat since that



time, and that construction on the proposed ESP facility would have only minimal and temporary impacts on aquatic organisms. FEIS at 7-6. Furthermore, because impingement and entrainment of aquatic organisms during operation of the proposed facility are expected to be minimal based on current intake structure and screen plans, because discharge heat plume size is small compared to the river environment, and because effluent discharge is monitored and regulated by the MDEQ through the NPDES permit program, the Staff concluded that the cumulative impacts on aquatic ecological resources from operations would be small. FEIS at 7-7, 7-8. Consequently, the Staff found that the contribution of the ESP facility to cumulative impacts on aquatic ecological resources would be small. FEIS at 7-8.

511. The Staff reviewed the cumulative impacts associated with socioeconomics, historic and cultural resources, and environmental justice. These include impacts on housing, transportation, tax revenues, and public services. FEIS at 7-8, 7-9. However, because most of the Staff's earlier analysis of these topics already involve metrics that incorporate total and cumulative effects, and because the Staff did not identify any additional cumulative impacts, the Staff concluded that the contribution of the ESP facility to cumulative impacts (both adverse and beneficial) in these areas would still be small or moderate (and potentially large in terms of net beneficial impact from tax revenues in Claiborne County). FEIS at 7-8, 7-9. This conclusion depends primarily on the actual distribution of new workers throughout the region and the extent to which local communities have access to the tax base represented by the new units. FEIS at 7-9.

512. The Staff reviewed the cumulative impacts associated with nonradiological health. Because the Staff found minimal risk from thermophilic microorganisms, low occupational injury rates, and minimal impacts on the public and workers from noise and dust emissions, the Staff concluded that the ESP facility's cumulative impacts on nonradiological

health would be small, though impacts from electromagnetic fields remain unresolved. FEIS at 7-9, 7-10.

513. The Staff reviewed the cumulative impacts associated with radiological impacts of normal operations. Because radiological exposure limits and standards for the protection of the public and for occupational exposures have been developed assuming long-term exposures, and therefore incorporate the cumulative impact, and because the Staff's earlier evaluation determined that the public and occupational doses predicted from the ESP facility operations would be well below regulatory limits and standards, the Staff concluded that the cumulative radiological impacts of operations would be small. FEIS at 7-10.

514. Finally, the Staff reviewed the cumulative impacts associated with fuel cycle, transportation, and decommissioning.

515. In light of the determinations made in its earlier analysis concerning the environmental impacts being no more than four times the impacts identified in Table S-3 (10 C.F.R. § 51.51), the Staff concluded that the cumulative fuel cycle impacts of operating GGNS and the proposed ESP unit(s) for the 1000-MW(e) light-water reactor scaled model to be SMALL. However, the Staff considered unresolved the cumulative impacts for other than light-water reactor designs because of a lack of information. FEIS at 7-10, 7-11.

516. With respect to transportation, the Staff noted that the addition of the proposed ESP facility would result in additional shipments of unirradiated fuel to the site and additional shipments of spent fuel and waste from the site, such that cumulative impacts would be approximately twice that of the existing operating plant. FEIS at 7-11. The Staff determined that because the proposed site values fell within the criteria specified in Table S-4 of 10 C.F.R. § 51.52, the cumulative impacts of transportation of unirradiated fuel, spent fuel, and radioactive waste for both GGNS and the proposed light-water reactor ESP unit(s) would be

SMALL, though cumulative impacts for non-LWR designs again were not considered to be resolved. FEIS at 7-11.

517. Finally, as SERI was not required to (and did not) address decommissioning in its ESP application, this issue is not resolved, although environmental impacts from decommissioning are expected to be small in accordance with the analysis in Supplement 1 to NUREG-0586 (DGEIS). FEIS at 7-11.

518. For the range of impact areas it evaluated, the Staff concluded that potential cumulative impacts from construction and operation are generally SMALL, although it determined that a few areas have the potential for a MODERATE impact and some mitigation measures may be warranted, including habitat restoration and assistance with infrastructure and public services in Claiborne County. FEIS at 7-12. Some issues were considered unresolved because of unavailable information and would have to be addressed by an applicant at the COL stage. FEIS at 7-12.

519. We find that the facts described and referenced in Chapter 7 of the Staff's FEIS include all factors relevant to the cumulative impacts of construction and operation of the proposed Grand Gulf ESP site.

520. Further, we find that the Staff evaluation documented in FEIS Chapter 7, as described above, is based on these facts, and provides reasonable support in logic to support the Staff findings in FEIS Chapter 7.

521. Accordingly, we find that the Staff's review of these matters was adequate.

h. FEIS Chapter 8, "Environmental Impacts of the Alternatives"

522. As set forth below, in FEIS Chapter 8 the Staff evaluated alternatives to the proposed action and the environmental impacts of those alternatives. FEIS at 8-1.

523. As part of a two-step evaluation process, the Staff first examined environmental issues at a reconnaissance level to determine if any alternative sites were environmentally

preferable to the proposed ESP site; second, if any alternative site were to appear environmentally preferable, the Staff would consider various factors to determine if any such site were obviously superior to the proposed site. FEIS at 8-1.

524. As part of its evaluation, the Staff also examined the no-action alternative, alternative energy sources, and plant design alternatives.

i. No-Action Alternative

525. The Staff first reviewed the no-action alternative, which would entail denial of the ESP request. The Staff noted that in that scenario, no impacts from preliminary site work and preparation would occur (although SERI did not submit a site redress plan, so work activities would not have been authorized if the ESP were granted), and, because no construction or operation would occur, the impacts assessed in the FEIS would not occur. FEIS at 8-2. However, the Staff stated that the no-action alternative would also preclude all benefits from the ESP process, including early resolution of siting issues prior to large resource investments in new plant design and construction, and early resolution of issues on the environmental impacts of construction and operation. FEIS at 8-2.

ii. Energy Alternatives

526. The Staff next addressed alternative energy plans, including alternatives not requiring new generating capacity, those relying on new generating capacity, and combinations of such options. In assessing alternatives, the Staff used a target value of 2000 MW(e) for the electrical output of a new nuclear generating facility at the ESP site, which was also the value SERI used in its application. FEIS at 8-3.

527. The Staff considered four alternatives that would not involve new generating capacity. These consisted of purchase of the needed electric power from other suppliers, reactivation of retired power plants, extension of the operating life of existing power plants, and implementation of conservation or demand side management programs.

528. The Staff concluded that conservation or demand side management was not a reasonable alternative to an ESP directed at base load electricity generation, and did not further consider this alternative. FEIS at 8-3.

529. Because of uncertainty concerning factors such as the timing for the construction of a new nuclear generating facility at the Grand Gulf ESP site and whether the plant would be a merchant or a regulated facility, factors which significantly impact the viability of options not involving new generating capacity, the Staff did not evaluate the remaining non-new-generating-capacity alternatives in great detail. FEIS at 8-3, 8-4.

530. With respect to the purchased power alternative, the Staff noted that the environmental impacts of power production would still occur, but would be located elsewhere within the region, nation, or in another country. FEIS at 8-4. The impacts would depend on the generation technology and location of the generation site and, therefore, are unknown. FEIS at 8-4. Finally, depending on whether new transmission lines and rights-of-way are necessary to receive the purchased power, the Staff concluded that the local environmental impacts could range from SMALL to LARGE. FEIS at 8-4.

531. With respect to extension of the life of existing nuclear power plants, the Staff found that although the environmental impacts are significantly less than new construction, continued operation does not provide additional generation capacity. FEIS at 8-5. With respect to refurbishment, the Staff noted that most fossil plants available for refurbishment are older and would require extensive and expensive work to meet environmental standards. FEIS at 8-5.

532. The Staff concluded that these three alternatives are not reasonable alternatives to providing new base load power generation capacity, but noted that it would be unreasonable for an applicant to request a COL if the electrical power sought could be reasonably purchased, or could be obtained through reactivation or extension of existing plants. FEIS at 8-5.

533. The Staff next considered alternatives involving new generating capacity. These consisted only of sources the Staff considered to be technically reasonable and commercially viable for base load power generation, which were limited to coal-fired and natural gas-fired generation. FEIS at 8-5.

534. The Applicant evaluated coal-fired generation in its environmental report, and in its evaluation the Staff assumed construction of four 509 MW(e) coal-fired units at the Grand Gulf ESP site. FEIS at 8-7. The Applicant estimated that the coal-fired plant would consume approximately 6 million MT/yr (6.6 million tons/yr) of pulverized bituminous coal with an ash content of approximately 11.9 percent, and that approximately 223,000 MT (246,000 tons) of lime would be used annually for flue gas desulfurization. FEIS at 8-7.

535. In terms of air quality, the Applicant estimated the coal-fired plant's annual emissions, including those for sulfur oxides (SO<sub>x</sub>) (12,100 MT (13,340 tons)), nitrogen oxides (NO<sub>x</sub>) (11,600 MT (12,800 tons)), carbon monoxide (CO) (1500 MT (1650 tons)), and particulate matter (PM) (350 MT (390 tons)). FEIS at 8-7. A coal-fired plant would also have unregulated carbon dioxide emissions that could contribute to global warming. FEIS at 8-7. The plant would also be subject to emissions caps and would have to obtain pollution credits, certain permits pursuant to the Clean Air Act, and comply with other source performance and visibility standards. FEIS at 8-7, 8-8. The Staff concluded that air quality impacts from coal-fired generation would be MODERATE, noting the analysis in the GEIS (NUREG-1437) that implied substantial air quality impacts and global warming risks from coal-fired plants, as well as the human health effects associated with coal combustion. FEIS at 8-8.

