NUREG-1817

Environmental Impact Statement for an Early Site Permit (ESP) at the Grand Gulf ESP Site

Draft Report for Comment

U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, DC 20555-0001

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Draft Report for Comment

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Washington, DC 20555-0001

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Abstract

This environmental impact statement (EIS) has been prepared in response to an application submitted to the U.S. Nuclear Regulatory Commission (NRC) by System Energy Resources, Inc. (SERI) for an early site permit (ESP). The proposed action requested in SERI's application is for the NRC to (1) approve a site within the existing Grand Gulf Nuclear Station boundaries as suitable for the construction and operation of a new nuclear power generating facility, and (2) issue an ESP for the proposed site identified as the Grand Gulf ESP site co-located with the existing Grand Gulf Nuclear Station. This EIS includes the NRC staff's analysis that considers and weighs the environmental impacts of constructing and operating up to two new nuclear units at the Grand Gulf ESP site or at alternative sites, and mitigation measures available for reducing or avoiding adverse impact. It also includes the staff's recommendation to the Commission regarding the proposed action.

The staff's recommendation to the Commission related to the environmental aspects of the proposed action is that the ESP should be issued. The staff's evaluation of the safety and emergency preparedness aspects of the proposed action will be documented in a separate safety analysis report prepared in accordance with Title 10 of the Code of Federal Regulations Part 52.

This recommendation is based on (1) the application, including the environmental report, submitted by SERI; (2) consultation with Federal, State, Tribal, and local agencies; (3) the staff's independent review; (4) the staff's consideration of comments related to the environmental review that were received during the public scoping process; and (5) the assessments summarized in this EIS, including the potential mitigation measures identified in the environmental report and this EIS. In addition, in making its recommendation, the staff concluded that there are no environmentally preferable or obviously superior sites.

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Executive Summary

On October 16, 2003, the U.S. Nuclear Regulatory Commission (NRC) received an application from System Energy Resources, Inc. (SERI) for an early site permit (ESP) for a location identified as the Grand Gulf ESP site, co-located with the Grand Gulf Nuclear Station. The proposed Grand Gulf ESP site is located in Claiborne County, Mississippi, approximately 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. An ESP is a Commission approval of a location for siting one or more nuclear power facilities and is a separate action from the filing of an application for a construction permit or combined construction permit and operating license (combined license) for such a facility. An ESP application may refer to a reactor's or reactors' characteristics or plant parameter envelope, which is a set of postulated design parameters that bound the characteristics of a reactor or reactors that might be built at a selected site. Alternatively, an ESP may refer to a detailed reactor design. The ESP is not a license to build a nuclear power plant. Rather, the application for an ESP initiates a process undertaken to assess whether a proposed site is suitable should SERI decide to pursue a construction permit or combined license.

Section 102 of the National Environmental Policy Act of 1969 (NEPA) (42 USC 4321) directs that an environmental impact statement (EIS) is required for major Federal actions that significantly affect the quality of the human environment. Subpart A of Title 10 of the Code of Federal Regulations (CFR) Part 52 contains the NRC regulations related to ESPs. The NRC has implemented Section 102 of NEPA in 10 CFR Part 51. As set forth in 10 CFR 52.18, the Commission has determined that an EIS will be prepared during the review of an application for an ESP. The purpose of SERI's requested action, issuance of the ESP, is for the NRC to determine whether the Grand Gulf ESP site is suitable for up to two new nuclear units by resolving certain safety and environmental issues before SERI incurs the substantial additional time and expense of designing and seeking approval to construct such units at the site. Part 52 of Title 10 describes the ESP as a "partial construction permit." An applicant for a construction permit or combined license for a nuclear unit or units to be located at the site for which an ESP was issued can reference the ESP, thus reducing the review of siting issues at that stage of the licensing process. However, a construction permit or combined license to construct and operate a nuclear power plant is a separate licensing action that requires its own environmental review in accordance with 10 CFR Part 51.

Three primary issues – site safety, environmental impact, and emergency planning – must be addressed in the ESP application. Likewise, in its review of the application, the NRC assesses SERI's proposal in relation to these issues and determines if the application meets the requirements of the Atomic Energy Act of 1954 and the NRC regulations. This EIS addresses the potential environmental impacts resulting from construction and operation of up to two new nuclear units at the proposed and alternative sites.

In accordance with 10 CFR 52.18, the EIS is focused on the environmental effects of construction and operation of a reactor, or reactors, that have characteristics that fall within the postulated site parameters.

Upon acceptance of the SERI ESP application, the NRC began the environmental review process described in 10 CFR Part 51 by publishing in the *Federal Register* a Notice of Intent (68 FR 75656) to prepare an EIS and conduct scoping. The staff held 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. Subsequent to the scoping meeting and the site visits and in accordance with NEPA and 10 CFR Part 51, the staff determined and evaluated the potential environmental impact of constructing and operating up to two new nuclear units at the Grand Gulf ESP site. Included in this EIS are (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 staff's recommendation regarding the proposed action.

During the course of preparing this EIS, the staff reviewed the application, including the environmental report submitted by SERI, consulted with Federal, State, Tribal, and local agencies, and followed the guidance set forth in review standard RS-002, *Processing Applications for Early Site Permits*, to conduct an independent review of the issues. The review standard draws from the previously published NUREG-0800, *Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants*, and NUREG-1555, *Environmental Standard Review Plan*. In addition, the staff considered the public comments related to the environmental review received during the scoping process. These comments are provided in Appendix D of this EIS.

Following the precedent of the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (NUREG-1437) and supplemental license renewal EISs, environmental issues are evaluated using the three-level standard of significance – SMALL, MODERATE, or LARGE – developed by NRC using guidelines from the Council on Environmental Quality. Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, provides the following definitions of the three significance levels:

> 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.

Mitigation measures were considered for each environmental issue and are discussed in the appropriate sections.

The staff plans to conduct a public meeting near the Grand Gulf ESP site 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 this EIS. After the comment period, the staff will consider and disposition all the comments received. These comments will be addressed in Appendix E of the final EIS.

The staff's recommendation to the Commission related to the environmental aspects of the proposed action is that the ESP should be issued. The staff's evaluation of the safety and emergency preparedness aspects of the proposed action will be documented in a separate safety analysis report prepared in accordance with 10 CFR Part 52.

This recommendation is based on (1) the application, including the environmental report submitted by SERI; (2) consultation with other Federal, State, Tribal, and local agencies; (3) the staff's independent review; (4) the staff's consideration of public comments related to the environmental review that were received during the scoping process; and (5) the assessments summarized in the EIS, including the potential mitigation measures identified in the environmental report and this EIS. In addition, in making its recommendation to the Commission, the staff has determined that there are no environmentally preferable or obviously superior sites.

Abbreviations/Acronyms

ABWR	advanced boiling water reactor
ac	acre
ACE	U.S. Army Corps of Engineers
ADAMS	Agency wide Document Access and Management Systems
AEC	U.S. Atomic Energy Commission
ALARA	as low as reasonably achievable
AQI	Air Quality Index
BEIR	biological effects of ionizing radiation
BOD	biological oxygen demand
Bq	becquerel
BTU	British thermal unit
BWR	boiling water reactor
°C	degree Celsius
CEDE	committed effective dose equivalent
CEQ	Council on Environmental Quality
CFR	*Code of Federal Regulations*
cfs	cubic feet per second
Ci	curies
COL	combined license
CORMIX	Cornell Mixing Zone Expert System
CP	construction permit
CWA	Clean Water Act
CZMA	Coast Zone Management Act of 1972
d	day
DBA	design-basis accident
DOE	U.S. Department of Energy
EIA	Energy Information Administration
EIS	environmental impact statement
ELF-EMF	extremely low frequency-electromagnetic fields
EMF	electromagnetic field
EPA	U.S. Environmental Protection Agency
ESBWR	economic simplified boiling water reactor
ESP	early site permit

°F	degree Fahrenheit
FAA	Federal Aviation Administration
FE	Federal endangered
FERC	Federal Energy Regulatory Commission
FR	*Federal Register*
FT	Federal threatened
ft	feet
FWS	U.S. Fish and Wildlife Service
gal	gallon(s)
GEIS	generic environmental impact statement
Gen&SIS	Geographical, Environmental & Siting Information System
GGNS	Grand Gulf Nuclear Station
gpd	gallons per day
gpm	gallons per minute
GT-MHR	gas turbine modular helium reactor
ha	hectare(s)
hr	hour
ICRP	International Council on Radiation Protection
IEEE	Institute of Electrical and Electronics Engineers
INEEL	Idaho National Engineering and Environmental Laboratory
IRIS	International Reactor Innovative and Secure
J	Joule
km	kilometer
kWh	kilowatt-hour
L	liter
L/s	liters per second
LDOTD	Louisiana Department of Transportation and Development
LDWF	Louisiana Department of Wildlife and Fisheries
LNHP	Louisiana Natural Heritage Program
LOCA	loss-of-coolant accident
LPDC	Louisiana Population Data Center
LWR	light water-cooled reactor
m	meter(s)
MDA	Mississippi Development Authority

MDCNAP	Marine Department of Conservation Natural Areas Program
MDEQ	Mississippi Department of Environmental Quality
MDWFP	Mississippi Department of Wildlife, Fisheries, and Parks
mi	mile
MISER	Massachusetts Institute for Social and Economic Research
MNFS	U.S. National Marine Fisheries Service
MNHESP	Massachusetts Natural Heritage and Endangered Species Program
MP&L	Mississippi Power and Light
MSL	mean sea level
MT	metric ton
MW(e)	megawatts electrical
MW(t)	megawatts thermal
NCES	National Center for Education Statistics
NEI	Nuclear Energy Insight
NEPA	National Environmental Policy Act of 1969
NESC	*National Electrical Safety Code*
ng	nanogram
NHPA	National Historical Preservation Act of 1966
NHS	normal heat sink
NIEHS	National Institute of Environmental Health Sciences
NJDFW	New Jersey Division of Fish and Wildlife
NMPC	Niagara Mohawk Power Corporation
NMPNS	Nine Mile Point Nuclear Station
NOAA	National Oceanic and Atmospheric Administration
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NRCS	Natural Resources Conservation Service (Claiborne County)
NYDEC	New York State Department of Environmental Conservation
NYDL	New York Department of Labor
NYDFWMR	New York State Division of Fish, Wildlife, and Marine Resources
NYSED	New York State Education Department
NYSIS	New York Statistical Information System
ODNR	Ohio Department of Natural Resources
OSHA	Occupational Safety and Health Administration
PBMR	pebble bed modular reactor
PM	particulate matter

PPE	plant parameter envelope
PWR	pressurized-water reactor
RAI	request for additional information
RCRA	Resource Conservation and Recovery Act of 1976
REMP	radiological environmental monitoring program
s	second(s)
SCR	selective catalytic reduction
SE	state endangered
SERI	System Energy Resources, Inc.
SERPIN	Southeastern Rare Plant Information Network
SMEPA	South Mississippi Electric Power Association
SO_x	sulfur oxides
SR	State Route
ST	state threatened
SWS	service water system
TDS	total dissolved salts
TEDE	total effective dose equivalent
TLDs	thermoluminescence dosimeters
TSS	total suspended salts
UHS	ultimate heat sink
USC	United States Code
USCB	U.S. Census Bureau
USGS	U.S. Geological Survey
VOC	volatile organic compounds
yr	year
/Q	normalized concentration

1.0 Introduction

By letter dated October 16, 2003, System Energy Resources, Inc. (SERI), a subsidiary of Entergy Corporation, submitted an application to the U.S. Nuclear Regulatory Commission (NRC) for an early site permit (ESP) for property co-located with the existing Grand Gulf Nuclear Station (GGNS) near Port Gibson, Mississippi (SERI 2003a). Under NRC regulations in Title 10 of the Code of Federal Regulations (CFR) Part 52, NRC is required to prepare an environmental impact statement (EIS) as part of its review of an ESP application. The NRC regulations implementing the *National Environmental Policy Act* (NEPA) are found in 10 CFR Part 51. The NRC staff has published a notice in the *Federal Register* (68 FR 75656) stating its intent to prepare an EIS, conduct scoping, and publish a draft EIS for public comment as required in 10 CFR 51.26. NRC will issue a final EIS after considering public comments on this draft. NRC will also prepare a separate safety evaluation report in accordance with 10 CFR Part 52.

To distinguish the areas discussed, "Grand Gulf site" refers to the entire 850-ha (2100-ac) property upon which reside the existing Grand Gulf Nuclear Station (Unit 1 and all existing facilities) and the proposed Grand Gulf ESP facility. This document refers to the "Grand Gulf site" for the entire property, "Grand Gulf Nuclear Station (GGNS)" for the existing facilities, and "Grand Gulf ESP facility/site" for the proposed facilities and area.

1.1 Background

An ESP is a Commission approval of a site or sites for one or more nuclear power facilities. The filing of an application for an ESP is a process that is separate from the filing of an application for a construction permit or combined construction permit and operating license (combined license, COL) for such a facility. The ESP application and review process makes it possible to evaluate and resolve safety and environmental issues related to siting before the applicant makes large commitments of resources. If the ESP is approved, the applicant can "bank" the site for up to 20 years for future reactor siting. In addition, if the ESP includes a site redress plan, the ESP holder can conduct specified site preparation activities allowed by 10 CFR 50.10(e)(1). An ESP does not authorize construction and operation of a nuclear power plant. To construct and operate a nuclear power plant, an ESP holder must obtain an NRC construction permit and an operating license, or a combined license, which is a separate major Federal action and will require preparation of an EIS in accordance with 10 CFR Part 51.

As part of its evaluation of the environmental aspects of the action proposed in an ESP application, NRC prepares an EIS in accordance with 10 CFR 52.18. Because site suitability encompasses construction and operational parameters, the EIS addresses impacts of both construction and operation of reactors and their associated facilities. In a review separate from the EIS process, the NRC analyzes the safety characteristics of the proposed site and emergency planning information. These latter two analyses are documented in a safety evaluation report that presents the conclusions reached by the NRC regarding whether there is reasonable assurance that a reactor or reactors (having characteristics that fall within parameters described by the applicant) can be constructed and operated without undue risk to the health and safety of the public, whether there are significant impediments to the development of emergency plans, and whether site characteristics are such that adequate security plans and measures can be developed. In addition, if the applicant proposes major features of emergency plans, or complete and integrated emergency plans, the safety evaluation report will document whether such major features are acceptable, or whether the complete and integrated emergency plans provide reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency.