536. In terms of waste management, the Applicant estimated that a 2000 MW(e) coal-fired plant would generate approximately 711,000 MT (784,000 tons) of ash and spent catalyst and an additional 660,000 MT (728,000 tons) of scrubber sludge annually. FEIS at 8-9. The Staff concluded that the impacts from waste generated at a coal-fired plant would be

MODERATE, noting discussion in the GEIS of coal combustion waste products, recent EPA endorsement of regulations to address such products because of health concerns, and the potential land use and groundwater quality impacts of waste disposal. FEIS at 8-9.

537. With respect to human health impacts, the Staff noted that coal-fired power generation introduces risks from mining, transportation, waste, emissions, and in some circumstances radiological doses. FEIS at 8-9. However, the Staff concluded that because of regulatory oversight exercised by the EPA and by State agencies, the human health impacts from radiological doses and inhaled toxins and particulates generated from coal-fired generation would be SMALL. FEIS at 8-9, 8-10.

538. In terms of other environmental impacts, the Applicant stated that a coal-fired plant would require approximately 1085 ha (2680 ac), including approximately 610 ha (1500 ac) to be converted to industrial use for the power block, infrastructure and support facilities, coal and limestone storage and handling, and landfill disposal of ash and scrubber sludge. FEIS at 8-10. Land use changes would also occur offsite in an undetermined coal-mining area to supply coal for the plant. The Staff concluded that the land-use impacts would be MODERATE. FEIS at 8-10. As a result of construction and operations, including coal and limestone mining, construction of a rail spur, and fly ash disposal, the Staff concluded that the ecological impacts could be MODERATE to LARGE. FEIS at 8-10. The Staff found that impacts on water use and quality would be SMALL and comparable to the impacts associated with a new nuclear facility, including the use of cooling water, cooling towers, blowdown, and waste discharge. FEIS at 8-10.

539. The Staff found that socioeconomic impacts from the coal-fired plant would be SMALL to MODERATE, based on the proximity to the surrounding population area and the relatively small number of workers (about 300) needed to operate the plant. FEIS at 8-11. The Staff also concluded that tax revenues would have a LARGE beneficial impact for Claiborne

County. FEIS at 8-11. The Staff also concluded that the visual and aesthetic impacts of a coal-fired generation plant would be MODERATE, based on the presence of power block units and exhaust stacks visible offsite, cooling towers and associated plumes, and mechanical noise audible offsite (particularly rail delivery of fuel), though some of these impacts are intermittent or could be visually mitigated. FEIS at 8-11, 8-12. The Staff found that the historic and cultural resource impacts would be SMALL (in light of the impacts from construction and operation of the existing GGNS), that environmental justice impacts would be LARGE and beneficial (given high property tax revenues), and that other construction and operation impacts would be SMALL. FEIS at 8-12.

540. The Applicant also evaluated natural gas-fired generation in its environmental report. The Staff assumed that the natural gas-fired plant would use combined-cycle combustion turbines and employ four units with a net capacity of 508 MW(e) per unit. FEIS at 8-14.

541. In terms of air quality, the Staff found that compared with a coal-fired plant, a natural gas-fired plant would release similar types of emissions but in lower quantities. FEIS at 8-14. The Applicant estimated that a natural gas-fired plant equipped with appropriate pollution control technology would annually emit approximately 109 MT (120 tons) of SO<sub>x</sub>, 417 MT (460 tons) of NO<sub>x</sub>, 553 MT (610 tons) of CO, and 63 MT (70 tons) of PM<sub>10</sub> (particulate matter having an aerodynamic diameter less than or equal to 10 µm). FEIS at 8-15. The plant would also have to obtain certain permits pursuant to the Clean Air Act, and comply with other stationary source and visibility standards. FEIS at 8-14. The Staff concluded that air quality impacts from new natural gas-fired power generation at the ESP site would be SMALL to MODERATE. FEIS at 8-15.

542. With respect to waste management, the Staff noted the finding in the GEIS that waste generation from natural gas is minimal; the Staff thus concluded that waste impacts from



natural gas-fired power generation would be SMALL. FEIS at 8-15. With respect to human health risks, while the Staff noted its finding in the GEIS analysis that cancer and emphysema are potential health risks from natural gas-fired plants, it noted MDEQ regulation of the ESP site and concluded that the impacts would be SMALL. FEIS at 8-15, 8-16.

543. In terms of other environmental impacts, the Applicant estimated that a natural gas plant would need approximately 91 ha (225 ac), including the power block and support facilities, cooling towers and support systems, and a natural gas pipeline. FEIS at 8-16. For any new natural gas-fired power plant, additional land would be necessary for natural gas wells and collection stations. FEIS at 8-16. In light of this relatively small land disturbance, the Staff concluded that land-use impacts from new natural gas-fired power generation would be SMALL, and ecological impacts would be SMALL to MODERATE. FEIS at 8-16. Based on the analysis in the GEIS, the Staff concluded that impacts on water use and quality would be SMALL. FEIS at 8-16.

544. With respect to socioeconomic impacts, the Staff concluded that based on the proximity to the surrounding population area and the relatively small number of workers (150) needed to construct and operate the plant in comparison to nuclear and coal-fired generation, the impacts would be SMALL. FEIS at 8-16, 8-17. The Staff concluded that the tax revenues would have a MODERATE beneficial impact on Claiborne County.

545. Although the turbine buildings, exhaust stacks (and emissions), cooling towers and associated plumes, and gas pipeline compressors would be visible offsite, and some noise would be audible offsite, the Staff concluded that the visual and aesthetic impacts of a natural gas-fired generation plant would be SMALL. FEIS at 8-17. Some of these impacts are mitigated by the industrial and rural location and relatively smaller land use. FEIS at 8-17. The Staff found that the historic and cultural resource impacts would be SMALL (in light of the existing GGNS), that environmental justice impacts would be MODERATE and beneficial (given

moderate property tax revenues), and that other construction and operation impacts would be SMALL. FEIS at 8-17.

546. SERI's application also identified other energy alternatives. However, as new nuclear units at the ESP site would constitute a base load generation plant, and the Applicant determined that these alternatives either could not generate base load power or could not do so economically, it concluded that these alternatives were not reasonable. FEIS at 8-19. These alternatives included oil-fired generation, wind, solar, hydroelectric, geothermal, wood waste, municipal solid waste, biomass-derived fuels, and fuel cells. FEIS at 8-19 to 8-22. Based on its independent review (including, for some issues, reliance on the analysis in the GEIS), the Staff determined that SERI's conclusion – that these alternatives are not reasonable – is acceptable. FEIS at 8-19.

547. The Staff concluded that oil-fired generation has become more expensive than nuclear or coal-fired generation options and is likely to become even less economical in the future, particularly as a base load plant. FEIS at 8-19. The Staff found that Mississippi does not have sufficient wind resources to use large-scale wind turbines and that wind turbines typically do not operate at a capacity factor comparable to a base load plant, making it an uneconomical alternative. FEIS at 8-19, 8-20. With respect to solar power, the Staff found that it would be uneconomical because of solar power's higher capital cost per kilowatt of capacity, high energy storage requirements (limiting its use as a base load supply), and high land use. FEIS at 8-20.

548. Similarly, because of the relatively low amount of undeveloped hydropower resources in Mississippi and the large land-use and related environmental and ecological resource impacts (flooding, destruction of natural habitat, and alteration of natural river courses) associated with siting hydroelectric facilities large enough to produce 2000 MW(e), the Staff concluded that local hydropower was not a feasible alternative. FEIS at 8-20, 8-21. Although geothermal energy has an average capacity factor of 90 percent and can be used for base load

power where available, the Staff found that no feasible eastern location for geothermal capacity can serve as an alternative to a base load nuclear power plant, making it an unreasonable alternative to the proposed ESP site. FEIS at 8-21.

549. Because of uncertainties associated with obtaining sufficient wood and wood waste to fuel a base load power plant (larger wood-waste power plants are only 40 to 50 MW(e) in size), the ecological impacts of large-scale timber cutting (for example, soil erosion and loss of wildlife habitat), and high inefficiency, the Staff concluded determined that wood waste is not a feasible alternative. FEIS at 8-21. Similarly, with respect to use of municipal solid waste, only about 89 waste-to-energy plants are operating in the United States, with an average output of approximately 28 MW(e) per plant; the Staff concluded that this would not constitute a feasible base load alternative to the proposed ESP site. FEIS at 8-22.

550. With respect to other biomass-derived fuels, including burning crops, converting crops to a liquid fuel such as ethanol, and gasifying crops (including wood waste), the Staff concluded, based on the analysis in the GEIS, that none of these technologies has progressed to the point of being competitive on a large scale or of being reliable enough to replace a large base load plant, and thus they do not represent reasonable alternatives. FEIS at 8-22. Finally, with respect to fuel cells, although significant efforts have been made to develop more practical and affordable fuel cell designs for stationary power applications, the Staff concluded that fuel cells currently are not economically or technologically competitive with other alternatives for base load electricity generation, and their future competitiveness compared to other fuels is speculative. FEIS at 8-22, 8-23. The Staff therefore concluded that fuel cells are not a reasonable alternative to the proposed ESP site. FEIS at 8-23.

551. The Staff also considered the possibility that some combination of alternatives might be more economical than the construction of a new base load plant at the proposed ESP site. Of the many possible combinations, the Staff evaluated the environmental impacts of an

assumed combination of three 508 MW(e) natural gas combined-cycle generating units at the Grand Gulf ESP site using closed-cycle cooling with cooling towers, 30 MW of wind energy, 30 MW of hydropower, 90 MW from biomass sources including municipal solid waste, and 326 MW from conservation and demand-side management programs. FEIS at 8-23, 8-24. However, after comparing the environmental impacts with those assessed for the proposed plant at the ESP site, the Staff concluded that, from an environmental perspective, none of the viable energy alternatives were clearly preferable to construction of a new base load nuclear power generation plant. FEIS at 8-24 to 8-26.

iii. Plant Design Alternatives

552. The Staff next addressed plant design alternatives. In its environmental report, SERI described the process behind its decision to propose natural or mechanical draft cooling towers or both with a makeup water intake in the Mississippi River and a blowdown discharge outfall downstream of the intake. FEIS at 8-24.

553. SERI considered seven heat-dissipation alternatives in its environmental report, including once-through cooling, wet mechanical draft cooling towers, wet natural draft cooling towers, wet-dry cooling towers, dry cooling towers, a cooling pond, and spray canals. FEIS at 8-26, 8-27. After ruling out other options for various reasons, SERI only included wet natural draft and wet mechanical draft cooling towers in its PPE. FEIS at 8-27. Based on its independent review – including a determination that the Mississippi River is not suited for once-through cooling, that land limitations make the site unsuitable for cooling pond or spray canal heat-dissipation designs, and that dry cooling technology has some detrimental effects on electricity production by reducing the energy efficiency of steam turbines – the Staff agreed that the other options were not suitable and concluded that wet mechanical draft cooling towers and wet natural draft cooling towers are suitable for the site. FEIS at 8-27, 8-28. However, system

design alternatives would be discussed at the CP or COL stage, because a specific cooling system design for the Grand Gulf ESP site has not been selected. FEIS at 8-28, 8-29.

554. For its intake system, SERI proposed to withdraw makeup water for the heat-dissipation system and the circulating water system directly from the Mississippi River through a shoreline embayment and intake constructed on the bank of the river. FEIS at 8-29. SERI considered two alternative types of water intake – either a direct intake from the river with a structure located on the riverbed and a pipeline connecting it to the bank, or a channel directing water to the intake structure on the shoreline – and the Staff found no basis to suggest that these alternatives would be environmentally preferable to SERI's proposed intake system. FEIS at 8-29.

555. For its discharge system, SERI stated that the thermal effluent from a new facility would also be released to the river through a new outfall structure that would be located downstream of the existing outfall. FEIS at 8-30. The Staff evaluated a shoreline diffuser outfall and a submerged single-point discharge, but it found no basis to suggest that the two discharge alternatives would be environmentally preferable to SERI's proposed discharge system. FEIS at 8-30.

556. In terms of water supply, the Staff did not identify any other water supply environmentally preferable to the Mississippi River and wells in the alluvial aquifer. FEIS at 8-30. Finally, with respect to water treatment, the Staff noted that although the water treatment requirements and water system effluents are not known, all chemical and thermal discharges would be regulated by the MDEQ through the NPDES process. FEIS at 8-30.

#### iv. Region of Interest and Alternative Site Selection Process

557. The Staff next examined Entergy's region of interest ("ROI") for possible siting of a new nuclear power plant, as well as its alternative site selection process. (Entergy Nuclear, a

division of Entergy Corporation, conducted the alternative site selection process for the Grand Gulf ESP application). FEIS at 8-31.

558. Entergy Nuclear selected its ROI for examining potential ESP sites as the locations of the seven existing Entergy sites with operating nuclear power plants licensed by the NRC at the time of its application for an ESP: Arkansas Nuclear One, Grand Gulf Nuclear Station, James A. FitzPatrick Nuclear Power Plant, Indian Point Energy Center, Pilgrim Nuclear Station, River Bend Station, and Waterford-3. FEIS at 8-31. The application explained that these sites were identified for several reasons. For example, NRC has approved the sites for nuclear plant construction and operation, site characterization data have been collected and are available, the operational impact of the existing nuclear plants is documented, and the sites and related facilities are controlled by Entergy. FEIS at 8-32. The Staff concluded that the criteria used to identify the ROI were reasonable for consideration and analysis of potential ESP sites. FEIS at 8-32.

559. The application next explained how Entergy Nuclear further screened its site list. It first removed Indian Point due to greater population density in the site vicinity. FEIS at 8-33. It then ranked the remaining sites with respect to 11 weighted screening criteria, including pricing, seismic evaluation, water availability, exclusion area, and spent fuel storage. FEIS at 8-33, 8-34. In the interest of regional and market diversity and to gain ESP experience in different environments, Entergy removed Waterford and Arkansas-One (its 4<sup>th</sup> and 5<sup>th</sup> ranked sites), but retained Pilgrim for further evaluation, along with Grand Gulf, River Bend, and FitzPatrick, its top three sites. FEIS at 8-33. The Staff concluded this was a reasonable basis for narrowing the sites for examination. FEIS at 8-34.

560. To narrow its site selection to a final site, Entergy Nuclear ranked the sites using a final set of 34 weighted screening criteria, including flooding, accident effects, radionuclide pathways, socioeconomics, highway and rail access, and labor rates. FEIS at 8-35 to 8-37.

This resulted in an ordered ranking of Grand Gulf, FitzPatrick, River Bend, and Pilgrim. The Staff concluded that the overall site selection process for alternative sites was reasonable and that the identification of the Grand Gulf ESP site was consistent with that approach. FEIS at 8-37.

v. Evaluation of Alternative Sites

561. The Applicant examined the River Bend, Pilgrim, and FitzPatrick alternative sites in detail. The Staff conducted its own independent examination, including visiting each of the three alternative sites as well as the proposed Grand Gulf ESP site to collect additional reconnaissance-level information. FEIS at 8-37, 8-38.

v-a. River Bend Site

562. The Staff began its analysis with the River Bend site. Located on over 1200 ha (3000 ac) along the east bank of the Mississippi River, about 6 km (4 mi) south of the town of St. Francisville, Louisiana, the site is similar in many respects to the Grand Gulf site. The Staff concluded that because of adequate area within the site boundary, the largely rural vicinity, and overlap with an existing nuclear unit, the land-use impacts on the site and vicinity of construction and operation are expected to be SMALL. FEIS at 8-38.

563. The Staff concluded that, because none of the River Bend transmission line rights-of-way cross any known protected land designations or special land uses, and because the physical and ecological impacts would be similar to those identified at Grand Gulf, the land-use impacts of transmission system construction and continued operation would be SMALL. FEIS at 8-38, 8-39.

564. With respect to water use, the Staff noted that the River Bend is sited adjacent to the Mississippi River downstream from the Grand Gulf ESP site, and that therefore construction activities would have similar impacts and water consumption would represent a similarly small fraction of the river's water supply. Likewise, the Staff found small impacts to water quality

because thermal and chemical discharge would be state-regulated via the NPDES process, and because discharge represents a small fraction of the river flow. The Staff concluded that impacts on water use and quality at the River Bend site would be SMALL. FEIS at 8-39.

565. For impacts on terrestrial resources, the Applicant estimated that the construction of a new generating facility would disturb approximately 160 ha (395 ac), similar to the area likely to be disturbed at the Grand Gulf ESP site, and would likely remove the three primary vegetation types (upland forests, bottomland hardwoods, and meadows and pastures) in similar proportions as did construction of the existing units at the River Bend site. FEIS at 8-39, 8-40. That would result in a moderate loss of forest habitat. FEIS at 8-40. The Staff assumed that other construction impacts typical of large projects, such as erosion and dust, could be mitigated by standard industrial and best management practices. FEIS at 8-40. The Staff also noted that if transmission line rights-of-way would need to be expanded, it could result in additional loss of forest habitat. FEIS at 8-40. Consequently, the Staff concluded that the impacts on terrestrial ecological resources from construction of a new generating facility at the River Bend site and construction associated with possible expansion of the existing River Bend transmission line rights-of-way would be MODERATE. FEIS at 8-40.

566. The Staff also found that the only Federally listed threatened or endangered terrestrial species in the site area was unlikely to be affected by construction of a new facility, and that critical habitat would not be impacted by expansion of the existing transmission line rights-of-way. FEIS at 8-40, 8-41. However, the Staff determined that three state-listed animal species and thirteen plant species could be adversely affected based on their proximity to the site. FEIS at 8-42, 8-43. Therefore, the Staff concluded that the impacts on threatened and endangered species from construction of a new generating facility on the River Bend site and possible expansion of the existing transmission line rights-of-way could range from SMALL to MODERATE. FEIS at 8-43.