1.1.1 Plant Parameter Envelope

The applicant for an ESP need not provide a detailed design of a reactor or reactors and the associated facilities, but should provide sufficient bounding parameters and characteristics of these components so that an assessment of site suitability can be made. Consequently, the ESP application may refer to a plant parameter envelope (PPE) as a surrogate for a nuclear power plant and its associated facilities.

The PPE is a set of values of plant design parameters that an ESP applicant expects will bound the design characteristics of the reactor or reactors that might be constructed at a given site. In effect, it serves as a surrogate for actual reactor design information. Use of this PPE approach allows an ESP applicant to defer the selection of a reactor design until the construction permit or combined license stage. The PPE reflects the upper bound values for each parameter it encompasses rather than the characteristics of any specific reactor design. The PPE is discussed in more detail in Section 3.2 of this EIS.

1.1.2 Site Preparation and Preliminary Construction Activities

The holder of an ESP, or an applicant for a construction permit (10 CFR Part 50) or a combined license (Subpart C of 10 CFR Part 52) that references an ESP with an approved site redress plan, may undertake site preparation and construction activities allowed by 10 CFR 50.10(e)(1), provided the final EIS for the ESP concludes that the site redress plan for the proposed activities, if implemented, will result in a site that is environmentally stable and aesthetically acceptable for non-nuclear uses that conform to local zoning laws. SERI has chosen not to include a site redress plan in its application and, therefore, would not be permitted to undertake site preparation activities prior to issuance of a combined license or construction permit.

1.1.3 Early Site Permit Application and Review

In accordance with 10 CFR 52.17(a)(2), SERI submitted an ESP application to NRC for property co-located with the existing GGNS near Port Gibson, Mississippi (SERI 2003a). The period requested for the ESP was 20 years. The environmental report (SERI 2003c) focused on the environmental effects of construction and operation of reactors with characteristics that fall within the PPE (see Appendix I). It also included an evaluation of alternative sites to determine if there is an obviously superior alternative to the proposed site. An ESP environmental report is not required to include an assessment of the need for power or a discussion of energy alternatives. The SERI environmental report did address energy alternatives (SERI 2003c).

The NRC standards for review of the ESP application are outlined in 10 CFR 52.18. As with the environmental report (SERI 2003c), this EIS focuses on the environmental effects of construction and operation of reactors with characteristics that fall within the PPE developed by SERI and includes an evaluation of alternative sites to determine if there is any obviously superior alternative to the proposed Grand Gulf ESP site. Also, this EIS includes an assessment of energy alternatives, but does not address the need for power.

The NRC staff conducts its reviews of ESP applications in accordance with guidance set forth in review standard RS-002, *Processing Applications for Early Site Permits* (NRC 2004). The review standard draws from the previously published NUREG-0800, *Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants* (NRC 1987), and NUREG-1555, *Environmental Standard Review Plan (ESRP)* (NRC 2000). RS-002 provides guidance to NRC staff reviewers to help ensure a thorough, consistent, and disciplined review of any ESP application. As stated in RS-002, an applicant may elect to use a PPE approach instead of supplying specific design information. The staff's June 23, 2003, responses to comments received on draft RS-002 provide additional insights on the staff's expectations and potential approach to the review of an application employing the PPE approach (NRC 2003). Specifically, the NRC staff tasked to perform the environmental review have been trained on using the guidance in the ESRP and RS-002, and on incorporating the PPE concept into their review. The reviewers understand that the ESRP review guidance needs to be adapted to account for the PPE concept. The findings in this EIS reflect the adaptation of the ESRP guidance to the PPE approach.

During the review of a combined license application from an applicant holding an ESP, the staff will assess the environmental impact of the construction and operation of a specific plant design. If the impacts that were documented during the ESP analysis, which was based on a PPE, are found to be greater than or equal to that of the proposed plant design, no additional analysis will be performed. However, any environmental impact not considered or not bounded at the ESP stage will be assessed at the combined license stage. In addition, measures and controls to limit any adverse impact will be identified and evaluated for feasibility and adequacy in limiting adverse impacts at the ESP stage, where possible, and at the construction permit or combined license stage. As a result of the staff's environmental review of the ESP application, the staff may determine that conditions or limitations on the ESP may be necessary in specific areas, as set forth in 10 CFR 52.24. Therefore, the staff has identified in this EIS when and how assumptions and bounding values limit its conclusions on the environmental impacts to a particular resource.

Following requirements set forth in 10 CFR 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 on July 29, 2003, January 21, 2004, and April 12 and 13, 2004, to gather information and to become familiar with the site and its environs. 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.

On December 31, 2003, NRC published a notice of intent in the *Federal Register* to prepare an EIS and conduct scoping (68 FR 75656). The public scoping period for this EIS closed on February 12, 2004. 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. The staff reviewed the comments received during scoping and consulted with Federal, State, regional, and local agencies. A list of the organizations contacted is provided in Appendix B. Comments received during the scoping period that were within the scope of this EIS are provided in Appendix D.

To guide its assessment of environmental impacts of a proposed action or alternative actions, the NRC has established a standard for quantifying environmental impacts using the Council on Environmental Quality guidance (40 CFR 1508.27). Using this approach, the NRC established three significance levels: SMALL, MODERATE, or LARGE. The 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.

This EIS presents the NRC staff's analysis that considers and weighs the environmental impacts of the proposed action at the Grand Gulf ESP site, including the environmental impacts associated with construction and operation of up to two new nuclear units at the site, the environmental impacts of granting an ESP at alternative sites, the environmental impacts of alternatives to granting an ESP (including the no-action alternative and alternate energy sources), and mitigation measures available for reducing or avoiding adverse environmental effects. This EIS also provides the NRC staff's recommendation to the Commission regarding the suitability of the Grand Gulf ESP site for construction and operation of reactors with characteristics that fall within the PPE.

A 75-day comment period will begin on the date of publication of the U.S. Environmental Protection Agency Notice of Availability of the EIS to allow members of the public to comment on the results of the NRC staff's review. During this comment period, a public meeting will be held in Port Gibson, Mississippi. At the meeting, the staff will describe the results of the NRC environmental review, answer questions related to the review, and provide members of the public with information to assist them in formulating their comments.

1.2 The Proposed Federal Action

The proposed Federal action is issuance, under the provisions of 10 CFR Part 52, of an ESP for the Grand Gulf ESP site for one or two additional nuclear power units with characteristics that fall within the PPE (see Appendix I). The proposed action does not include approval to construct or operate the proposed new unit or units, nor does it include authorization to conduct site preparation and preliminary construction activities. While the construction and operation of new units are not currently proposed, this EIS analyzes the environmental impacts that would result from the construction and operation of up to two new nuclear units at the Grand Gulf ESP site or at three alternative sites. The impacts are analyzed to determine whether an alternative site is obviously superior to the proposed site.

The Grand Gulf ESP site is located in Claiborne County in southwestern Mississippi (see Figure 1-1). 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. It is situated within the existing boundaries of the Grand Gulf site, with the new nuclear power unit or units to be sited adjacent to the existing Unit 1. The original GGNS Unit 1 site was designed and evaluated for two nuclear units and two turbine generator sets. Construction of the second unit was halted prior to its completion. However, the majority of the Unit 2 power block buildings were completed, along with the outer cylindrical concrete wall of the reactor containment building. The switchyard was designed and constructed to accommodate two units.

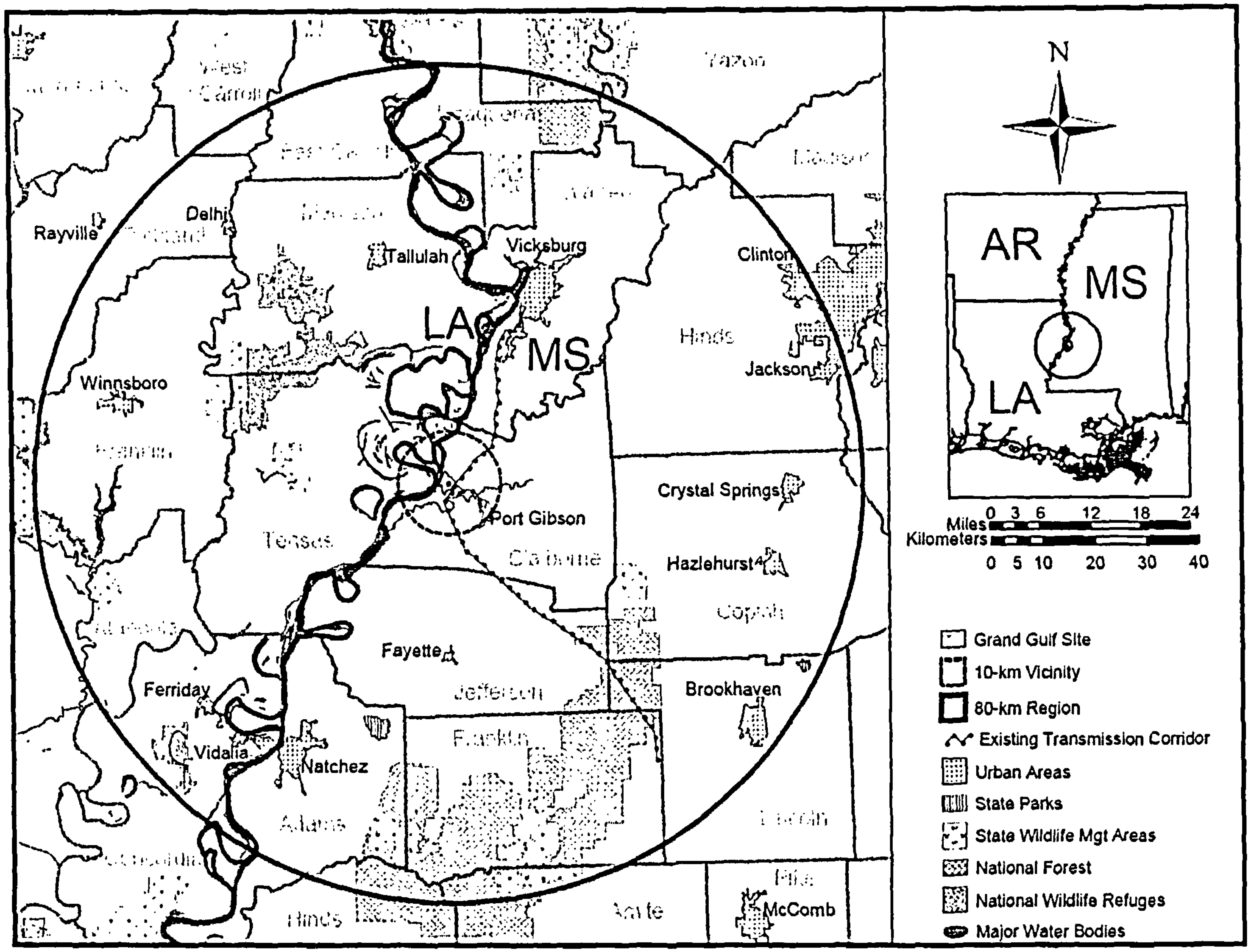

Figure 1-1. Region within 80 Kilometers (50 Miles) of the Proposed Grand Gulf Early Site Permit Site

No specific plant design has been chosen for the new unit(s). Instead, a PPE was chosen by SERI to provide bounds for evaluating the impacts from construction and operation of one or two nuclear power units at the Grand Gulf ESP site. The PPE for the Grand Gulf ESP site (see Appendix I) envisions construction and operation of various numbers of new reactors and/or modules, configured as one or two operating units, up to a total of 8600 MW(t) or 3000 MW(e). Final thermal power will be dependent on the reactor plant type selected for construction at the construction permit or combined license phase. The PPE states that waste heat would be dissipated by either mechanical draft or natural draft cooling towers. 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.

1.3 The Purpose and Need for Proposed Action

The purpose and need for the proposed action (issuance of an ESP) is to provide stability in the licensing process by addressing safety and environmental issues before facilities are built, rather than after construction is completed. This process allows for early resolution of many safety and environmental issues that may be identified for the ESP site. In the absence of an ESP, safety and environmental reviews of applications for construction permits and operating licenses under 10 CFR Part 50 continue during plant construction. Alternatively, all safety and environmental issues would have to be addressed at the time of the staff's review of a combined license submitted under 10 CFR Part 52 if no ESP for the site were referenced. Although actual construction and operation of the facility would not take place until a combined license is granted, certain lead-time activities, such as ordering and procuring certain components and materials necessary to construct the plant, may begin before the combined license is granted. As a result, without the ESP review process, there could be a considerable expenditure of funds, commitment of resources, and passage of time before site safety and environmental issues are finally resolved.

1.4 Alternatives to Proposed Action

Section 102(2)(C)(iii) of NEPA states that EISs will include a detailed statement on alternatives to the proposed action. The NRC regulations for implementing Section 102(2) of NEPA provide for inclusion of a chapter in an EIS discussing the environmental impact of the proposed action and the alternatives (10 CFR Part 51, Subpart A, Appendix A). Chapter 8 of this EIS discusses the environmental impacts of four categories of alternatives: (1) the no-action alternative, (2) alternative energy sources, (3) system design alternatives, and (4) alternative sites.

The no-action alternative is discussed in Section 8.1. Section 8.2 discusses the environmental impacts associated with energy alternatives to the proposed action. Section 8.3 discusses alternative plant systems at the ESP site, including alternative heat dissipation systems and alternative circulating water systems. Section 8.4 discusses alternative sites to the proposed Grand Gulf ESP site. The three sites that are considered in detail are sites with existing operating nuclear power plants owned and operated by Entergy Corporation (Entergy) and licensed by NRC. The three sites are the River Bend Station in Louisiana, James A. FitzPatrick Nuclear Power Plant in New York, and Pilgrim Nuclear Station in Massachusetts. Section 8.4 includes subsections discussing Entergy's region of interest for identifying alternative nuclear power plant sites, the methodology used by Entergy to select alternative sites, and the proposed ESP site and the environmental impacts associated with constructing and operating one or two new nuclear generating units at the three alternative sites. The environmental impacts at the Grand Gulf ESP site and at the alternative sites are compared in Chapter 9, which also provides a qualitative determination of whether an obviously superior alternative site to the proposed site exists.

1.5 Compliance and Consultations

Prior to construction and operation of a new reactor or reactors, SERI would be required to hold certain Federal, State, and local environmental permits, as well as meet relevant Federal, State, and local regulatory requirements. In its environmental report (SERI 2003c), SERI provided a list of the authorizations from and consultations with Federal, State, and local authorities that would be associated with construction and operation of one or more new nuclear power units at the Grand Gulf ESP site. Because an ESP is limited to establishing the acceptability of the proposed site for future development, the authorizations SERI will need from Federal, State, and local authorities for construction and operation are not yet necessary; therefore, they have not been obtained. Potential authorizations and consultations relevant to the proposed ESP are included in Appendix G. The information provided is based on guidance from NUREG-1555 (NRC 2000).

The staff reviewed the environmental report (SERI 2003c) and contacted the appropriate Federal, State, and local agencies to identify any compliance, permit, or significant environmental issues of concern to the reviewing agencies that may affect the suitability of the proposed Grand Gulf ESP site for construction and operation of one or two nuclear power units that fall within the SERI PPE.

1.6 Report Contents

The subsequent chapters of this EIS are organized as follows:

- Chapter 2 describes the environment of the Grand Gulf ESP site that would be affected by construction and operation of an additional nuclear power facility at the site.
- Chapter 3 provides a description of the proposed nuclear power facility, based on the PPE included in the SERI application.
- Chapters 4 and 5 analyze the environmental consequences of construction (Chapter 4) and operation (Chapter 5) of the proposed nuclear power facility at the Grand Gulf ESP site.
- Chapter 6 analyzes the environmental impacts of the fuel cycle, transportation of radioactive materials, and decommissioning at the Grand Gulf ESP site.
- Chapter 7 discusses the cumulative impacts of the proposed action as defined in 40 CFR 1508.7.
- Chapter 8 examines the impacts associated with implementing alternatives to granting an ESP at the Grand Gulf ESP site, including the no-action alternative, alternative energy sources, station design alternatives, and alternative sites.
- Chapter 9 presents a comparison of the proposed action and the alternatives.
- Chapter 10 summarizes the findings of the preceding chapters and presents the conclusions reached by NRC staff with respect to the approval of the proposed site for an ESP based on the staff's evaluation of environmental impacts.

The appendixes to the EIS provide the following additional information:

- Appendix A - Contributors to the Environmental Impact Statement
- Appendix B - Organizations Contacted
- Appendix C - Chronology of NRC Staff Environmental Review Correspondence Related to System Energy Resources Inc.'s Application for an Early Site Permit (ESP) at the Grand Gulf ESP Site
- Appendix D - Scoping Meeting Comments and Responses

- Appendix E - Draft Environmental Impact Statement Comments and Responses
- Appendix F - Key Correspondence
- Appendix G - Authorizations and Consultations
- Appendix H - Data and Information to Support Specific Analyses
- Appendix I - Plant Parameter Envelope Values
- Appendix J - System Energy Resources, Inc. Commitments and Assumptions Relevant to the Analysis of Impact

Dimensional units in this EIS are presented in metric form. In cases where the dimensional unit in the source document was English, it was converted to metric and the original unit is presented parenthetically. Conversions necessarily induce small rounding errors.

Potential impacts to the area surrounding the Grand Gulf ESP site are categorized as impacts to the vicinity (immediate area) and to the region (next immediate area):

Vicinity Definition
When describing the impacts to land use, the vicinity is defined as the area with a radius of 10 km (6 mi) from the center of the proposed power block.

When describing the socioeconomic impacts, the vicinity is defined as the area with a radius of 16 km (10 mi) from the center of the proposed power block.

Region Definition
When describing the impacts to land use and socioeconomics, the region is defined as the area with a radius of 80 km (50 mi) from the center of the proposed power block.

1.7 References

10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities."

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 52. Code of Federal Regulations, Title 10, *Energy*, Part 52, "Early Site Permits, Standard Design Certifications, and Combined Licenses for Nuclear Power Plants."

40 CFR Part 1508. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 1508, "Terminology and Index."

68 FR 75656. December 31, 2003. "System Energy Resources, Inc., Grand Gulf Site; Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process." *Federal Register*, U.S. Nuclear Regulatory Commission.

National Environmental Policy Act of 1969, as amended (NEPA). 42 USC 4321, et seq.

System Energy Resources, Inc. (SERI). 2003a. *Grand Gulf Site Early Site Permit Application.* Jackson, Mississippi. Available at http://www.nrc.gov/reading-rm/adams.html, Accession No. ML032960315.

System Energy Resources, Inc. (SERI). 2003c. "Part 3 Environmental Report." *Grand Gulf Site Early Site Permit Application*, Jackson, Mississippi. Available at http://www.nrc.gov/reading-rm/adams.html, Accession No. ML032960315.

U.S. Nuclear Regulatory Commission (NRC). 1987. *Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants.* NUREG-0800, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2000. *Environmental Standard Review Plan.* NUREG-1555, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2003. Response to comments on Draft RS-002, *Processing Applications for Early Site Permits.* Available at http://www.nrc.gov/reading-rm/adams.html, Accession No. ML031710698.

U.S. Nuclear Regulatory Commission (NRC). 2004. *Processing Applications for Early Site Permits.* RS-002, Washington, D.C.

2.0 Affected Environment

The site proposed by System Energy Resources, Inc. (SERI) for an early site permit (ESP) is located in Claiborne County, Mississippi, within the existing boundaries of the currently operating Grand Gulf Nuclear Station (GGNS) site. The site is on the east bank of the Mississippi River at River Mile 406, approximately 40 km (25 mi) south of Vicksburg, Mississippi and 60 km (37 mi) north-northeast of Natchez, Mississippi. The proposed Grand Gulf ESP facility location is described in Section 2.1, with the land, meteorology and air quality, geology, radiological environment, water, ecology, socioeconomics, historic and cultural resources, and environmental justice conditions of the site presented in Sections 2.2 through 2.10, respectively. Section 2.11 examines related Federal projects, and references are presented in Section 2.12.

To distinguish the areas discussed, "Grand Gulf site" refers to the entire 850-ha (2100-ac) property upon which GGNS Unit 1 and all existing facilities are located as well as the proposed Grand Gulf ESP facility. This environmental impact statement (EIS) refers to the "Grand Gulf site" for the entire property, "Grand Gulf Nuclear Station" for the existing facilities, and "Grand Gulf ESP facility/site" for the proposed facilities and area.

2.1 Site Location

SERI's proposed ESP facility is within the Grand Gulf site. The Grand Gulf site is located in rural Claiborne County and is accessible by both river and road. Public transportation routes are limited within the site vicinity. The major highway within the vicinity of the Grand Gulf site is U.S. Highway 61, which passes by on the east-southeast. U.S. Highway 61 parallels the Mississippi River from New Orleans, Louisiana, to St. Louis, Missouri, and is approximately 7.2 km (4.5 mi) from the Grand Gulf site at the closest point. From Port Gibson, the highway goes north to Vicksburg, Mississippi, and south-southwest to Natchez, Mississippi. A section of the Natchez Trace Parkway passes approximately 10 km (6 mi) southeast of the Grand Gulf site running southwest towards Natchez and to the northeast to Jackson. State Highway 18 runs east from Port Gibson to Jackson. A number of county and rural roads are within the vicinity of the site. Figure 2-1 shows the area within a 10-km (6-mi) radius of the proposed Grand Gulf ESP facility.

Figure 1-1 shows the location of the Grand Gulf ESP facility in relation to the counties and larger cities and towns in the region–the area within a radius of 80 km (50 mi) from the center of the proposed power block. The Grand Gulf ESP site consists primarily of woodlands and farms as well as two lakes, Hamilton Lake and Gin Lake. These lakes were once the channel of the Mississippi River and have an average depth of 2.4 to 3 m (8 to 10 ft). The land in the vicinity of the Grand Gulf site is mostly rural.

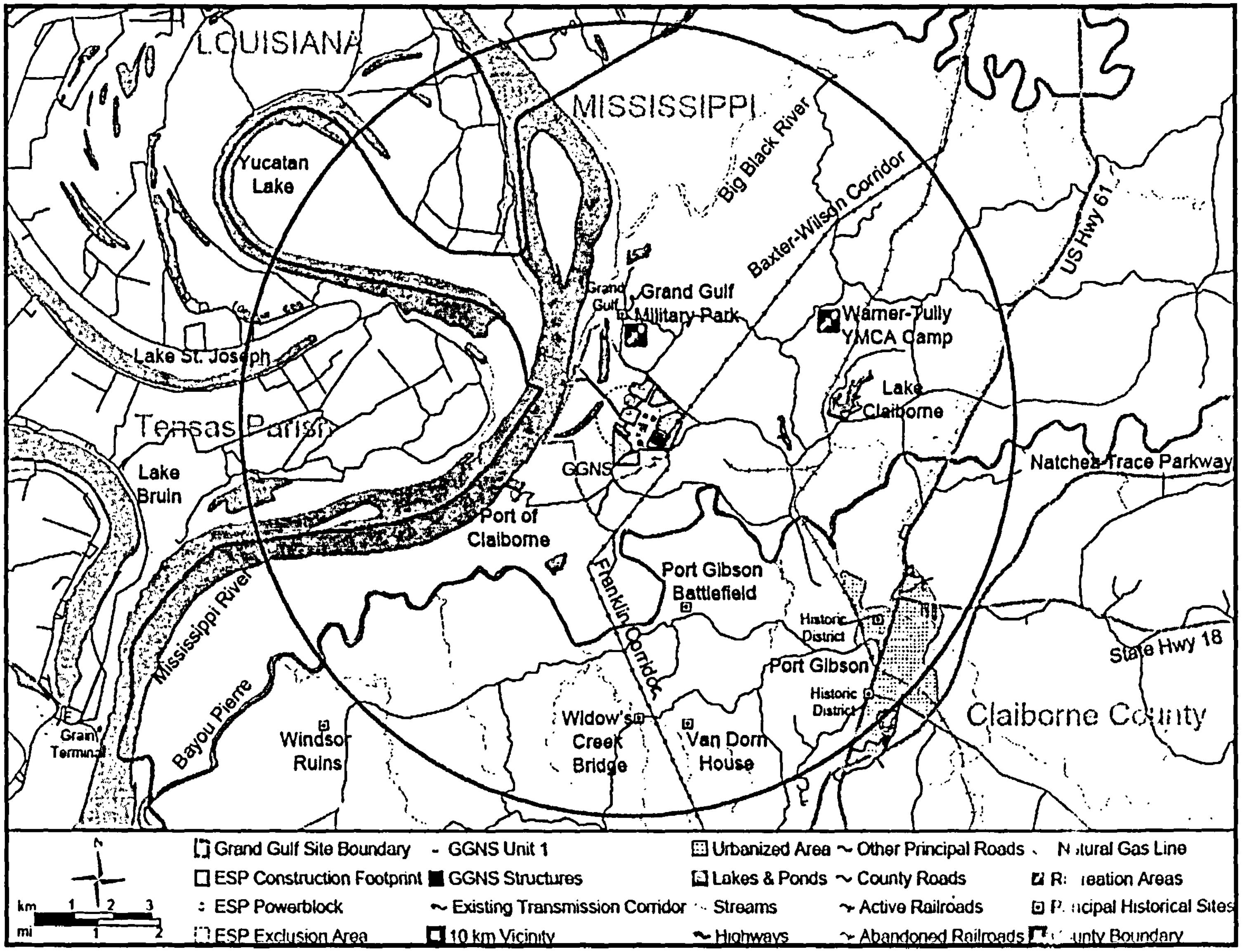

Figure 2-1. Map Showing Location and Vicinity within 10 Kilometers (6 Miles) of the Proposed Grand Gulf Early Site Permit Site

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). The area is generally at elevations of 17 to 23 m (55 to 75 ft) above mean sea level (MSL). The eastern half of the site is rough and irregular with steep slopes and deeply cut stream valleys and drainage courses. Ground elevations in this portion of the Grand Gulf ESP site range from 24.4 m (80 ft) above mean sea level to more than 61 m (200 ft) above mean sea level inland. Elevations of about 122 m (400 ft) above mean sea level occur on the hilltops east and northeast of the site. Grade elevation for the existing GGNS facility structures is 40.4 m (132.5 ft) above mean sea level (SERI 2003c).

2.2 Land

The Grand Gulf ESP site is 160 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. Claiborne County lies in southwestern 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. This section describes the land uses of the site, vicinity, and region affected by the Grand Gulf ESP facility.

2.2.1 Site and Vicinity

The Grand Gulf ESP facility would be constructed on the existing GGNS site, slightly to the west and north of the GGNS power block. The Grand Gulf ESP site lies within the property boundary shown in Figure 2-1 and encompasses approximately 850 ha (2100 ac). SERI, South Mississippi Electric Power Association, and Entergy Mississippi, Inc., are currently the primary owners of the Grand Gulf site. Entergy Operations, Inc., holds the operating license for the GGNS and maintains control of entrances and exits from the Grand Gulf site property. Approximately 160 ha (400 ac) of the 850 ha (2100 ac) would be directly affected by construction on the Grand Gulf ESP site (SERI 2003c). The area at the site that may be used for construction primarily occupies land previously disturbed when GGNS was constructed in the early 1970s.

The vicinity of the Grand Gulf ESP site is defined by a circle drawn with a 10-km (6-mi) radius from the center of the proposed power block location (Figure 2-1). The vicinity includes a portion of Claiborne County in Mississippi and Tensas Parish in Louisiana. Table 2-1 provides the land cover classifications within the 10-km (6-mi) vicinity, in the 80-km (50-mi) region, and along the affected transmission corridors. The land use within the vicinity of the site includes primarily agricultural and undeveloped lands. The nearest incorporated community is the town of Port Gibson about 5 mi (8 km) southeast of the site. The small community of Grand Gulf lies about 2.7 km (1.56 mi) north of the Grand Gulf ESP site.