567. Concerning operational impacts, the Staff found negligible impacts from cooling tower drift, bird collisions with cooling towers and transmission lines, and transmission line right-of-way maintenance (per the GEIS evaluation), minimal impact from cooling tower noise given the likely noise thresholds, and minimal impact to shoreline habitat in light of the small water quantities withdrawn relative to Mississippi River flows. FEIS at 8-43 to 8-45. The Staff concluded that the impacts of operation of one or more nuclear units at the River Bend site on terrestrial resources and threatened and endangered species would be SMALL. FEIS at 8-45.

568. Concerning impacts on aquatic resources, the Staff found that, given River Bend's use of a closed-cycle cooling system, and because the intake and discharge systems for the existing River Bend Station could be upgraded and used for operation of a new facility with small construction impacts, effects such as erosion and sedimentation could be mitigated using standard industrial procedures and best management practices. FEIS at 8-45. Similarly, by use of closed-cycle cooling, incremental impacts from entrainment, impingement, and heat shock on aquatic resources would be negligible, and additional thermal discharge would remain small as a percentage of the river's flow. FEIS at 8-45. The Staff concluded that the overall impacts on aquatic resources from construction and operation of one or more new nuclear units and associated cooling towers at the River Bend site would be SMALL. FEIS at 8-45. Also, because none of the Federally or state-listed species in the site vicinity have been found recently on the River Bend site, the Staff concluded that the overall impacts on threatened and endangered aquatic species at the River Bend site would be SMALL. FEIS at 8-46, 8-47.

569. The Staff also examined potential socioeconomic impacts. First, after taking account of planned road work, the fact that most construction work would occur on-site, that offsite areas supporting construction would experience only incremental impacts, that noise from plant operation would be controlled in accordance with standard noise protection and abatement procedures, and that required air quality permits and limitations on chemical use

would limit odors, the Staff concluded that the physical impacts of construction and operation would be SMALL. FEIS at 8-47, 8-48.

570. Second, given that the estimated population within an 80-km (50-mi) radius of the River Bend site is approximately 907,000, that most (approximately 70 percent) of the construction workforce is expected to come from within the region, that the portion of the station operation workforce (as well as family members) expected to relocate into the region is only about 2000 during construction and a smaller, unspecified number during operations, the Staff concluded that the demographic impacts from construction and operation near the River Bend site would be SMALL. FEIS at 8-48. Similarly, as River Bend is located in one of the stronger economic areas in Louisiana, with a diverse regional economy, the Staff found that economic impacts of the new facility would be minor everywhere in the region except West Feliciana Parish, where the impact could be beneficial and significant. FEIS at 8-49. Likewise, because of Louisiana's tax structure and revenues, the Staff concluded that the overall impacts from construction and operation on taxes would be barely noticeable, with the exception of West Feliciana Parish, where the impacts of the property taxes collected would be significant and beneficial. FEIS at 8-50, 8-51. Consequently, the Staff determined that the overall social and economic impacts at the River Bend site would range from LARGE beneficial to SMALL beneficial in the parishes near the site. FEIS at 8-51.

571. In terms of local infrastructure, the Staff found that the impacts of a construction workforce and related transportation of construction supplies and materials on the transportation infrastructure at the River Bend site would be noticeable (and temporary), particularly for portions of U.S. Highway 61. FEIS at 8-51, 8-52. It noted that some roads could have their level of service degraded, while other roads may need improvement to carry heavy loads of construction materials to the River Bend site. FEIS at 8-52. As the site is industrial

and isolated by the size and wooded nature of the site, the Staff found no noticeable impacts on recreation or aesthetics would result from a new facility. FEIS at 8-52, 8-53.

572. The Staff concluded that impacts on housing and public services from construction and operation of one or more new nuclear units at the River Bend site would be SMALL to MODERATE adverse, based on existing construction and upgrade plans for housing and water; existing capabilities of police, fire, and medical services, as well as of the local education system; projected economic benefits for the disadvantaged, and the proximity of the River Bend site to the larger Baton Rouge metropolitan area. FEIS at 8-53 to 8-55.

573. Based on information gathered in connection with the construction of the existing River Bend unit, as well as on protective measures (including notification and consultation) that would be implemented if historic and/or cultural resources were discovered during construction or during operations, the Staff concluded that the impacts on historic and cultural resources at the River Bend site would be SMALL. FEIS at 8-56. Similarly, in the Staff's environmental justice analysis, although slightly over half of the population of West Feliciana Parish is African-American and about 20 percent of the population live below the Federal poverty level, the Staff did not identify any adverse and disproportionate impacts on these minority and low-income populations. FEIS at 8-56, 8-57.

v-b. Pilgrim Site

574. The Staff next evaluated the alternative of the Pilgrim Nuclear Power Station site. The Pilgrim site is located on 647 ha (1600 ac) along the coast of Cape Cod, about 10 km (6 mi) east southeast of the central business district in the town of Plymouth, Massachusetts. FEIS at 8-57. The Staff found that the area around the site and the vicinity has become increasingly urbanized since construction of the existing facility, but that no land would be preempted for additional facilities because the ESP site would use a portion of the existing Pilgrim site. FEIS at 8-57. The Staff determined that while the types of impacts are likely to be

similar to those expected at Grand Gulf, Pilgrim is also subject to the Coastal Zone Management Act of 1972 ("CZMA") because it is located in the coastal zone of Cape Cod. FEIS at 8-57. Nevertheless, the Staff assumed that SERI would comply with all provisions of the CZMA as implemented in the Cape Cod region, and the Staff concluded that the land-use impacts on the site and vicinity of construction and operations would be SMALL. FEIS at 8-57.

575. The Staff found that because of zoning regulations and higher population density near Pilgrim relative to the Grand Gulf ESP site, the land-use impacts of transmission system construction associated with a new ESP facility could range from SMALL to MODERATE, but that for transmission system operations, impacts still would be SMALL. FEIS at 8-58.

576. With respect to water use, the Staff noted that, given Pilgrim's location on Cape Cod Bay, consumptive use would be small relative to the ocean supply. FEIS at 8-58. Furthermore, despite concerns that Pilgrim's entrainment level could increase with a new facility, and though intake and discharge rates would be higher than at Grand Gulf due to the salt water environment, the Staff concluded that the impacts on surface-water use and water supply at the Pilgrim site would be SMALL given the water supply available. FEIS at 8-58. Likewise, the Staff found small impacts to water quality because thermal and chemical discharge would be state-regulated via the NPDES process, and because the discharge represents a small fraction of the ocean water supply. The Staff concluded that impacts on water quality at the Pilgrim site would be SMALL. FEIS at 8-58, 8-59.

577. For impacts on terrestrial resources, the Applicant noted that because a new facility would be located on the western portion of the Pilgrim site, it would primarily affect oak and pine forest habitat, rather than small ponds and artificial wetlands. FEIS at 8-59. Consequently, the Staff found that impacts on habitat would be minor. FEIS at 8-59. The Staff assumed that other construction impacts typical of large projects, such as erosion and dust, could be mitigated by standard industrial and best management practices. FEIS at 8-59.

Although transmission line right-of-way expansion is likely to be necessary, the single transmission line at Pilgrim is relatively short, so the terrestrial ecological impacts associated with any expansion would be expected to be small. FEIS at 8-59. The Staff therefore concluded that all impacts on terrestrial ecological resources from construction of a new Pilgrim facility (and right-of-way expansion) would be SMALL. FEIS at 8-59, 8-60.

578. However, the Staff noted that a number of Federally and state-listed species are found in the vicinity of the Pilgrim site, and that while the majority are found between the 2 and 10 mile radii, at least two (the Plymouth redbelly turtle and the adder's-tongue fern) are known to occur within the 2-mile radius. FEIS at 8-60 to 8-64. The Staff found that Plymouth redbelly turtle critical habitat, and the State-listed species, could be affected by construction or by expansion of the transmission line right-of-way. FEIS at 8-60 to 8-64. Based on potential impacts on the Federally listed redbelly turtle and potential impacts on many of the State-listed species, the Staff concluded that impacts on threatened and endangered species from a new facility on the Pilgrim site would be MODERATE to LARGE. FEIS at 8-64.

579. In terms of operational impacts on terrestrial resources, the Staff found negligible impacts from bird collisions with cooling towers (per the GEIS evaluation), and minimal impact from cooling tower noise given the likely noise thresholds (and the large expanses of open habitat into which mobile wildlife species could move if disturbed). FEIS at 8-65. While the Staff also found impacts from transmission line right-of-way maintenance to be generally minimal (again in light of the GEIS analysis), it found potential long-term impact on redbelly turtle habitat. FEIS at 8-66. Moreover, because of the uncertainty surrounding cooling towers that use salt water, the Staff conservatively concluded that there could be damage to offsite vegetation resulting from salt drift from operation of cooling towers for new Pilgrim units. FEIS at 8-65. Thus, combined with the potential impact on redbelly turtle habitat from transmission line right-of-way maintenance, the Staff concluded that the impacts of operation of one or more

nuclear units at the Pilgrim site on terrestrial resources and threatened and endangered species would be SMALL to MODERATE. FEIS at 8-66.