Table 2-1. Land Use in the Area of the Grand Gulf Early Site Permit Site

	80-km (50-mi) Region		10-km (6-mi) Vicinity		Transmission Corridors	
Land-Use Class	**Hectares (Acres)**	**Percent**	**Hectares (Acres)**	**Percent**	**Hectares (Acres)**	**Percent**
Agricultural	557,511 (1,377,640)	27.7	3552 (8777)	11.3	100 (246)	14.7
Developed Nonresidential	4100 (10,132)	0.2	140 (346)	0.4	1 (3)	0.2
Residential	30,313 (74,904)	1.5	504 (1245)	1.6	11 (28)	1.7
Undeveloped	1,230,416 (3,040,423)	61.2	20,114 (49,703)	64.0	525 (1296)	77.7
Water or Wetlands	189,089 (467,249)	9.4	7118 (17,589)	22.6	39 (96)	5.8
Total Area	**2,011,428 (4,970,348)**		**31,429 (77,662)**		**676 (1669)**	

Notes: U.S. Geological Survey land-cover classes have been aggregated for presentation purposes. Rounding may affect totals.
The Grand Gulf Early Site Permit site is 850 ha (2100 ac) zoned industrial. Land cover varies within the site.
Source: Vogelmann et al. 2001

A number of recreational areas are in the vicinity of the Grand Gulf ESP site. The Grand Gulf Military Monument (160 ha [400 ac]) abuts the northern edge of the Grand Gulf site and has its main facilities about 3 km (2 mi) north of the Grand Gulf ESP site. The Grand Gulf Military Monument provides a year-round, 25-site campground and hosts many living history events and other activities for area visitors. The Warner-Tully YMCA Camp (43.7 ha/108 ac) is a youth summer camp located approximately 6 km (3 mi) northeast of the site. Lake Claiborne is a private residential development with recreational facilities located on the lake about 6 km (3 mi) east of the Grand Gulf ESP site. Two oxbow lakes located on the Grand Gulf site (Hamilton and Gin lakes) provide limited small boating and fishing opportunities, and public access is permitted. Yucatan Lake in Louisiana also falls within the 10-km (6-mi) vicinity and offers boating and fishing opportunities.

About 19 km (11 mi) of the Mississippi River courses through the vicinity. The river provides a critical inland shipping route from the Gulf Coast to the interior of the South and Midwest. There is direct access to the Grand Gulf ESP site from the Mississippi River along the entire western edge of the Grand Gulf site. The Port of Claiborne has constructed a small shipping port on the river at River Mile 404.8 in Claiborne County. The mean depth of channel and berth at Port Claiborne is 4.3 m (14 ft). Services provided at this port include mooring assistance, stevedore, dryage, and deep-water berths. Port cargo includes forest products, pulpwood, feed grains, and agricultural products (SERI 2003c).

SERI has acquired and will maintain surface ownership of all the land within the Grand Gulf site property boundary with the following exceptions (Entergy 2003c; SERI 2004e):

- South Mississippi Electric Power Association (SMEPA) has a 10-percent undivided interest in the GGNS Unit 1 power block area, a 38-ha (94-ac) tract containing the cooling towers, containment buildings, and other major structures. SMEPA also has a 10-percent undivided ownership interest in two very long and narrow strips of land (3 and 2 ha [7.5 and 5 ac]) on which the GGNS Unit 1 water supply and discharge piping are located.

- Entergy Mississippi, Inc., owns the 21-ha (52-ac) GGNS facility switchyard area on the site. However, under a 1999 agreement with Mississippi Power and Light (now Entergy Mississippi, Inc.), SERI has authority to exercise complete control and determine all activities on Entergy Mississippi, Inc., property and easements on the site, including exclusion of Entergy Mississippi, Inc., personnel and third parties. SERI has transferred such rights to Entergy Operations, Inc., Entergy Operations, Inc., has unrestricted access to the switchyard area.

- A 1-ha (2-ac) residential property, which is totally surrounded by the proposed Grand Gulf ESP site property boundary in the southwest sector of the site, is privately owned.

SERI, SMEPA, and Entergy Operations, Inc., own or effectively control the mineral rights in the proposed power block and associated exclusion area. Currently, mining, exploration, drilling, and other mineral-extraction activities are not being conducted at the Grand Gulf ESP site. Past unsuccessful exploration activities on or near the Grand Gulf ESP site and the geological character of the subsurface structure in the vicinity indicate that commercial mineral production appears unlikely in the foreseeable future. A geological appraisal dated January 1987 (Entergy 2003c; SERI 2004g) confirmed this conclusion.

Under State law, prospective mineral developers have no legal right to use physical force or to create a public disturbance to gain access to a property to explore for or to extract minerals. They would be prohibited from drilling any oil or gas well until a permit is issued by the State Oil and Gas Board following a notice and public hearing. Since SERI and SMEPA own, and Entergy Operations, Inc., controls substantially all of the minerals on the Grand Gulf site, SERI and Entergy Operations, Inc., would participate in any hearings and would have the opportunity to object to the drilling and/or the location of any well. Therefore, 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, they effectively control the ability to exercise these rights and to preclude the exercising of these rights.

The Grand Gulf ESP site is accessible by both river and road. The major highways in the area lie mainly to the east, north, and south of the site, and a number of county roads serve the area (Figures 1-1 and 2-1). U.S. Highway 61 and State Highway 18 connect Port Gibson with Natchez, Vicksburg, and Jackson, Mississippi. There are no direct routes from the site into Louisiana, immediately west of the Mississippi River. U.S. Highway 61 parallels the Mississippi River from New Orleans, Louisiana to St. Louis, Missouri, and is approximately 7 km (4.5 miles) from the site at the closest point. From the town of Port Gibson, the highway goes north to Vicksburg and southwest to Natchez. A section of the Natchez Trace Parkway passes approximately 10 km (6 mi) southeast of the Grand Gulf ESP site running southwest towards Natchez, Mississippi, and northeast to Clinton, Mississippi. State Highway 18 runs east from Port Gibson to Jackson. A number of county and rural roads are within the site vicinity.

No active railroads or navigable waterways traverse the Grand Gulf ESP site. However, a currently abandoned spur of the Illinois Central Gulf railroad once served the area during construction of GGNS Unit 1. The remains of this spur extend 29.2 km (18.2 miles) to the north of the Grand Gulf ESP site where active service begins. One county-maintained road runs through the Grand Gulf ESP site (see Figure 2-1). Bald Hill Road cuts through the south-southeast, south, south-southwest, and southwest sectors of the Grand Gulf site. Another road (unpaved) traverses the GGNS site property in the north, north-northwest, northwest, west-northwest, and west sectors, providing access to the two lakes on the property. Two Entergy-Mississippi transmission lines traverse the eastern edge of the Grand Gulf site. 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. Entergy allows public access to parts of the Grand Gulf site property for recreational purposes (SERI 2003c).

The nearest gas pipeline is 6.5 km (3.75 miles) east of the Grand Gulf site boundary (Figure 2-1). SERI and SMEPA own all the surface rights at the Grand Gulf ESP site except the switchyard, which is owned by Entergy Mississippi, Inc. A number of easements over the Grand Gulf ESP site are in effect (SERI 2003c).

A review of the Claiborne County Soil Survey issued in 1963 and inquiry with the Claiborne County Natural Resources Conservation Service indicate the presence of soil types that may be considered "prime farmland" at the Grand Gulf site (SERI 2003c). However, some exclusions apply. If land is frequently flooded during the growing season or is already in or committed to urban development or water storage, it is not considered "prime farmland" (SERI 2003c; 2004h). No coastal zones or wild and scenic rivers were identified in or around the area that may be used for construction.

2.2.2 Transmission Corridors and Offsite Areas

SERI has chosen not to include a site redress plan in its application and, therefore, would not be permitted to undertake site preparation activities, including transmission corridors, prior to obtaining a construction permit (CP) or combined license (COL). Consequently, because of regulatory constraints at the ESP stage, it is not possible to determine how or which specific transmission lines or corridors may be affected by the addition of the Grand Gulf ESP facility. Once the ESP permit 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 will be required (18 CFR 35). This process determines the optimal routing of any new transmission service by performing studies of feasibility, impact, and facilities associated with the transmission request. See Section 3.3. As a result, for analysis purposes, the staff assumed that the existing transmission lines leaving the GGNS switchyard would most likely be upgraded to handle the power generated by the proposed facility. The existing GGNS switchyard was built with provision for equipment installation and operation of a second unit. This portion of the switchyard would be used, with modifications as required, for a new facility's switching equipment and connection to existing transmission line(s).

Entergy Mississippi, Inc., owns the two FERC-regulated 500-kV transmission line rights-of-way that originate from the GGNS switchyard (Figure 2-1). The Baxter Wilson transmission line right-of-way extends north 40.6 km (25.2 mi) from the switchyard to the Baxter Wilson substation adjacent to the Baxter Wilson combined-cycle power plant just south of Vicksburg, Mississippi. The Franklin transmission line right-of-way extends southeast 70.1 km (43.6 mi), traversing the Homochitto National Forest, to the Franklin substation near McCall Creek in northeastern Franklin County, Mississippi.

Land use within the transmission corridors consists of agricultural and undeveloped lands. Table 2-1 provides a summary of land cover in the potentially affected transmission line rights-of-way. The staff assumed that affected transmission line rights-of-way would have 61-m (200-ft) vegetation management buffers. The area covered by these buffers represents corridors totaling 676 ha (1669 ac).

2.2.3 Region

The affected region is determined by drawing a circle with a radius of 80 km (50 mi) from the center of the proposed power block location (Figure 1-1). That region encompasses significant portions of the following counties in Mississippi and parishes in Louisiana:

- Mississippi - Adams, Amite, Claiborne, Copiah, Franklin, Hinds, Issaquena, Jefferson, Lincoln, Rankin, Sharkey, Warren, and Yazoo

- Louisiana - Catahoula, Concordia, East Carroll, Franklin, Madison, Richland, Tensas, and West Carroll

Interstate 20 passes approximately 35 km (20 mi) north of the Grand Gulf ESP site connecting Vicksburg and Jackson, Mississippi, with towns to the east and west. Interstate 55 passes approximately 58 km (36 mi) east of the Grand Gulf ESP site, connecting Jackson, Mississippi, and New Orleans, Louisiana. U.S. Highway 65 runs north and south in Louisiana and lies approximately 18 km (11 mi) to the west of the Grand Gulf ESP site. U.S. Highway 84 runs east and west, connecting U.S. Highway 65 and Interstate 55, and passes within about 50 km (31 mi) to the south of the site. Figure 2-1 shows the locations of Federal highways and railroads in the site vicinity. The Mississippi River, which passes 1.6 km (1 mi) west of the Grand Gulf ESP facility, provides another route for transportation. The nearest river port facility is Port Claiborne at River Mile 404.8. A larger river port facility, which is also a U.S. Customs port of entry, lies north of the site near River Mile 437 in Vicksburg.

The region consists mainly of forest and agricultural lands. Land cover information for Claiborne County and the adjoining counties is presented in Table 2-1. No known local or regional land use plans or other regional development plans affect the Grand Gulf ESP site. About 110 km (70 mi) of the Natchez Trace Parkway, designated as National Scenic Byway and All American Road, traverses the region.

Table 2-2 provides agricultural land use by major crop in the affected region. Because of the topography of the region, agriculture thrives as an industry on the Louisiana side of the Mississippi River. The Louisiana side is typically a flat alluvial plain, while the Mississippi side is typically upland and rolling, forested hill country. On the Mississippi side, farms are generally smaller than on the Louisiana side (USDA 2004a; 2004b).

Table 2-3 provides information on the region's livestock production. Information from the Claiborne County Agricultural Extension office indicated there are approximately 300 to 400 head of cattle, and no commercial dairy milk cows reported within a 10-km (6-mi) radius of the site, and most of the cattle are located southwest of the Grand Gulf ESP site (SERI 2003c).