580. With respect to impact on aquatic resources, the Staff found that the existing intake structure would be sufficient for new ESP units and that discharge to Cape Cod Bay would not increase substantially. FEIS at 8-66. However, although the Staff concluded that the overall impacts at the Pilgrim ESP site from construction would be SMALL, it found that the overall impacts from operation and associated cooling towers, because of identified potential for increased entrainment of winter flounder larvae, would be SMALL to MODERATE. FEIS at 8-67. Finally, having found no incidents, impingement, or entrainment involving threatened or endangered aquatic species at the Pilgrim site, the Staff concluded that the overall impacts of a new facility on such species would be SMALL. FEIS at 8-68.

581. The Staff also examined potential socioeconomic impacts at Pilgrim. First, the Staff noted that some minor road repairs and upgrades might be necessary, that all construction activities would occur on-site, that offsite areas supporting construction are expected to be already operational and would experience only minor incremental impacts, that noise from plant operation would be controlled in accordance with standard noise protection and abatement procedures (including proper road conditions), and that required air quality permits and limitations on chemical use would limit odors. FEIS at 8-68 to 8-70. However, the Staff also noted some visual intrusion would result because cooling towers would be proposed for new units, and no towers are present at the current unit. FEIS at 8-69. Therefore, the Staff concluded that the physical impacts of construction and operation would be SMALL to MODERATE. FEIS at 8-70.

582. Second, given that the estimated population within an 80-km (50-mi) radius of the Pilgrim site is more than six million (3.5 million in the five counties nearest the site), that the majority (approximately 75 percent) of the construction workforce is expected to come from

within the region, that the portion of the station operation workforce (as well as family members) expected to relocate into the region is only about 2000 during construction and a smaller, unspecified number during operations, the Staff concluded that the demographic impacts from construction and operation near the Pilgrim site would be SMALL. FEIS at 8-70.

583. However, because Pilgrim is located in an area of Massachusetts heavily dependent on tourism (such that local leaders consider construction of a new facility at Pilgrim incompatible with their development plans), and an area where housing and growth control are already concerns, the Staff found that while economic impacts of the new facility would be minor for most of the region, they could be MODERATE adverse in Plymouth County, depending on how certain sectors of the economy are affected. FEIS at 8-70, 8-71. Likewise, the Staff noted that while the impacts of the property taxes collected would be significant and beneficial primarily to the town of Plymouth, some local officials believe this could be partially offset by negative effects on tourism. FEIS at 8-72. Consequently, the Staff determined that the overall social and economic impacts at the Pilgrim site would range from MODERATE adverse to MODERATE beneficial. FEIS at 8-72.

584. In terms of local infrastructure, the Staff found that the impacts of a construction workforce and related transportation of construction supplies and materials on the transportation infrastructure at the Pilgrim site would be noticeable, particularly for Power House Road and Massachusetts Highway 3A. FEIS at 8-73. It noted that these roads would experience a significant degradation of their level of service, and there are no current plans to upgrade either one. FEIS at 8-73. Although the existing site has a clearly established industrial nature and is not visually obtrusive, the Staff concluded that new cooling towers would be visually obvious from several vantage points and visual plumes would have some negative aesthetic impact. FEIS at 8-73, 8-74. The Staff concluded that as long as any new

transmission lines are confined to existing rights-of-way, the aesthetic effects of new transmission lines are not likely to be significant. FEIS at 8-74.

585. The Staff concluded that impacts on infrastructure and community services from construction and operation of one or more new nuclear units at the Pilgrim site would be MODERATE adverse, despite existing adequate capabilities of police, fire, and medical services; the projected economic benefits for the disadvantaged; and the proximity of the Pilgrim site to the Boston metropolitan area. FEIS at 8-73 to 8-76. Some of the nearest local access roads would become overcrowded and might be degraded by heavy traffic during construction, while current conditions of limited housing might also worsen during the construction period. FEIS at 8-73 to 8-76.

586. Based on previous archaeological surveys, as well as on protective measures that would be implemented if historic and/or cultural resources were discovered during construction or during operations, the Staff concluded that the impacts on historic and cultural resources at the Pilgrim site would be SMALL. FEIS at 8-76. Similarly, in the Staff's environmental justice analysis, while Plymouth County has a minority population of approximately 12 percent, and a few low income block groups in the area were identified, the Staff did not identify any adverse and disproportionate impacts on these minority and low-income populations. FEIS at 8-77.

\_\_\_\_\_ v-c. FitzPatrick Site

587. As a third alternative, the Staff evaluated the FitzPatrick Nuclear Power Plant site. The FitzPatrick site is located on 360 ha (900 ac) along the shore of Lake Ontario, about 11 km (7 mi) east-northeast of Oswego, New York. FEIS at 8-77. The area around the site and the vicinity is known as Nine Mile Point and is shared with the Nine Mile Point Nuclear Station. FEIS at 8-77. The Staff found that no land would be preempted for additional facilities because the ESP site would use a portion of the existing FitzPatrick site. FEIS at 8-78. The



Staff determined that while the types of impacts are likely to be similar to those expected at Grand Gulf, FitzPatrick is also subject to the Coastal Zone Management Act of 1972 because it is located in the coastal zone of Lake Ontario. FEIS at 8-78. Nevertheless, the Staff assumed that SERI would comply with all provisions of the CZMA as implemented in the Lake Ontario region, and the Staff concluded that the land-use impacts on the site and vicinity of construction and operations would be SMALL. FEIS at 8-78.

588. The Staff found that because of higher population density along the FitzPatrick transmission line right-of-way relative to that for the Grand Gulf ESP site, the land-use impacts of transmission system construction associated with a new ESP facility could range from SMALL to MODERATE (given the higher likelihood of conflicting uses), but that for transmission system operations, impacts still would be SMALL. FEIS at 8-78.

589. With respect to water use, the Staff noted that, because of FitzPatrick's location on Lake Ontario, consumptive use from construction activities and from cooling tower use during operations would be small relative to the lake capacity. FEIS at 8-79. Likewise, the Staff found small impacts to water quality because thermal and chemical discharge would be state-regulated via a State Pollutant Discharge Elimination System permit, and because the additional heat and discharge would represent a small fraction of the lake water volume. The Staff concluded that impacts on water quality at the FitzPatrick site would be SMALL. FEIS at 8-79.

590. For impacts on terrestrial resources, the Applicant noted that because a new generating facility at FitzPatrick likely would be located in the northeast quarter or southern half of the site, forests and old fields would be affected, as well as wetlands because of their relatively uniform distribution across those areas of the site. FEIS at 8-80. Consequently, the Staff noted that habitat impacts from construction of a new generating facility on the site would be expected to be substantial. FEIS at 8-80. The Staff assumed that other construction

impacts typical of large projects, such as erosion and dust, could be mitigated by standard industrial and best management practices. FEIS at 8-80. As transmission line right-of-way expansion is likely to be necessary, and the area along FitzPatrick's single transmission line right-of-way covers considerable forest, cropland, and also some wetland areas, the terrestrial ecological impacts associated with any expansion would be expected to be significant, including the loss of potentially 252 ha (622 ac) of forest habitat. FEIS at 8-80. The Staff therefore concluded that all impacts on terrestrial ecological resources from construction of a new FitzPatrick facility (and right-of-way expansion) would be MODERATE to LARGE. FEIS at 8-80.

591. The Staff found no Federally listed animal or plant species in the vicinity of the FitzPatrick site. FEIS at 8-80. While the Staff noted several state-listed animal and plant species that may occur between the 2 and 10 mile radii, and determined that some species could potentially be affected by construction of the new facility and expansion of the transmission line right-of-way, the Staff concluded that the overall impacts on threatened and endangered species from construction of a new generating facility on the FitzPatrick site and possible expansion of the existing transmission line right-of-way would be SMALL. FEIS at 8-80 to 8-83.

592. In terms of operational impacts on terrestrial resources, the Staff found mostly negligible impacts from cooling tower drift and bird collisions (per the GEIS evaluation), and minimal impact from cooling tower noise given the likely noise thresholds (and the large expanses of open habitat into which mobile wildlife species could move if disturbed). FEIS at 8-83. As the Staff also found impacts from transmission line right-of-way maintenance to be generally minimal (again in light of the GEIS analysis), the Staff concluded that the impacts of operation of one or more nuclear units at the FitzPatrick site on terrestrial resources and threatened and endangered species would be SMALL. FEIS at 8-83, 8-84.

593. With respect to impact on aquatic resources, the Staff found that the existing intake structure would be sufficient for the cooling towers of new ESP units and that discharge flow to Lake Ontario would not increase substantially. FEIS at 8-84. After also taking into account the effects of the existing acoustic deterrent system, the Staff did not expect impingement, entrainment, or heat shock from the current system to increase substantially for the operation of new units. FEIS at 8-84. Finally, having found no Federally-listed aquatic species in the FitzPatrick site vicinity and no evidence of state-listed aquatic species in the ongoing area monitoring studies, the Staff concluded that the overall impacts of a new facility on aquatic ecological resources as well as threatened or endangered species would be SMALL. FEIS at 8-84 to 8-86.

594. The Staff also examined potential socioeconomic impacts at FitzPatrick. First, the Staff noted that new roads are being built and extensive work is planned for existing roads, that all construction activities would occur on-site, that offsite areas supporting construction are expected to be already operational and would experience only minor incremental impacts, that noise from plant operation would be controlled in accordance with standard noise protection and abatement procedures (including proper road conditions), and that required air quality permits and limitations on chemical use would limit odors. FEIS at 8-86, 8-87. Therefore, the Staff concluded that the physical impacts of construction and operation on socioeconomics would be SMALL. FEIS at 8-87.

595. Second, given that the estimated population within an 80-km (50-mi) radius of the FitzPatrick site is approximately 943,000 (122,000 in Oswego County), that the majority (approximately 70 percent) of the construction workforce is expected to come from within the region, and that the portion of the station operation workforce expected to relocate into the region is small compared to the regional base population, the Staff concluded that the

demographic impacts from construction and operation near the FitzPatrick site would be SMALL. FEIS at 8-87, 8-88.

596. Similarly, the Staff noted that FitzPatrick is located in an area of New York with an economy that is mature, diverse, and undergoing reinvention, and that local development leaders consider a new FitzPatrick facility to be compatible with development plans. FEIS at 8-88. The Staff found that while economic impacts of the new facility would be minor with respect to most of the economic bases of the region, they would likely be positive and noticeable in Oswego County. FEIS at 8-88. Likewise, the Staff noted that the impacts of the property taxes collected would be significant and beneficial primarily to Oswego County, the town of Scriba, and the Mexico School District, but not noticeable throughout the rest of the region in the context of total tax revenues. FEIS at 8-89. Consequently, the Staff determined that the overall social and economic impacts at the FitzPatrick site would range from MODERATE beneficial to SMALL beneficial. FEIS at 8-90.

597. In terms of local infrastructure, the Staff found that the impacts of a construction workforce and related transportation of construction supplies and materials on the transportation infrastructure would likely affect portions of County Road 1, County Road 1a, and New York State Route 104, particularly during shift changes. FEIS at 8-91. The Staff noted that some local roads could have their level of service degraded during construction, and some might need additional repair. FEIS at 8-91. FitzPatrick's established status as an industrial site, and the already-existing cooling towers at the nearby Nine Mile Point site, led the Staff to conclude there would be insignificant impacts on recreation or aesthetics at FitzPatrick as long as transmission lines are confined to existing rights-of-way. FEIS at 8-91.

598. The Staff concluded that impacts on housing and public services from construction and operation of one or more new nuclear units at the FitzPatrick site would be SMALL, based on the present soft housing market, substantial excess water capacity; existing

capabilities of police, fire, and medical services, as well as of the local education system; projected economic benefits for the disadvantaged, and the proximity of the FitzPatrick site to the larger Syracuse metropolitan area. FEIS at 8-92 to 8-94. Taking into account the potential impact of construction on transportation, the Staff concluded that overall impacts on infrastructure and community services from construction and operation at the FitzPatrick site would be SMALL to MODERATE. FEIS at 8-94.

599. Based on previous investigations, as well as on protective measures (including notification and consultation) that would be implemented if historic and/or archaeological resources were discovered during construction or during operations, the Staff concluded that the impacts on historic and cultural resources at the FitzPatrick site would be SMALL. FEIS at 8-94, 8-95. Similarly, the Staff found in its environmental justice analysis that Oswego County is only about 3.5 percent minority, there are no concentrations of minority residents, and there are two (non-minority) low-income census block groups within the city of Oswego, but no others in the county. FEIS at 8-95. The Staff found no adverse and disproportionate impacts on these populations. FEIS at 8-95.

v-d. Generic Impacts Consistent Among Alternative Sites

600. Because the Staff found that several impact areas did not vary among the four sites analyzed – and therefore did not affect the evaluation of whether an alternative site is environmentally preferable to the proposed site – the Staff discussed these issues generically rather than with respect to each site. FEIS at 8-95. These areas were air quality; nonradiological and radiological effects on members of the public, workforce, and biota; postulated accidents; and hydrological alterations. FEIS at 8-95.

601. With respect to air quality, the Staff noted the expectation that SERI would implement similar dust, burning, and engine emission controls for construction at any site. FEIS at 8-96. It also noted that the regions around each site except Pilgrim were in attainment

for National Ambient Air Quality Standards, and that for the area around Pilgrim (which is in nonattainment for certain ozone standards), the impacts would likely still be SMALL, because the population of the area indicates that most workers would be local and hence vehicle emissions would not be expected to increase. FEIS at 8-96. Similarly, the Staff found that impacts resulting from cooling tower operation or periodic operation of auxiliary boilers and generators would likely be consistent among sites. FEIS at 8-96.

602. In terms of nonradiological health impacts, the Staff found that with respect to noise, odor, vehicle exhaust, and dust emissions, construction would be in compliance with relevant state regulations, and while two of the three alternative sites would have minimal impacts on the surrounding population because of their rural location, even at Pilgrim the impacts would be SMALL due to mitigative actions. FEIS at 8-97. The Staff determined that occupational health impacts would be the same for employees at all sites, because thermophilic microorganisms would not be a concern at alternative sites for any facilities using either type of cooling towers, and health impacts on workers from noise would be monitored and controlled at each site in accordance with applicable U.S. Occupational Safety and Health Administration regulations. FEIS at 8-97. Likewise, impacts on members of the public from operation of the transmission system in terms of electrical shock, electromagnetic field ("EMF") exposure, noise, and aesthetics would be the same at each site. FEIS at 8-97.

603. For radiological health impacts, the Staff found that exposure pathways for gaseous and liquid effluents would be similar for the alternative locations. FEIS at 8-97. Moreover, while there would be differences in the estimated radiation doses at each of the sites (though the same bounding liquid and gaseous effluent releases would be used to evaluate doses for each alternative site), the Staff concluded that doses estimated for the alternative sites would, like those at the Grand Gulf site, be expected to be well within the design objectives in Appendix I of 10 C.F.R. Part 50, even considering the differences in pathways

analyzed, atmospheric and water dispersion factors, and population size. FEIS at 8-98. The Staff noted that even for sites near larger population centers (such as Pilgrim) whose dose estimate would be higher than for the Grand Gulf, the dose would still be small compared to the population dose from natural background radiation. FEIS at 8-98.

604. Similarly, the Staff found that occupational doses would be approximately the same for workers at nuclear facilities at any of the alternative sites, and that the proposed advanced reactor designs would result in less annual occupational exposure than that received by workers at currently operating reactors. FEIS at 8-98. Finally, the Staff concluded that no measurable radiological impacts on populations of biota would be expected from the radiation and radioactive material released to the environment as a result of the routine operation of the proposed facility, or of operation at any of the alternative sites. FEIS at 8-99.

605. With respect to postulated accidents, the Staff concluded that because the Grand Gulf ESP site and the three alternative sites are sufficiently similar in terms of climate and terrain and would be located in the vicinity of an existing nuclear reactor, it is highly unlikely that differences in local meteorological conditions would be sufficient to cause doses from DBAs at any of the alternative sites to exceed regulatory limits or guidelines. FEIS at 8-99. Although the Staff did not conduct detailed consequence analyses for each of the alternate sites, but did so only for the Grand Gulf ESP site, the Staff determined that release characteristics would have been the same at all sites and that probability-weighted consequences would be well below those estimated for severe accidents at current generation reactors. FEIS at 8-100.

606. In terms of hydrological alterations, the Staff noted that the Grand Gulf site and alternative sites are all adjacent to large water bodies, such that any changes to the flow patterns of the water bodies based on the plant's water fluxes would be small and localized. FEIS at 8-100. The Staff also noted that at each site, potential construction impacts on surface

water runoff or groundwater recharge, or effects on the groundwater table from consumptive use, could be mitigated or eliminated through management practices or water treatment. FEIS at 8-100.

607. Finally, with respect to the impact of electromagnetic fields on terrestrial flora and fauna, the Staff noted its conclusion in the GEIS, concerning the minimal incremental EMF impact posed by the possible addition of new transmission lines for a new generating facility; therefore, the Staff found that EMF impacts would be expected to be the same (and likely minimal) at Grand Gulf as well as at each of the alternative sites. FEIS at 8-100, 8-101.

608. We find that the facts described and referenced in Chapter 8 of the Staff's FEIS include all factors relevant to the assessment of environmental impacts of alternatives to the proposed Grand Gulf ESP site, including the no-action alternative, energy alternatives, plant design alternatives, the alternate site selection process, and the three identified alternative sites.

609. Further, we find that the Staff evaluation documented in FEIS Chapter 8, as described above, is based on these facts, and provides reasonable support in logic to support the Staff findings in FEIS Chapter 8.

610. Accordingly, we find that the Staff's review of these matters was adequate.

i. FEIS Chapter 9, "Comparison of the Impacts of the Proposed and Alternative Sites"

611. As set forth below, in FEIS Chapter 9 the Staff compared the environmental impacts of a new facility at the Grand Gulf ESP site with the impacts (discussed in Chapter 8) of the alternatives to the proposed action, in order to determine 1) if any of the alternative sites are environmentally preferable, and 2) if so, whether there is a site that is obviously superior to the proposed site. FEIS at 9-1, 9-2.