Table 2-2. 2002 Major Agricultural Crops and Land in Production within 80 Kilometers (50 Miles) of the Grand Gulf Early Site Permit Site [hectares (acres)]

County	Land Area	Corn	Cotton	Rice	Sorghum	Soybeans	Wheat	Hay	Land Harvested	Total in Major Crops
Catahoula, LA	182,245	7080	13,568	4922	11,192	635	1339	2174	40,911	71,947
	(450,335)	(17,495)	(33,526)	(12,163)	(27,657)	(1570)	(3309)	(5373)	(101,093)	(177,785)
Concordia, LA	180,240	15,543	9508	4955	3386	20,775	2164	562	56,894	70,842
	(445,382)	(38,407)	(23,494)	(12,245)	(8368)	(51,337)	(5347)	(1389)	(140,587)	(175,054)
East Carroll, LA	109,153	21,109	12,245	6880	1070	28,976	2294	352	72,926	77,120
	(269,722)	(52,162)	(30,259)	(17,000)	(2644)	(71,600)	(5669)	(870)	(180,204)	(190,566)
Franklin, LA	161,516	16,308	22,054	263	923	8466	11,830	3361	63,207	79,729
	(399,112)	(40,299)	(54,497)	(651)	(2282)	(20,921)	(29,233)	(8304)	(156,187)	(197,014)
Madison, LA	161,638	29,204	20,237	1940	2315	15,273	2295	453	71,718	85,332
	(399,415)	(72,164)	(50,007)	(4795)	(5721)	(37,741)	(5671)	(1120)	(177,219)	(210,858)
Richland, LA	144,640	12,150	13,801	3313	1195	7997	4890	3085	46,431	66,326
	(357,411)	(30,023)	(34,103)	(8187)	(2952)	(19,762)	(12,084)	(7622)	(114,733)	(163,894)
Tensas, LA	156,043	21,921	28,917	268	3153	8065	3357	228	65,910	71,085
	(385,589)	(54,168)	(71,456)	(663)	(7792)	(19,928)	(8296)	(563)	(162,866)	(175,653)
West Carroll, LA	93,084	6024	6450	3337	2159	6046	6033	3576	33,625	52,279
	(230,015)	(14,885)	(15,937)	(8245)	(5336)	(14,941)	(14,909)	(8837)	(83,090)	(129,184)
Adams, MS	119,208	1797				2558		1422	5778	16,376
	(294,567)	(4440)				(6322)		(3515)	(14,277)	(40,466)
Amite, MS	188,966	142						5319	5461	16,633
	(466,944)	(350)						(13,144)	(13,494)	(41,101)
Claiborne, MS	126,073	1687	1396			947	484	2038	6552	13,092
	(311,531)	(4169)	(3450)			(2339)	(1196)	(5037)	(16,191)	(32,351)
Copiah, MS	201,140	196						4044	4240	18,075
	(497,025)	(484)						(9994)	(10,478)	(44,664)

Table 2-2. (contd)

County	Land Area	Corn	Cotton	Rice	Sorghum	Soybeans	Wheat	Hay	Land Harvested	Total in Major Crops
Franklin, MS	146,230	490						1399	1889	5536
	(361,341)	(1212)						(3457)	(4669)	(13,679)
Hinds, MS	225,119	4459	4911			870	27	6282	16,549	44,001
	(556,278)	(11,019)	(12,135)			(2150)	(067)	(15,522)	(40,893)	(108,728)
Issaquena, MS	106,983	5008	7015	1253		12,014	2491	301	28,082	35,868
	(264,360)	(12,374)	(17,335)	(3097)		(29,687)	(6155)	(744)	(69,392)	(88,632)
Jefferson, MS	134,521	238	1819			1352		1594	5003	12,583
	(332,408)	(589)	(4494)			(3341)		(3938)	(12,362)	(31,092)
Lincoln, MS	151,697	206						4306	4512	13,303
	(374,851)	(509)						(10,641)	(11,150)	(32,873)
Rankin, MS	200,599	1091	2592			458		4186	8327	17,157
	(495,690)	(2695)	(6405)			(1132)		(10,344)	(20,576)	(42,395)
Sharkey, MS	110,777	13,708	18,388	1363	382	22,166	739	32	56,779	59,986
	(273,735)	(33,874)	(45,437)	(3369)	(945)	(54,774)	(1825)	(80)	(140,304)	(148,229)
Warren, MS	151,932	4174	3100			7043	445	982	15,744	21,638
	(375,431)	(10,315)	(7659)			(17,404)	(1099)	(2427)	(38,904)	(53,468)
Yazoo, MS	238,146	9939	47,177		974	5823	2970	3364	70,247	87,608
	(588,468)	(24,559)	(116,577)		(2407)	(14,388)	(7339)	(8313)	(173,583)	(216,483)
Total Region	3,289,950	172,474	213,178	28,496	26,751	149,466	41,359	49,062	680,786	936,515
	(8,129,610)	(426,192)	(526,771)	(70,415)	(66,104)	(369,337)	(102,199)	(121,234)	(1,682,252)	(2,314,169)

Source: USDA 2004a; 2004b

Table 2-3. 2002 Livestock Production and Farm Value within 80 Kilometers (50 Miles) of the Grand Gulf Early Site Permit Site

	Livestock Inventory				Farm Inventory		
County	Beef Cows (Head)	Milk Cows (Head)	Hogs and Pigs (Head)	Chickens Sold (Number)	Farms	Average Value per Farm ($)	Average Value Per Acre ($)
Catahoula, LA	4902		346	30	432	577,352	1164
Concordia, LA	2042		(a)		331	690,690	1127
East Carroll, LA	744		1553		238	1,101,056	1194
Franklin, LA	11,200		76		856	334,280	1191
Madison, LA	1888		15		275	928,926	1105
Richland, LA	(a)	(a)	102	(a)	538	494,785	1045
Tensas, LA	497		30		230	1,047,322	1055
West Carroll, LA	7384		84		703	384,114	1781
Adams, MS	3844		159		269	336,308	1004
Amite, MS	9918	2896	16	12,930,000	639	348,222	1572
Claiborne, MS	6654		(a)	1000	297	380,948	1203
Copiah, MS	10,679	870	1270	9,900,000	690	350,023	1646
Franklin, MS	(a)	(a)	5	(a)	210	392,149	1644
Hinds, MS	18,167	1690	497	20	1246	343,373	1348
Issaquena, MS	(a)		100		91	1,529,891	1169
Jefferson, MS	6199	9	86	3,900,000	315	419,870	1467
Lincoln, MS	11,647	2160	(a)	9,900,000	641	446,949	2255
Rankin, MS	(a)	(a)	(a)	30,040,000	804	351,427	1485
Sharkey, MS					100	1,727,477	1064
Warren, MS	(a)	(a)	(a)		282	471,906	1095
Yazoo, MS	(a)	(a)	655		564	729,113	1102
Region[a]	95,765	7625	4994	66,680,000	9751	491,662	1273

(a) Not disclosed by the U.S. Department of Agriculture (USDA), not included in totals.
Source: USDA 2004a; 2004b

2.3 Meteorology and Air Quality

Climatological information presented in this section was obtained from the Jackson, Mississippi, first-order National Weather Service station (NCC 1980; NCDC 2004a), which is about 80 km (50 mi) northeast of the proposed Grand Gulf ESP site. This station provides a good indication of the general climate at the Grand Gulf ESP site because of its proximity and long period of record. Recent climatological data for Jackson are available online from the National Climatological Data Center in Asheville, North Carolina (NCDC 2004a). This section also contains information from responses to U.S. Nuclear Regulatory Commission (NRC) requests for additional information (SERI 2004f), which provide site-specific data for the Grand Gulf ESP site and data for Vicksburg, Mississippi. Vicksburg is on the Mississippi River about 32 km (20 mi) north of the proposed Grand Gulf ESP site.

2.3.1 Climate

The Grand Gulf ESP site is within the GGNS site on the east bank of the Mississippi River in southwestern Mississippi about 240 km (150 mi) from the coast of the Gulf of Mexico. The dominant air mass in the region during most of the year is a maritime tropical air mass originating in the Gulf of Mexico. As a result, the climate of the region is humid most of the year. The winters are relatively short and mild with occasional brief cold periods associated with outbreaks of continental polar air. These cold periods rarely last more than three or four days. Summers are long and warm; however, temperatures above 38°C (100°F) are infrequent and long periods of very hot weather are rare. During these summer months, the weather at the site is dominated by the western edge of the Bermuda High.

Mississippi is south of the track of winter cyclones. This location, in combination with the dominant influence of the Bermuda High in the summer, results in a limited wind resource in the area. Wind energy resource maps prepared for the U.S. Department of Energy (DOE) indicate that Mississippi wind resources fall into Wind Power Class 1, the lowest of seven classes used to rate the resource (DOE 2004c). DOE does not list commercial wind power projects in Mississippi (DOE 2004a).

On average, about 60 percent of the sky at Jackson, Mississippi, is covered by clouds. However, cloudiness varies seasonally and diurnally. Daytime cloudiness at Jackson covers more than 50 percent of the sky during the winter, with maximum sky cover of about 80 percent in December and January. The rest of the year, the average daytime sky cover is 50 percent or less, with minimum sky cover of about 30 percent during September (NCDC 2004a). The DOE estimates the annual average solar resource in the vicinity of the Grand Gulf ESP site to be 4.5 to 5.0 kWh/m^2 per day for flat-panel collectors, and 4.0 to 4.5 kWh/m^2 per day for concentrating collectors (DOE 2004b). The DOE lists two photovoltaic energy projects with a total installed capacity of 44.2 kW in Mississippi (DOE 2004a).

2.3.1.1 Wind

Recent wind data from the GGNS meteorological system show that the winds at the Grand Gulf ESP site are relatively light (SERI 2004f). The average wind speed for the Grand Gulf site during the period from 2001 through 2003 is 1.9 m/s (4.3 mph). This speed is significantly lower than average wind speeds at Vicksburg (SERI 2004f) and Jackson (NCDC 2004a), Mississippi. More than 99 percent of the time, the wind speed at the Grand Gulf ESP site was less than 5.8 m/s (13 mph) (SERI 2004f). The most prevalent wind direction is from the northeast. Winds from the northeast and southeast quadrants are far more frequent than winds from the southwest and northwest quadrants. The highest wind speeds tend to have a southerly component.

Wind direction persistence is an important consideration in evaluation of the consequences of accidents. Tables 2.7-88 through 2.7-95 in the SERI response to an NRC request for additional information (SERI 2004f) describe wind direction persistence at GGNS, Vicksburg, and Jackson, Mississippi. Considering the period of record at each site (3 years at GGNS, 5 years at Vicksburg, and 10 years at Jackson), it appears that the GGNS has a somewhat greater persistence than the other two sites. The maximum persistence of wind direction within the 22.5° sector at GGNS was 32 hours for northeast winds. The maximum persistence in 9 of the 16 sectors exceeded 12 hours. The maximum persistence for wind direction within three adjacent sectors at GGNS was 102 hours for winds from the north, north-northeast, and northeast. Persistence exceeded 24 hours for all sets of three winds direction sectors except those sets centered on east and west-southwest. For five adjacent wind direction sectors, the maximum persistence was 122 hours for the five sectors centered on north-northeast. The maximum wind persistence in all sets of sectors exceeded 36 hours.

2.3.1.2 Atmospheric Stability

Atmospheric stability is a measure of the tendency of the atmosphere to dilute material. It can be estimated from the magnitude of change in the ambient temperature with height ($\Delta T/\Delta h$, or delta-T). Seven atmospheric stability classes based on the temperature difference between two levels are defined in Safety Guide 23 (also referred to as Regulatory Guide 1.23) (AEC 1972). SERI's meteorological monitoring system, which is described in Section 2.3.3, is designed to measure temperature difference for use in estimating atmospheric stability.

When the temperature decreases rapidly with height, the atmospheric stability is described as extremely unstable, and when it increases rapidly with height, the atmospheric stability is described as extremely stable. Extremely unstable atmospheric conditions generally occur on summer afternoons when the wind speed is light. These conditions are associated with good dilution of material. Extremely stable atmospheric conditions generally occur on clear nights, and are associated with very limited dilution. When it is cloudy and windy, atmospheric stability is generally neutral.

Delta-T data for 2002 and 2003 from the GGNS meteorological system indicate that on average the atmospheric stability is neutral about 35 percent of the time. 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.

2.3.1.3 Temperature

The long-term (95-yr) annual average temperature in Jackson is 18.4°C (65.2°F), with monthly average temperatures ranging from 8.4°C (47.2°F) in January to 27.7°C (81.9°F) in July. 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. The lowest temperature at the current and comparable measurement locations, based on a 63-yr period of record, is -17°C (2°F). Temperatures below -18°C (0°F) have been observed in the area. 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).

The monthly mean temperatures for 2000 through 2003 are consistent with monthly mean temperatures for a 5-year period at Vicksburg and a 40-year period at Jackson (SERI 2004d).

2.3.1.4 Atmospheric Moisture

Precipitation averages about 142 cm (56 in.) per year and is uniformly distributed throughout the year. The months of January, March, April, November, and December average more than 13 cm (5 in.) of precipitation, while the months of June, August, September, and October average less than 10 cm (4 in.). The maximum precipitation in a 24-hr period was 22 cm (8.5 in.) in April 2003. On average, about one third of the days each month experience measurable precipitation. Typically, snow falls almost every year, but only about 4 years in 10 have measurable snowfall. The maximum snowfall in a 24-hour period, 15 cm (6 in.), occurred in January 1982. On occasion, the 24-hr snowfall in the vicinity of Jackson has exceeded 15 cm (6 in.). In January 1940, 27 cm (10.6 in.) was recorded, and in February 1960, 23 cm (9.1 in.) was recorded (NCC 1980).

The 30-year normal relative humidity at Jackson, Mississippi has an annual average of about 75 percent with a diurnal variation in the annual average value from about 91 percent at 6:00 a.m. to about 58 percent at noon (NCDC 2004a). Seasonal variation of relative humidity is small. The 6:00 a.m. monthly average relative humidities range from a minimum of 87 percent in March to a maximum of 95 percent in August. The noon monthly average humidities range from a minimum of 53 percent in April to a maximum of 65 percent in January. Relative humidities for Vicksburg, Mississippi, reported in the environmental report (SERI 2003c) are consistent with those for Jackson, Mississippi.

When the relative humidity is near 100 percent, small water droplets (fog) form in the atmosphere and reduce visibility. Records for Jackson indicate that heavy fog, which reduces the visibility to 400 m (0.25 mi) or less can occur in any month. On average, heavy fog occurs on more than 22 days per year with 3 days in December and January, and less than 1 day in June (NCDC 2004a). The environmental report (SERI 2003c) indicates that Vicksburg, Mississippi, averages approximately 92 hours per year of fog, with fog defined as reduction of visibility to less than 1 km (0.62 mi).

The combination of wet- and dry-bulb temperatures are used to evaluate the performance of cooling towers. Tables 2.3-16, 2.3-17, and 2.3-18 in a SERI response to an NRC request for additional information (SERI 2004b) list wet-bulb temperatures and associated dry-bulb temperatures for the 1-, 5-, and 30-day periods with least cooling capacity in about a 36-year period of record. For the worst day, the average wet-bulb temperature was 27.2°C (81.0°F) with an average dry-bulb temperature of 30°C (86°F).

2.3.1.5 Severe Weather

The Grand Gulf ESP site can experience severe weather in the form of thunderstorms, snow, ice, tornadoes, and hurricanes. Other significant weather events can be associated with these events. For example, lightning, hail, and high winds frequently occur with thunderstorms, and tornadoes can occur with both thunderstorms and hurricanes.

Meteorological records for Jackson, Mississippi, indicate that thunderstorms can be expected on about 68 days per year (NCDC 2004a). Thunderstorms are most frequent in summer. The months of June, July, and August average 9 or more thunderstorm days per year. Months from October through February average fewer than 3 thunderstorm days per year. National Climatic Data Center Storm Data lists 23 hail events with hail 1.9 cm (0.75 in.) or greater in diameter in Claiborne County since 1971 (NCDC 2004b). This number is likely an underestimate because no events were listed from 1972 through 1982.