612. In its analysis earlier in the FEIS – supported by examination of the application and supporting documents, the Staff’s site visits, and its independent review -- the Staff found that SERI reasonably identified alternative sites, adequately evaluated the environmental impacts of construction and operation, and used a logical means of comparing sites. FEIS at 9-2. To compare the proposed action with the alternatives, the Staff weighed the impact significance levels (SMALL, MODERATE, or LARGE) it had determined with respect to Grand Gulf for each major impact area with the corresponding levels for each of the three identified alternative sites. FEIS at 9-2. Where the Staff had been unable to reach a single determination level for Grand Gulf (or an alternative site) due to insufficient information, the Staff indicated a likely impact level for unresolved issues – so that a comparison could be made – based on professional judgment, experience, and consideration of controls likely to be imposed under required Federal, State, or local permits that would not be acquired until an application for a construction permit or combined license is underway. FEIS at 9-2.

613. The Staff determined that the impact level from construction would be SMALL for most of the environmental issues at each of the sites. See FEIS at Table 9-1. The Staff’s issue-by-issue impact determinations were explained more fully in Chapter 4 for the Grand Gulf ESP site and in Chapter 8 for the alternative sites. The Staff found that construction of transmission corridors at the Pilgrim and FitzPatrick sites would have SMALL to MODERATE land use impacts. FEIS at 9-5. For terrestrial ecosystems, the Staff determined that impacts would likely be MODERATE at Grand Gulf and River Bend and as much as LARGE at FitzPatrick because of probable impacts to forests and wetlands and associated habitats. FEIS at 9-5. For threatened and endangered species, the Staff determined that impacts would likely be SMALL to MODERATE at River Bend and MODERATE TO LARGE at Pilgrim because of potential impacts to protected species. FEIS at 9-5. The Staff found socioeconomic and environmental justice impacts ranging from SMALL to MODERATE adverse impacts in some

aspects, and up to LARGE beneficial impacts in other aspects, such as social and economic benefits because of tax revenue. FEIS at 9-5.

614. Similarly, the Staff determined that the impact level from operations would be SMALL for most of the environmental issues at each site. See FEIS Table 9-2. Once again, the Staff's issue-by-issue impact determinations were explained more fully in Chapter 5 for the Grand Gulf ESP site and in Chapter 8 for the alternative sites. Exceptions to the Staff's findings of SMALL impacts from operations included aquatic and terrestrial ecosystems and threatened and endangered species at the Pilgrim site, arising from potential impacts to the winter flounder larvae and on the redbelly turtle. FEIS at 9-5. Additionally, the Staff's findings concerning social and economic impacts in socioeconomics at the alternative sites included LARGE to SMALL beneficial impacts, principally due to added tax revenue and beneficial impacts on the local economy. FEIS at 9-5. As noted earlier, the Staff determined that impacts at the Grand Gulf ESP site would be LARGE and beneficial, while impacts on infrastructure and community services would be MODERATE adverse at the Grand Gulf ESP site and SMALL to MODERATE adverse at the alternative sites. FEIS at 9-5. Finally, the Staff found that environmental justice impacts would be SMALL at the alternative sites, but up to LARGE and beneficial at the Grand Gulf ESP site. FEIS at 9-5, 9-6.

615. The Staff then analyzed whether any of the alternative sites are environmentally preferable. First, with respect to construction impacts, while the Staff concluded that impacts were generally small for all four analyzed sites, the Staff identified several differences between the environmental impacts of construction at the proposed and alternative ESP sites. FEIS at 9-6. However, while the Grand Gulf site had some higher adverse impacts with respect to demographics, terrestrial ecosystems and infrastructure and community services (as well as one area, social and economic benefits from tax revenues, of significantly higher beneficial impacts), the Staff found that each alternative site had higher adverse impacts for the same

issues or in other respects. FEIS at 9-6. The Staff concluded that none of the differences were sufficient to determine that any of the alternative sites is environmentally preferable to the Grand Gulf ESP site. FEIS at 9-6.

616. Second, with respect to operational impacts, the Staff again noted that impacts were generally small for all four analyzed sites, and identified several differences between the environmental impacts at the proposed and alternative ESP sites. FEIS at 9-7. However, while the Grand Gulf site again had some higher adverse impacts with respect to demographics and infrastructure and community services (and also had significantly higher potential social and economic benefits), the Staff found that the alternative sites had, on the whole, either closely comparable impacts or slightly less beneficial impacts than the Grand Gulf site. FEIS at 9-7. The Staff again concluded that none of the differences were sufficient to determine that any of the alternative sites is environmentally preferable to the Grand Gulf ESP site. FEIS at 9-7.

617. Because the Staff determined that none of the alternative sites was environmentally preferable to the Grand Gulf ESP site, it concluded by extension that none of the alternative sites is obviously superior to the Grand Gulf ESP site. FEIS at 9-7.

618. Finally, the Staff compared the proposed action with the no-action alternative. The Staff noted that denial of the ESP application would prevent early resolution of safety and environmental issues for the site, and it further found that although SERI could follow any of several paths to satisfy its electric power needs, each of the paths would have associated environmental impacts. FEIS at 9-7, 9-8. The Staff additionally concluded that no significant environmental impacts would be avoided by the no-action alternative because no such impacts are caused by a site-suitability determination. FEIS at 9-8.

619. We find that the facts described and referenced in Chapter 9 of the Staff's FEIS include all factors relevant to the assessment of whether any of the alternate sites constitutes an environmentally preferable, or obviously superior, site.

620. Further, we find that the Staff evaluation documented in FEIS Chapter 9, as described above, is based on these facts, and provides reasonable support in logic to support the Staff findings in FEIS Chapter 9, including its conclusion that there is no obviously superior site to the proposed Grand Gulf ESP site.

621. Accordingly, we find that the Staff's review of these matters was adequate.

j. FEIS Chapter 10, "Conclusions and Recommendations"

622. In reaching its ultimate findings and recommendation concerning the ESP application, the Staff provided its conclusions on a number of determinations required by NEPA. These determinations included analysis of any unavoidable adverse environmental impacts, any irreversible and irretrievable commitments of resources, the relationship between short-term uses and long-term productivity of the human environment, and the cumulative impacts of the proposed action.

623. With respect to unavoidable adverse environmental impacts (NEPA section 102(2)(C)(ii)), the Staff noted that the ESP, if granted, will not authorize any activities by SERI that would have an environmental impact. FEIS at 10-4. The Staff noted that because SERI did not choose to include a site redress plan (as provided by 10 C.F.R. § 52.17(c) and 10 C.F.R. § 52.25), it would not be authorized to perform any limited work activities (10 C.F.R. § 50.10(e)(1)), meaning that there are no unavoidable adverse environmental impacts at this stage. FEIS at 10-4. However, issuance of an ESP may lead to construction and operation of a new nuclear facility under a CP or COL. Therefore, although final assessment of adverse environmental impacts from construction and operation at the Grand Gulf ESP site would be performed at the CP or COL stage for issues that were not resolved in the ESP review,<sup>20</sup> the Staff summarized the impacts described in Chapters 4 and 5 of its ESP FEIS analysis.

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<sup>20</sup> See FEIS at Tbls. 4-3, 5-17, 9-1, 9-2, and 10-3.

624. With respect to construction activities, such unavoidable impacts were primarily related to land use (involving ground disturbance and loss of some forest and field acreage), but also included some potential socioeconomic impacts on traffic and housing. FEIS at 10-4 to 10-6. The Staff reiterated from its earlier analysis the ways in which most impacts would be mitigated, such as reducing dust emissions with control plans and conducting surveys for protected species prior to construction. FEIS at 10-4 to 10-6.

625. Likewise, with respect to operations, the Staff reiterated that unavoidable impacts would be small, and it summarized mitigation activities, such as road improvements to offset traffic increases and best management practices to reduce impingement and entrainment of aquatic species. FEIS at 10-6, 10-7.

626. With respect to irreversible and irretrievable commitments of resources (NEPA section 102(2)(C)(v)), the Staff again found there would be none because the ESP will not authorize any activities by SERI that would have an environmental impact. FEIS at 10-6. Because the proposed action does not involve commitment of resources, and a complete assessment of irreversible and irretrievable commitments of resources would be performed at the CP or COL stage, the Staff noted that the issue remains unresolved. FEIS at 10-6. The Staff noted, however, that irretrievable commitments of resources during construction generally would be similar to that of any major construction project and would depend on the specific design. FEIS at 10-6, 10-7, Tbl. 10-2. The Staff also determined that the construction materials and uranium required would be of small consequence with respect to the availability of such resources. FEIS at 10-8.

627. With respect to the relationship between short-term uses and long-term productivity of the human environment (NEPA section 102(2)(C)(iv)), the Staff found that there will be no short-term use of the environment, again because the ESP does not authorize SERI to perform any site preparation activities. FEIS at 10-8. Furthermore, because the long-term

productivity assessment would be performed at the CP or COL stage, the Staff considered the issue unresolved. FEIS at 10-8.

628. With respect to cumulative impacts, the Staff repeated its conclusions from FEIS Chapter 7 that most cumulative impacts were determined to be small. FEIS at 10-8. The Staff also reiterated that several impact issues, including ones with the potential for MODERATE or LARGE adverse impacts, were not resolved due to lack of necessary information. FEIS at 10-8. As these issues were not resolved, they would have to be addressed in any future CP or COL application that references an ESP for the Grand Gulf site. FEIS at 10-8.

629. In light of its findings and conclusions, the Staff's recommendation to the Commission related to the environmental impacts of the proposed action was that the ESP should be issued. FEIS at 10-9.