On average, hurricanes strike the Gulf Coast along the Louisiana and Mississippi coastlines several times a decade. The Grand Gulf ESP site is sufficiently far inland that the strength of the most storms diminish to less than hurricane strength by the time they reach the vicinity of the site. No hurricane or tropical storm events are listed for Claiborne County in the National Climatological Data Center Storm Data database (NCDC 2004b). However, this database does list several hurricane and tropical storm events for nearby counties. In October 2002, Hurricane Lili did have hurricane strength when it reached the vicinity of the Grand Gulf ESP site. Lili is listed as a hurricane event for both Hinds and Warren counties. Data for the 2004 hurricane season have not been entered into the National Climatological Data Center database yet; but news and damage reports suggest that the track of Hurricane Ivan in September 2004 passed southeast of and close to the Grand Gulf ESP site.

The NRC staff has conducted an independent assessment of tornadoes in the vicinity of the Grand Gulf ESP site using National Climatological Data Center data for 1950 through August 2003 (Ramsdell 2004). For this time period, there were 592 tornado events within the two-degree box centered on the Grand Gulf ESP site. Given the distribution of areas associated with the events, it is estimated that the expected probability of a tornado striking the site is approximately 7.4×10^{-4} yr^{-1} with 95 percent confidence that the strike probability is less than 9.4×10^{-4} yr^{-1}. A tornado struck the Grand Gulf site on April 17, 1978. Detailed reports of this event are included in the GGNS *Updated Final Safety Analysis Report* (Entergy 2003c).

2.3.2 Air Quality

The Grand Gulf ESP site is in Claiborne County, Mississippi, which is on the western edge of the Mobile, Alabama-Pensacola, Florida-Panama City, Florida-Southern Mississippi Interstate Air Quality Control Region. The area across the Mississippi River from the site is in the Monroe, Louisiana-El Dorado, Arkansas Interstate Air Quality Control Region. None of the counties in these air quality control regions has been designated as nonattainment of the National Ambient Air Quality Standards (40 CFR 81.325; 40 CFR 81.319). There are no mandatory Class 1 Federal Areas where visibility is an important value within 160 km (100 mi) of the proposed Grand Gulf ESP site.

The Mississippi Department of Environmental Quality (MDEQ) conducts air quality monitoring throughout the state. However, no monitoring is conducted in Claiborne County. The closest monitoring site is in Vicksburg, where the State monitors ozone and particulate matter smaller than 2.5 micrometers. Monitoring results for Vicksburg, Mississippi, for 2001, 2002, and 2003 show that concentrations of these pollutants are well below National and Mississippi Ambient Air Quality Standards (MDEQ 2002a; 2003; 2004a). More extensive monitoring is conducted in Jackson, Mississippi, with similar results.

The Air Quality Index (AQI) is a national standard method for reporting air pollution levels for the general public. The AQI is based on comparison of the concentrations of six pollutants with National Ambient Air Quality Standards. The six pollutants are ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide, particulate matter smaller than 10 micrometers, and particulate matter smaller than 2.5 micrometers. The air pollution level for each day is placed in one of six categories based on the AQI. In order of decreasing air quality, the categories are Good, Moderate, Unhealthy for Sensitive Groups, Unhealthy, Very Unhealthy, and Hazardous.

Jackson is the only location in Mississippi for which AQIs are summarized by MDEQ. According to the MDEQ, the air quality in Jackson was classified Good or Moderate for all of 2001 and 2003 (MDEQ 2002a; 2003; 2004a). In 2002, the average air quality was Good or Moderate for all months, but the air quality did decrease to Unhealthy for Sensitive Groups at least one day in September.

All of the areas, for which monitoring data and AQIs exist, are more densely populated than Claiborne County and the area around the Grand Gulf ESP site. Consequently, air quality at the Grand Gulf ESP site should be better than indicated by the monitoring data and AQIs.

2.3.3 Meteorological Monitoring

The Grand Gulf site has had a meteorological monitoring program since March 1972. In August 1972, meteorological instrumentation was installed on a permanent tower approximately 1500 m (5000 ft) north-northwest of Unit 1 to provide the onsite meteorological information required for licensing of the GGNS. This instrumentation is described in the GGNS Final Environmental Statement (AEC 1973) and in SERI's environmental report (SERI 2003c). In December 2000, the tower and instrumentation were replaced by a new tower and state-of-the-art instrumentation. The new tower is located approximately 1.6 km (1 mi) northwest of the control building. The new instrumentation and data collection system are described in detail in the environmental report (SERI 2003c) and summarized below.

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. Instrumentation at the 10-m (33-ft) level of the tower measures wind direction, wind speed, temperature, and relative humidity. Instrumentation at the 50-m (162-ft) level measures wind direction, wind speed, and temperature. The temperature difference between the two levels is also determined. A tipping-bucket rain gage is located near the base of the tower. A 10-m (33-ft) backup meteorological tower measures wind direction, wind speed, and temperature at the 10-m (33-ft) level.

Signals from the instruments are sent to the facility's data computer at about 10-second intervals. They are also recorded in data storage modules in a small building near the base of the tower. Each datum is checked to determine if it is within instrument limits. Fifteen-minute and hourly averages are calculated for each parameter. In addition, 15-minute and 1-hour average values of sigma theta (standard deviation of the wind direction fluctuations) are calculated from the wind direction data. These data (observations and averages) are available to the control room and facility personnel.

The meteorological instrumentation is inspected routinely to ensure that no damage has occurred to the tower or instrumentation and that the instruments are operating properly. These routine inspections are supplemented by semiannual calibration of instruments on the primary tower, check of the tension of tower cables, and visual inspections of wiring. Overall data recovery rates for the meteorological instrumentation for 2001, 2002, and 2003 were 98 percent, 99 percent, and 96 percent, respectively (SERI 2004d).

The staff viewed the meteorological site and instrumentation, reviewed the available information on the meteorological measurement program, and evaluated data collection by the program. Based on this information, the staff concludes that the program provides data that represent the onsite meteorological conditions as required by 10 CFR 100.20(c). The data also provide an acceptable basis for making estimates of atmospheric dispersion for the evaluation of the consequences of routine and accidental releases required by 10 CFR 50.34(a)(1) and 10 CFR Part 50, Appendix I. If continued, the GGNS meteorological monitoring system is suitable for preoperational and operational monitoring as outlined in the *Environmental Standard Review Plan 6.4* (NRC 2000).

2.4 Geology

A description of the geological, seismological, and geotechnical conditions at the Grand Gulf ESP site is provided in Section 2.5 of SERI's Site Safety Analysis Report (SERI 2003b). Subsurface investigations performed in 2002 as part of the ESP application provided additional information. These involved engineering, geologic, and geotechnical site investigations performed for the proposed location of the new facility to characterize site conditions.

The Grand Gulf ESP site lies within the Mississippi Alluvial Plain Section of the Coastal Plain Physiographic Province. Several important aquifer systems are in the vicinity of the Grand Gulf ESP site including: Mississippi River Valley Alluvial Aquifer system, Coastal Lowlands Aquifer system, and the Mississippi Embayment Aquifer system. The site is south of the southern extent of the Mississippi River Valley Alluvial Aquifer system. However, the site is within the very northern extent of the Coastal Lowlands Aquifer system and in the center of the Mississippi Embayment Aquifer system.

The Coastal Lowlands Aquifer System consists of a gulfward-thickening, heterogeneous, unconsolidated to poorly consolidated wedge of discontinuous beds of sand, silt, and clay that range in age from Oligocene to Holocene. Beneath the Coastal Lowlands Aquifer System is the Mississippi Embayment Aquifer System. At the site, the Mississippi Embayment Aquifer System consists of several aquifers that range from late Cretaceous to middle Eocene in age with a combined thickness of over 1500 m (5000 ft).

During the subsurface investigation completed for the existing Grand Gulf Unit 1, 275 borings were drilled within the site area to maximum depth of 136 m (447 ft). An additional 3 borings were performed as part of SERI's ESP site characterization activities. These borings provide the basis of the description of the stratigraphy at the Grand Gulf ESP site.

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. 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. 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. The Catahoula formation underlies both the terrace deposits in the uplands and the alluvium in the lowlands. The ESP facility would be located in the uplands portion of the site.

At this time, a plant design has not been selected, and the exact footprint and embedment depth of the plant have not been determined. After a plant design has been selected, additional site exploration, laboratory testing, and geotechnical analyses will be performed to develop final plant design criteria for the construction permit and combined license phase of the project.

No activity involving exploration, drilling, or otherwise extracting minerals occurs at the Grand Gulf site. 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 (SERI 2003c).

2.5 Radiological Environment

A radiological environmental monitoring program (REMP) has been conducted around the Grand Gulf site since 1978. The preoperational program established information on background radiation in the environment (AEC 1973). After GGNS Unit 1 began operation in 1985, the REMP monitored the following: air, water, sediment, fish and food products, and direct radiation. Milk is also sampled when there is commercial milk production within 8 km (5 mi) of the site. The REMP has indicator and control locations within a 29-km (18-mi) radius of the site. Sample results from the indicator locations are compared to the control locations and preoperational data to determine (1) pathways for radionuclides released into the environment, (2) potential buildup of long-lived radionuclides, and (3) potential exposure to plants and animals. The results of this monitoring are documented in an annual environmental operating report for GGNS. The staff reviewed historical data from the REMP reports for the past 3 years and found that environmental measurements of this time period were similar to those during the preoperational monitoring phase (Entergy 2002b; 2003b; 2004b).

Each year, Entergy issues a report titled "Annual Radioactive Effluent Release Report," which documents gaseous and liquid releases and potential doses from GGNS. The staff reviewed annual radioactive effluent release reports for calendar years 2001, 2002, and 2003 (Entergy 2002a; 2003a; 2004a). Maximum doses to a member of the public were calculated using effluent concentration and historical annual average meteorological data for the site. For the 3 years of data reviewed, the maximum annual dose to a member of the public was estimated to be 0.017 mSv (1.7 mrem). The data showed that doses to the maximally exposed individuals around GGNS were a small fraction of the limits specified in Federal environmental radiation standards (10 CFR Part 20; 10 CFR Part 50, Appendix I; 40 CFR Part 190). In addition to the environmental monitoring program conducted by GGNS, information on the State's environmental monitoring program was reviewed.

2.6 Water

This section describes the hydrological processes and physical site features that define the movement, distribution, and quality of surface water and groundwater at the Grand Gulf ESP site. Additionally, this section describes the current and likely future uses of water at the site to meet the various water needs of the population in the vicinity. The existing GGNS plant has significantly altered the local hydrological environment and is included as a key feature of the affected environment. Hydrological, thermal, and chemical monitoring programs for the existing GGNS provide an important source of information for understanding the current environmental baseline and the likely incremental impacts of the Grand Gulf ESP facility on the water resources in the vicinity.

2.6.1 Hydrology

This section describes the site-specific and regional hydrological features of the existing environment that could be altered by the construction, operation, or decommissioning of the proposed new facility. A description of the site's hydrological features was presented in Section 2.3.1 of the environmental report (SERI 2003c). The hydrological features of the site related to site safety (e.g., probable maximum flood) are described by SERI in the Site Safety Analysis Report portion (Part 2) of the application (SERI 2003b).

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. These three areas can be seen in Figure 2.2. In the following sections, the surface and subsurface hydrology are discussed for each of the three areas. Additionally, surface and subsurface hydrological monitoring programs are discussed.

2.6.1.1 Surface Water Hydrology

Mississippi River

With an average discharge of 16,800 m^3/s (593,000 cfs) draining 2,980,000 km^2 (1,150,000 mi^2), the Mississippi River is the largest river in the United States. 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. The depth of the thalweg of the Mississippi River at the site is about 4.9 m (16 ft) below MSL. Historically, the Mississippi River near the site has been very active with frequent changes in the channel alignment and thalweg (Schumm et al. 1994). However, the Mississippi River is now subject to the management and control of the U.S. Army Corps of Engineers (ACE).

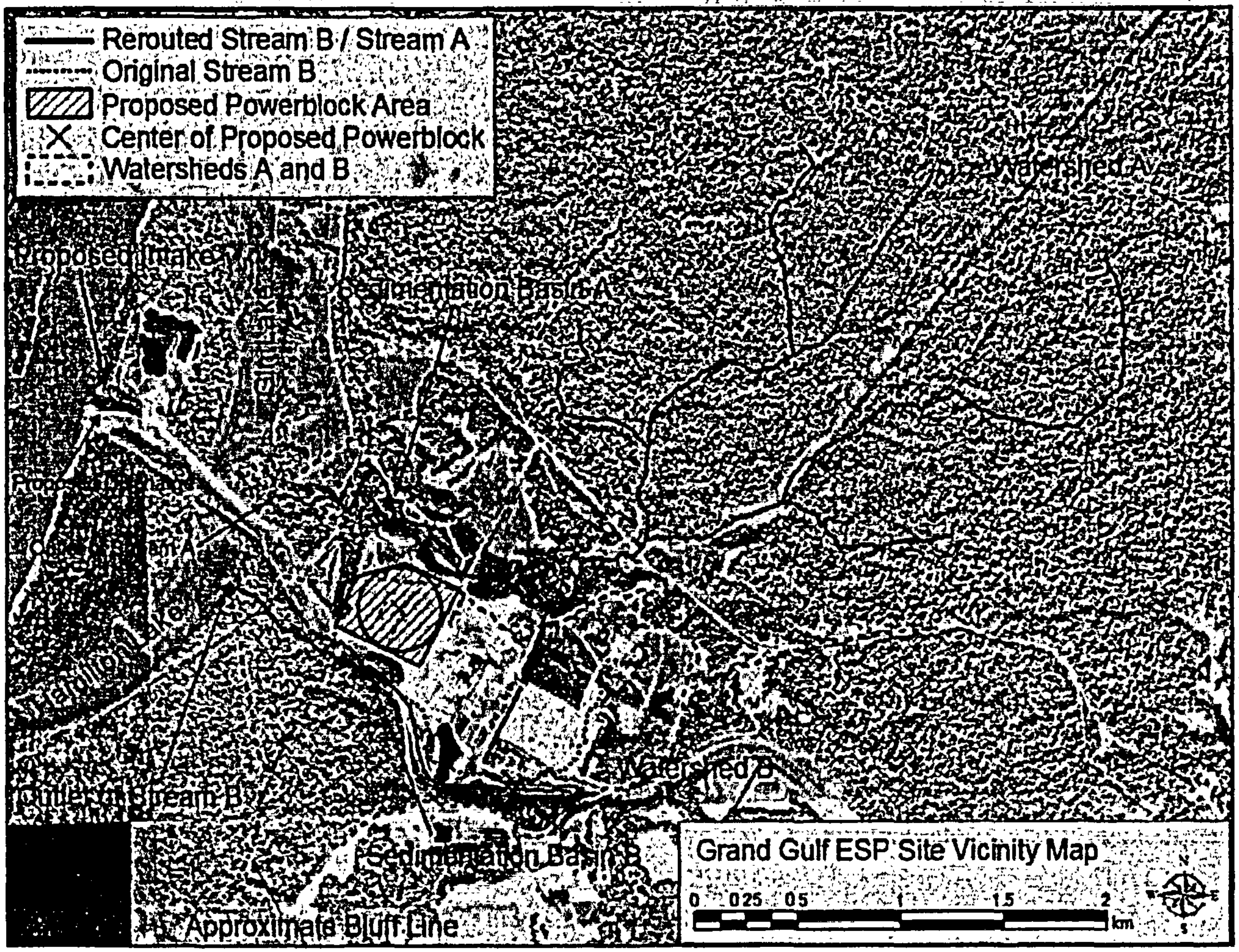

Figure 2-2. Surface Drainage Plan for the Grand Gulf Early Site Permit Site (SERI 2003c, Figure 2.3-1)

Through an aggressive and ongoing program of dredging, installation of river bank revetments and armor, levee construction and maintenance, and upstream reservoir regulation, the ACE has stabilized the historical movement of the river into a relatively stable channel alignment. 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.

The Mississippi River flow varies considerably throughout the year and between years. Based on streamflow data from Vicksburg, Mississippi from 1929 through 1983, the 7-day, 10-year low flow and 100-year flood have been estimated at 3400 m^3/s (127,000 cfs) and 62,380 m^3/s (2,203,000 cfs), respectively (van der Leeden et al. 1990). February, March, April, and May are the months with the highest mean monthly discharges and as such are the periods that the river would most likely rise over its normal banks inundating the adjacent lowland floodplain.

Lowland Plain

The lowland plain of the Grand Gulf ESP site is the area between the Mississippi River and the bluffs. With an elevation of about 20 m (70 ft) above MSL, the lacustrine or palustrine wetlands of the lowlands are subject to nearly annual inundation by the Mississippi River. In periods when the Mississippi is not inundating the lowlands, movement of water through the lowlands is primarily associated with the streamflow of small tributaries that drain the uplands into Hamilton Lake before joining the Mississippi River. Both Gin Lake and Hamilton Lake, within the lowlands, show the characteristics of shallow oxbow lakes formed by the historic migration of the Mississippi River. Construction of a haul road from the GGNS site to the Mississippi River divided the lowlands. A buried pipeline follows the path of the haul road and discharges GGNS's cooling tower blowdown to a small embayment along the Mississippi River.

Uplands

Based on digital topographic data, the staff delineated the two upland watersheds and their associated stream channels as shown in Figure 2-2. These watersheds correspond closely to those presented by SERI in the environmental report (SERI 2003c). Following the naming convention used by SERI, the two watersheds are called "A" and "B." Watershed A lies to the north of Watershed B. The staff estimated the areas of Watershed A and Watershed B as 7.61 km^2 (2.94 mi^2) and 1.76 km^2 (0.68 mi^2), respectively.

The watersheds are very distinct in nature. Whereas Watershed A is mostly covered with a dense canopy of trees and brush, the majority of Watershed B has been cleared of vegetation for the GGNS site. The stream channel in Watershed A follows its natural course, whereas the course of the stream channel in Watershed B has been altered, and the channel lined to provide drainage for the GGNS site. The alterations to the Watershed B have resulted in it behaving more like urban watershed with flashy responses to rainfall with little or no baseflow, whereas Watershed B responds like a forested watershed with a more attenuated response to rainfall and continuous baseflow.

Sedimentation basins were constructed on both stream channels downstream from the existing site. However, because of the greater flow and higher sediment load, the sediment basin on Stream A has been filled with sediment and now represents more of a constructed wetland than a basin to trap sediment. Because of the lower flow and lower sediment yield, the sediment basin in Watershed B remains a viable trap for sediment.

The local precipitation is relatively uniform throughout the year. With an average annual precipitation of 130 cm (53 in.), eight months have average monthly precipitation of 10 to 15 cm (4 to 6 in.) and four months have average monthly precipitation of 5 to 10 cm (2 to 4 in.). March and October are the months with both the highest and lowest monthly average precipitation and runoff, respectively. Because of the relatively warm winters, the region experiences little precipitation as snow.

2.6.1.2 Groundwater Hydrology

Several important aquifer systems are in the vicinity of the proposed site including: Mississippi River Valley Alluvial Aquifer system, Coastal Lowlands Aquifer system, and the Mississippi Embayment Aquifer system. The site is within the very northern extent of the Coastal Lowlands Aquifer system and in the center of the Mississippi Embayment Aquifer system.

During the subsurface investigation completed for the existing Grand Gulf Unit 1, 275 borings were drilled within the site area to maximum depth of 136 m (447 ft). An additional 3 borings were performed as part of SERI's ESP site characterization activities. These borings provide the basis of the description of the of stratigraphy at the Grand Gulf ESP site.

At this time, a plant design has not been selected, and the specific footprint and embedment depth of the plant have not been determined. After a plant design has been selected, additional site exploration, laboratory testing, and geotechnical analyses will be performed to develop final plant design criteria for the combined license phase of the project.

Mississippi River

The morphology of the Mississippi River has defined much of the alluvial aquifer system near the site. The Holocene alluvium near the river has been affected by deposition and erosion. Faster-moving sections of the river are able to scour and cut down to the Catahoula formation, whereas slower-moving sections of the river provide an opportunity for the sediment in the river to deposit.

Beneath and adjacent to the river, the alluvium is in close hydraulic connection with the river. The fluctuation of the Mississippi River causes fluctuation in the alluvial aquifers. Generally, at the site the alluvium discharges to the river. However, during floods the direction of flow in the alluvial aquifers can reverse.

The GGNS cooling system uses radial (Ranney) wells reaching out beneath the Mississippi River stream bed to induce river water to migrate through the alluvium to the collectors. The connection between the alluvium and the river means that the existing plant is essentially using river water and not groundwater. The radial well system lets the existing plant use the alluvial aquifer to filter out the sediment in the river water without resulting in significant impacts to the local groundwater resources.

Lowland Plain

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. The lowland, west of the bluffs, at an elevation of about 20 m (70 ft) above MSL, consists of a layer of Holocene alluvium more than 30 m (100 ft) thick, including backswamp areas and meander belts of the Mississippi River. The Miocene Catahoula formation underlies the alluvium in the lowlands.

In addition to the effect of the Mississippi River, infiltration from local precipitation and shallow surface water bodies, such as Gin Lake and Hamilton Lake, can recharge the lowland alluvial aquifer. The unconfined water surface in the alluvial aquifer in the lowlands is at most a few feet beneath the ground surface. The aquifers in the deeper Catahoula formation are more likely to be recharged via lateral flow from outcrops a distance from the site.

Upland

The surface of the upper plain is about 23 m (75 ft) of loess overlaying about 10 m (40 ft) coarse-grained alluvial sand and gravel deposits of the Upland Complex. The unconfined aquifer in the loess and alluvium is recharged from local precipitation and lateral movement. The water table elevation is not significantly influenced by the fluctuations in the Mississippi River. The Catahoula formation underlies the terrace deposits in the upland.

2.6.1.3 Hydrological Monitoring

Preoperational and ongoing operational monitoring of the GGNS facility provide a limited hydrological baseline of the affected environment within and near the Grand Gulf ESP site. Many of the construction impacts of an ESP facility at the site are likely to be similar to the impacts that occurred during construction of the existing plant. For instance, groundwater drawdowns caused by dewatering wells are likely to have similar impacts to the impacts experienced and monitored during the construction of the GGNS facility.

The flow and water surface elevation of the Mississippi River are continuously monitored by the ACE and the U.S. Geological Survey (USGS). A USGS stream gauge (Station 0789000) is upstream of the site at Vicksburg, Mississippi. The ACE also operates a station at Vicksburg (Station #15145) and a station downstream from the site at Natchez, Mississippi (Station #15155). The ACE also publishes a hydrographic survey, including the maps of the riverbed elevations of the Mississippi River adjacent to the site.

As part of the GGNS National Pollutant Discharge Elimination System (NPDES) permit, streamflows are monitored on Stream A and Stream B downstream of Sedimentation Basin A and Sedimentation Basin B, respectively. For Stream A, SERI reported annual average flows of 0.00954 m^3/s (0.337 cfs) for 1999 and 0.0934 m^3/s (3.30 cfs) for 2001. For Stream B, SERI reported annual average flows of 0.00832 m^3/s (0.294 cfs) for 1999 and 0.0138 m^3/s (0.487 cfs) for 2000. Additionally, flows are recorded for each of the outfalls from the GGNS facility discharging into Sedimentation Basin A, Sedimentation Basin B, and directly into the Mississippi River.

Total annual water withdrawals from radial wells adjacent to the Mississippi River, dewatering wells, and wells in the Catahoula formation for potable water supplies are reported to the MDEQ. 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.

Groundwater levels were initially measured in 1972 with 15 piezometer and 36 observation well locations (SERI 2003b). The number of locations in the Catahoula formation, terrace deposits, and alluvium was 10, 33, and 8, respectively. These data reported by SERI for 1972 through 1976 provide a baseline for the pre-GGNS groundwater elevations. The data show both inter-annual and intra-annual variation in the three strata of as much as 12 m (40 ft). While the magnitude of water surface changes vary considerably between wells, generally the direction of water surface change is consistent (i.e., all wells and strata increase and decrease together), suggesting that the three strata have some degree of hydraulic connection.

Water levels in one piezometer, nine observation wells, seven monitoring wells and eight dewatering wells in the Catahoula formation, terrace deposits, and alluvium are measured monthly. The number of locations in the Catahoula formation, terrace deposits, alluvium, and perched aquifers in the fill around the GGNS reactor block are 2, 5, 2, and 15, respectively. The environmental report (SERI 2003c) contains recent groundwater sampling data from published sources and from results of ongoing monitoring programs at the GGNS site.

The NRC staff found the hydraulic conductivity information from various permeability tests reported by SERI for the Catahoula formation is currently inadequate to provide a reliable basis to estimate the groundwater drawdowns associated with withdrawals from this formation. Prior to issuance of a COL, the applicant would be required to implement a subsurface characterization and groundwater monitoring program consistent with the specific design (location, embedment depth, etc.) of the new facility. However, other than these exceptions, the staff found that continuation of the existing monitoring program would provide an adequate hydrological monitoring program.

2.6.2 Water Use

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. SERI presented estimated water use data for 1995 in Claiborne County. The NRC staff used 2000 data from the USGS (USGS 2004). The staff found that total estimated water use in Claiborne County was 130,000 m^3/d (34.3 MGD). Groundwater comprises all of that total except 1600 m^3/d (0.4 MGD) of surface water.

2.6.2.1 Surface Water Use

Although surface water is not directly used at the existing GGNS, the facility withdraws groundwater that is hydraulically connected to the river, as further described below. Total surface water withdrawals in Claiborne County are predominantly for agricultural use, with no surface water usage reported for public supply, domestic self-supplied systems, mining, hydroelectric power, thermoelectric power, industrial or commercial uses (SERI 2003c).

The nearest downstream user of Mississippi River water is Southeast Wood Fiber located at the Claiborne County Port facility, 1.3 km (0.8 mi) downstream of the Grand Gulf ESP site. The maximum intake requirement for this facility is less than 3400 m^3/d (0.9 MGD) for industrial purposes; however, none of this intake is used as potable water (MDEQ 2004b). There are only three public water supply systems in the state of Mississippi that use surface water as a source, and none of these are located within 80 km (50 mi) of the Grand Gulf ESP site (SERI 2003c).

There are no downstream or upstream intakes in Mississippi within 160 km (100 mi) of the Grand Gulf ESP site that use the Mississippi River as a potable water supply (MDEQ 2002).

The ACE maintains a depth of 3 m (9 ft) at low water on the Mississippi River for navigational uses.

2.6.2.2 Groundwater Use

Service water for the existing GGNS is supplied from radial (Ranney) collector wells located beneath and adjacent to the Mississippi River. The collector wells pump water from the Mississippi alluvial aquifer via induced infiltration from the Mississippi River (Entergy 2003c).

Total groundwater withdrawal in Claiborne County for 2000 was 128,000 m^3/d (33.9 MGD), with the majority used for cooling at GGNS.

Entergy Operations, Inc., is required to submit an Annual Water Use Survey to the MDEQ. According to the recent data for the 2003 calendar year, the facility currently lists 7 active wells with a total of 0.116 million L/d (30.8 MGD) pumped in 2003. All of this water was pumped from the four radial collector wells except 0.302 million L/d (0.08 MGD) pumped from three wells in the Catahoula formation used for general site purposes including potable, sanitary, air conditioning, and landscape maintenance.

Public water supply wells in Claiborne County, excluding GGNS, are supplied from the Catahoula formation. Nine active public water supply systems were located in Claiborne County as of July 2004 (EPA 2004). The closest area of concentrated groundwater withdrawal is the Port Gibson municipal water system about 8 km (5 mi) southeast of the site. It pumps from five wells completed in the Catahoula formation and is the largest system in the county, serving a population of 4845. Within 3.2 km (2 mi) of the Grand Gulf ESP site, essentially all groundwater is used for domestic purposes.