630. We find that the Staff evaluation documented in FEIS Chapter 10, as described above, provides reasonable support in logic to support the Staff findings in FEIS Chapter 10, including its recommendation that the ESP should be issued.

631. Accordingly, we find that the Staff's review of these matters was adequate.

### 3. Findings Regarding "Baseline" NEPA Determinations

632. As was noted previously, *see supra* Part III, regardless of whether a proceeding is contested or uncontested, in accordance with the notice of hearing issued in this case, this Licensing Board is required to make the following "baseline" determinations regarding NEPA issues:

- i. Determine whether the requirements of section 102(2)(A), (C), and (E) of [NEPA] and Subpart A of 10 C.F.R. Part 51 have been complied with in the proceeding;

- ii. Independently consider the final balance among conflicting factors contained in the record of the proceeding with a view to determining the appropriate action to be taken; and
- iii. Determine whether the construction permit should be issued, denied, or appropriately conditioned to protect environmental values.

See Hearing Notice at 2636.

633. In its response to the questions certified to it by the Chief Administrative Judge, providing guidance to licensing boards regarding the appropriate standard of review to be used when making these “baseline” NEPA determinations, the Commission stated that “licensing boards must reach their own independent determination on uncontested NEPA ‘baseline’ questions — i.e., whether the NEPA process ‘has been complied with,’ what is the appropriate ‘final balance among conflicting factors,’ and whether the ‘construction permit should be issued, denied or appropriately conditioned.’” CLI-05-17, 62 NRC at 45. In reaching these independent determinations, “boards should not second-guess underlying technical or factual findings by the NRC Staff,” and “[t]he only exceptions to this would be if the reviewing board found the Staff review to be incomplete or the Staff findings to be insufficiently explained in the record.” *Id.* The Commission further directed licensing boards to follow the approach set forth in *Calvert Cliffs’ Coordinating Comm., Inc. v. AEC*, in which the United States Court of Appeals for the District of Columbia Circuit stated:

The Commission’s regulations provide that in an uncontested proceeding the hearing board shall on its own determine whether the application and the record of the proceeding contain sufficient information, and the review of the application by the Commission’s regulatory staff has been adequate, to support affirmative findings

on various nonenvironmental factors. NEPA requires at least as much automatic consideration of environmental factors. In uncontested hearings, the board need not necessarily go over the same ground covered in the detailed [environmental impact] statement. But it must at least examine the statement carefully to determine whether the review . . . by the Commission's regulatory staff has been adequate. And it must independently consider the final balance among conflicting factors that is struck in the staff's recommendation.

449 F.2d 1109, 1118 (D.C. Cir. 1971) (footnote and internal quotation marks omitted). The Board's findings with respect to these three "baseline" NEPA issues are set forth below.

a. Staff Compliance With Section 102(2)(A), (C), and (E) of NEPA

634. i. Upon the basis of the Board's review of the draft environmental impact statement, the FEIS, and other elements of the record of this proceeding, the Board concludes that (1) the Staff utilized a systematic, interdisciplinary approach integrating its use of the natural and social sciences in its decision-making regarding environmental impacts as required under NEPA; and (2) the Staff has complied with the requirements set forth in section 102(2)(A), (C), and (E) of NEPA.<sup>21</sup> The FEIS documents the Staff's environmental review, in which the Staff considered the potential environmental impacts of the proposed action, i.e., issuance of an ESP. Specifically, we have reviewed the Staff's consideration of numerous subjects and impacts, including: purpose and need for the proposed action, the alternatives to the proposed action, compliance with applicable regulations, meteorology and air quality, geology, the radiological environment, water resources and water use, local ecology, socioeconomics, aesthetics, cultural resources, environmental justice, threatened and endangered species, transportation, noise, land use, public and worker health, accidents, waste management and fuel cycle impacts, decommissioning, cumulative impacts, and resource

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<sup>21</sup> NEPA section 102(2)(A) requires all federal agencies to "utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decision-making which may have an impact on man's environment." 42 U.S.C. § 4332(2)(A).



commitments. See FEIS at v to xvi. The Staff utilized the expertise of professional scientists, engineers, and social scientists in conducting its review. See *id.* at Appendices A and B. We concur with the Staff's conclusions, which we find well-documented and logical, and we hereby adopt those conclusions.

635. ii. Section 102(2)(C) of NEPA requires a federal agency to address in its environmental impact statement: (1) the environmental impact of the proposed action; (2) any unavoidable adverse impacts associated with implementation of the proposed action; (3) alternatives to the proposed action; (4) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity; and (5) any irreversible and irretrievable commitment of resources that might result from the proposed action. See 42 U.S.C. § 4332(2)(C). The Board has reviewed the FEIS and finds that the Staff has complied with these requirements in performing its environmental review. Chapters 1, 8, and 9 of the FEIS describe the proposed action and examine reasonable alternatives, including the no-action alternative. See FEIS at 1-6 to 1-9, ch. 8, ch. 9. Chapters 4, 5, and 6 detail the potential impacts associated with the construction, operation, and decommissioning of a reactor or reactors which have characteristics that fall within the site parameters, while Chapter 7 addresses the cumulative impacts. See *id.* at ch.4, ch. 5, ch.6, ch. 7.

636. iii. NEPA section 102(2)(C) also requires that an agency "consult with and obtain the comments of any Federal agency which has jurisdiction by law or special expertise with respect to any environmental impact involved." 42 U.S.C. § 4332(2)(C). Based upon our review of the FEIS, we find that the Staff has complied with this requirement. Appendix B lists the agencies and persons consulted during the Staff's review. See FEIS at Appendix B. Appendix F of the FEIS includes key consultation correspondence received by the Staff, and

Appendices D and E contain public comments received by the Staff at its scoping meeting and in response to its DEIS. *See id.* at Apps. D, E, & F.

637. iv. Finally, section 102(2)(E) of NEPA requires a federal agency to “study, develop, and describe appropriate alternatives to the recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources.” 42 U.S.C. § 4332(2)(E). The FEIS includes a detailed discussion of alternatives to the proposed action. *See* FEIS at chs. 8 and 9.

638. In performing its evaluation, the Staff considered energy alternatives, plant design alternatives, the Applicant’s alternative site selection process, and the Applicant’s three alternative sites. *See id.* The Staff considered whether the ESP Applicant (1) reasonably identified alternative sites, (2) evaluated the likely environmental impacts of construction and operation at these sites, and (3) used a logical means of comparing sites that led to the Applicant’s selection of the proposed site. FEIS at 9-2 to 9-7. While the Staff identified some differences in the environmental impacts of both construction and operation at the proposed and alternative ESP sites, the Staff concluded that none of these differences is sufficient to determine that any of the alternative sites is environmentally preferable to the Grand Gulf ESP site. FEIS at 9-6, 9-7. The Staff concluded that there are no environmentally preferable or obviously superior alternative sites. FEIS at 9-7. Based upon our review of these sections of the FEIS, the Board finds that the Staff has met its obligations under NEPA with respect to consideration of alternatives.

b. Ultimate NEPA Determination Regarding License Issuance

639. The Board has undertaken, without second-guessing technical and factual findings by the Staff, an independent review of the SERI application with respect to the three NEPA “baseline” questions. Based upon our review of the FEIS and the record of this proceeding, the Board agrees with the Staff that there are no environmentally preferable or

obviously superior alternative sites. Accordingly, the Board agrees with the Staff's recommendation that the early site permit be issued to SERI.

V. SUMMARY FINDINGS OF FACT AND CONCLUSIONS OF LAW

640. The Board has, in attempting to fulfill its mandatory hearing obligations discussed above, reviewed the material portions of the record in this proceeding. Based upon that review, we have reached the following determinations:

641. A. With respect to safety issues, the Board has determined that the application and the record of the proceeding contain sufficient information, and that the review of the application by the Staff has been adequate, to support findings in accordance with the Commission's January 2004 notice of hearing, that (1) the issuance of an early site permit will not be inimical to the common defense and security or to the health and safety of the public; and (2) taking into consideration the site criteria contained in 10 C.F.R. Part 100, a reactor, or reactors, having the characteristics that fall within the parameters for the site, can be constructed and operated without undue risk to the health and safety of the public.

642. B. With respect to environmental issues, the Board has determined that the review conducted by the Staff pursuant to 10 C.F.R. part 51 has been adequate, in accordance with the Commission's January 2004 hearing notice, *see also* 10 C.F.R. § 2.104(b)(2)(ii). In addition, the Board finds that (1) the requirements of sections 102(2)(A), (C), and (E) of NEPA have been satisfied; (2) having conducted its own independent balancing of the conflicting environmental and other factors (including an analysis to determine that there are no obviously superior sites), that the overall balance supports issuance of the license; and (3) protection of the environment does not require denial or any further conditioning of the license. The Board thus concludes that these factors support issuance of the requested early site permit.

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For the foregoing reasons, it is [on this date], ORDERED, that, in accordance with 10 C.F.R. § 2.340, this decision shall become immediately effective. Further, in accordance with 10 C.F.R. § 2.713, this decision shall constitute the final decision of the Commission forty (40) days from the date of issuance, unless a petition for review is filed in accordance with 10 C.F.R. § 2.341, or unless the Commission directs otherwise.