SERI estimated future groundwater demands in the vicinity of the site on the basis of projected population growth. According to the population projections (SERI 2003c), the population within a 3.2-km (2-mi) radius of the Grand Gulf ESP site will increase by 14 percent to 58 persons by the year 2070 (excluding GGNS plant personnel). Current water use in this area is primarily for domestic consumption (SERI 2003c). Conservatively assuming the entire projected population used groundwater as a source, and each person used 382 L/d (101 GPD) (Carr et al. 1990), the estimated groundwater withdrawal within a 3.2-km (2-mi) radius of the Grand Gulf ESP site by the year 2070 will be 22,200 L/d (5860 GPD). Much of that groundwater consumption would likely return to the surficial aquifer via septic drainfields. A listing of water wells within a 6.4-km (4-mi) radius of the Grand Gulf ESP site can be found in SERI (2003c).

2.6.3 Water Quality

Surface water and groundwater quality in the vicinity of the ESP site are adequate for a variety of uses. The water quality of the Mississippi River and the two small onsite drainages, Stream A and Stream B, has been slightly altered by the construction and operation of the GGNS facility. The induced infiltration from the operation of the GGNS radial wells has ensured that the quality of the groundwater in the vicinity of the radial wells is nearly identical to the water quality of the Mississippi River, except for suspended sediment. The water quality of the groundwater in the Catahoula formation does not appear to have been influenced by the construction or operation of the GGNS facility.

2.6.3.1 Surface Water Quality

The Mississippi River integrates the qualities of all its multitude of inflows throughout its course to the Grand Gulf site. 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. The water quality of the Mississippi is monitored by the USGS at Vicksburg, Mississippi upstream of the Grand Gulf ESP site. 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. The Mississippi River water is generally hard to very hard and therefore requires softening to avoid scale formation when heated.

At the Grand Gulf site, water quality of Streams A and B (see Figure 2.2) is affected by the GGNS facility. Stream A is generally unaffected by the GGNS facility until it reaches Sedimentation Basin A. At this location, discharges include: storm water runoff, standby service water leakage, treated sanitary wastewater, and miscellaneous wastewater from the GGNS Energy Services Center, including water softener backwash and air-conditioning cooling tower blowdown. These sources contribute nutrients, chlorine, and sediment to the sedimentation basin. In compliance with its National Pollutant Discharge Elimination System (NPDES) permit, Entergy Operations, Inc., is required to monitor these. The maximum monthly average nutrient concentration of the sanitary waste treatment system reported by SERI, expressed in terms of biological oxygen demand (BOD_5), for 2000 and 2001 was 25 mg/L. The maximum total suspended solids from the combined outflow from Sediment Basin A reported by SERI for 1999, 2000, and 2001 was 97 ppm.

The watershed and channel for Stream B were nearly entirely modified as a result of the construction of the GGNS facility. The water quality of Stream B has been altered by the loss of the vegetation and soil cover. 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. Sedimentation Basin B also receives standby service water leakage, intermittent circulating water basin overflows, storm water runoff, and water from a variety of building drains. In compliance with its NPDES permit, Entergy Operations, Inc., is required to monitor these sources. The maximum amount of total suspended solids the combined outflow from Sedimentation Basin B reported by SERI for 1999, 2000, and 2001 was 26 ppm.

2.6.3.2 Groundwater Quality

The GGNS facility uses radial wells adjacent to and with laterals extending beneath the Mississippi River to provide cooling water. The high rate of water induced to infiltrate from the Mississippi River into the Holocene alluvium has ensured that the dissolved solids concentrations of the groundwater in the vicinity of the radial wells are nearly identical to the water quality of the Mississippi River. Suspended sediment in the river water is trapped in the stream bed, thereby reducing the suspended solids in the cooling water. The water quality of the groundwater in the Catahoula formation does not appear to have been influenced by the construction or operation of the GGNS facility.

The GGNS uses wells in the Catahoula formation as the source of water for several purposes, including potable water needs. The water is sampled for the Mississippi Health Department pursuant to the Safe Drinking Water Act. The water quality of the groundwater from the Catahoula formation, although very hard, is suitable for potable uses. Water quality generally decreases as wells go deeper below the Catahoula formation.

2.6.3.3 Thermal Monitoring

Pre-application, pre-operational, and ongoing operational monitoring of the GGNS facility provide a limited baseline of the temperatures in the Mississippi River. The operational impact of the additional thermal load in the cooling tower blowdown from the Grand Gulf ESP facility would be additive to the thermal impact of the GGNS facility. It is expected that the discharge volume would increase, but discharge temperature would not change. Therefore, the existing thermal plume would increase in area, but would not have a higher maximum temperature. Adequate temperature baseline data can be developed from the existing plant's discharge to calibrate and validate thermal plume models such as CORMIX. (See Section 5.3.2 for a discussion of the thermal analysis performed by the NRC staff using the CORMIX model.)

However, the NRC staff found the thermal plume data for the existing GGNS discharge are currently inadequate to calibrate the CORMIX model. Prior to issuance of a COL, the applicant would be required to collect sufficient temperature data at a variety of locations and a variety of stream conditions to calibrate the CORMIX model. It is expected that this same information would also be used by the COL applicant in the 316(a) demonstration that will be required by

MDEQ pursuant to the Clean Water Act. Other than this exception, the staff found that continuation of the existing new operational monitoring program would provide an adequate thermal monitoring program for a new power generation facility at the Grand Gulf ESP site.

2.6.3.4 Chemical Monitoring

Pre-application, pre-operational, and ongoing operational monitoring of the GGNS facility provide a limited water quality baseline of the affected environment within and near the proposed Grand Gulf ESP site. Many of the operational impacts of an ESP facility at the site are likely to be similar to the impacts that are occurring as a result of the existing plant. For instance, nutrient loads to Sedimentation Basin A from the sanitary treatment system are likely to increase proportionally to the increase in staff for both facilities. The current water quality baseline data can be used to calibrate and validate mixing models such as CORMIX. (See Section 5.3.2 for a discussion of the chemical mixing analysis performed by the staff using the CORMIX model.)

As no specific design has been selected, water treatment and waste water designs are currently unknown. Water treatment is likely to be required to improve the quality of water withdrawn from the Mississippi River that is proposed to be used in the closed-cycle cooling system. Other than the sanitary effluents, there currently is no basis to evaluate the suitability of the current monitoring program to fit the needs of the ESP liquid effluents. Prior to operation, the applicant for a COL at the Grand Gulf ESP site would be required to define the effluents and obtain an NPDES permit from MDEQ.

2.7 Ecology

The vast majority of the Grand Gulf site has been left undisturbed since construction of the GGNS Unit 1. The site is roughly bisected by a north-south line of bluffs located parallel to and east of the Mississippi River. The Grand Gulf site consists of seasonally inundated bottomland west of the bluffs along the river and uplands atop the bluffs. About one-half of the site is bottomland, including forested, shrub, and emergent marsh wetlands. 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. The Grand Gulf ESP site consists primarily of upland hardwood forest and bottomland forested wetlands. 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.

Sections 2.7.1 and 2.7.2 provide general descriptions of terrestrial and aquatic environments near the Grand Gulf ESP site. Detailed descriptions, where needed to support the analysis of the potential environmental impact from construction, operation, and decommissioning of new nuclear power generating facilities, are provided. The descriptions are provided to support mitigation activities identified during the assessment to avoid, reduce, minimize, rectify, or compensate for potential impact. Descriptions are also provided to help compare the alternatives to the Grand Gulf ESP site. Also included are descriptions of monitoring programs for terrestrial and aquatic environments.

2.7.1 Terrestrial Ecology

The Grand Gulf ESP site overlaps the Mississippi Valley Alluvial Plain and Mississippi Valley Loess Plains ecoregions as described by Omernik (1987). The Mississippi Valley Alluvial Plain ecoregion consists of a broad, flat alluvial plain with river terraces, swales, and levees providing the main elements of relief. Soils are typically finer-textured and more poorly drained than the upland soils of the adjacent Mississippi Valley Loess Plains ecoregion. Bottomland deciduous forest vegetation covers the Mississippi Valley Alluvial Plain ecoregion where it has not been cleared for cultivation. The Mississippi Valley Loess Plains ecoregion consists primarily of irregular plains, some gently rolling hills, and bluffs near the Mississippi River. Thick loess is one of the distinguishing characteristics. Oak-hickory and oak-hickory-pine forest was the natural vegetation in this ecoregion. In the Mississippi portion of this ecoregion there is a mosaic of forest and cropland (Omernik 1987).

Reconnaissance visits to the Grand Gulf site were made by Enercon Services, Inc. (Enercon), on behalf of SERI, during August 19-24 and October 29-November 1, 2002 (SERI 2004d, Attachment 16). The purpose of these visits was to identify jurisdictional waters of the United States including wetlands, and qualitatively assess existing ecological resources (including vegetation and wildlife) for comparison with descriptions provided in Mississippi Power and Light's (MP&L's) Final Environmental Report (1973). Information provided in the MP&L Final Environmental Report was based on field surveys conducted from June 1972 to August 1973 prior to construction of GGNS Unit 1 (SERI 2003c).

Figure 2-3 is an aerial photograph of the Grand Gulf area taken in 1971, prior to construction of the GGNS Unit 1. Figure 2-4 is an aerial photograph taken in 2001 depicting the GGNS Unit 1 and proposed construction areas for the Grand Gulf ESP facility. A comparison of Figures 2-3 and 2-4 shows the vast majority of the Grand Gulf site has been left undisturbed since construction of the GGNS Unit 1. It is noteworthy, however, that the main channel of the Mississippi River north of the barge slip (Figure 2-4) has moved to the east in the intervening 30 years, as evidenced by the property line extending into the river. This represents a loss of about 34 ha (85 ac) of terrestrial habitat. The ACE has stabilized the banks of the river by constructing revetments; therefore, further erosion of the eastern bank is not anticipated (SERI 2003c).

The conclusion drawn from the Enercon reconnaissance visits and comparison of Figures 2-3 and 2-4 is that the ecological descriptions in the final environmental report (MP&L 1973)

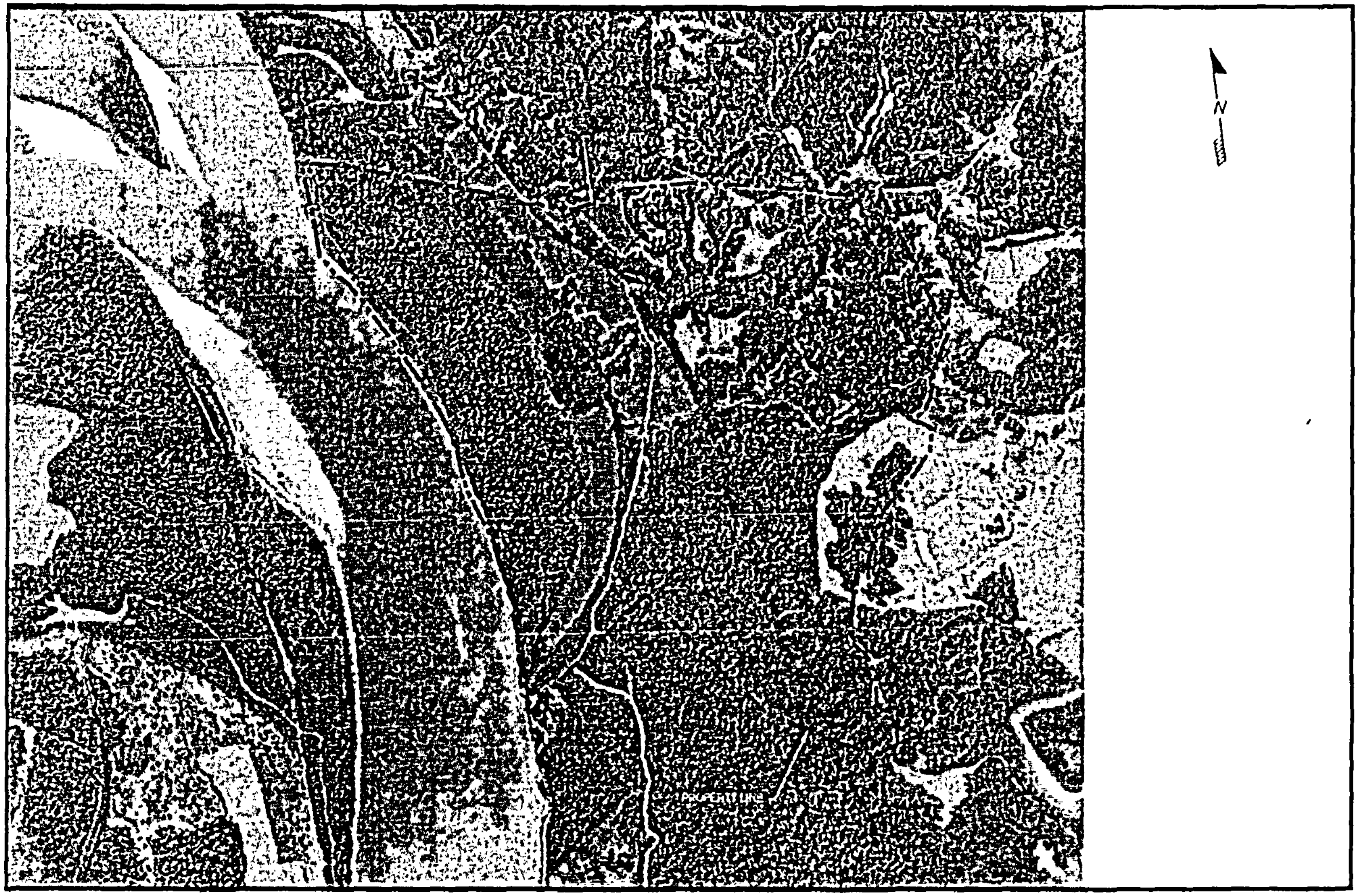

Figure 2-3. Aerial Photograph of the Grand Gulf Area (October 11, 1971) Prior to Construction of Grand Gulf Nuclear Station Unit 1 Facility (SERI 2003c, Figure 2.4-1)

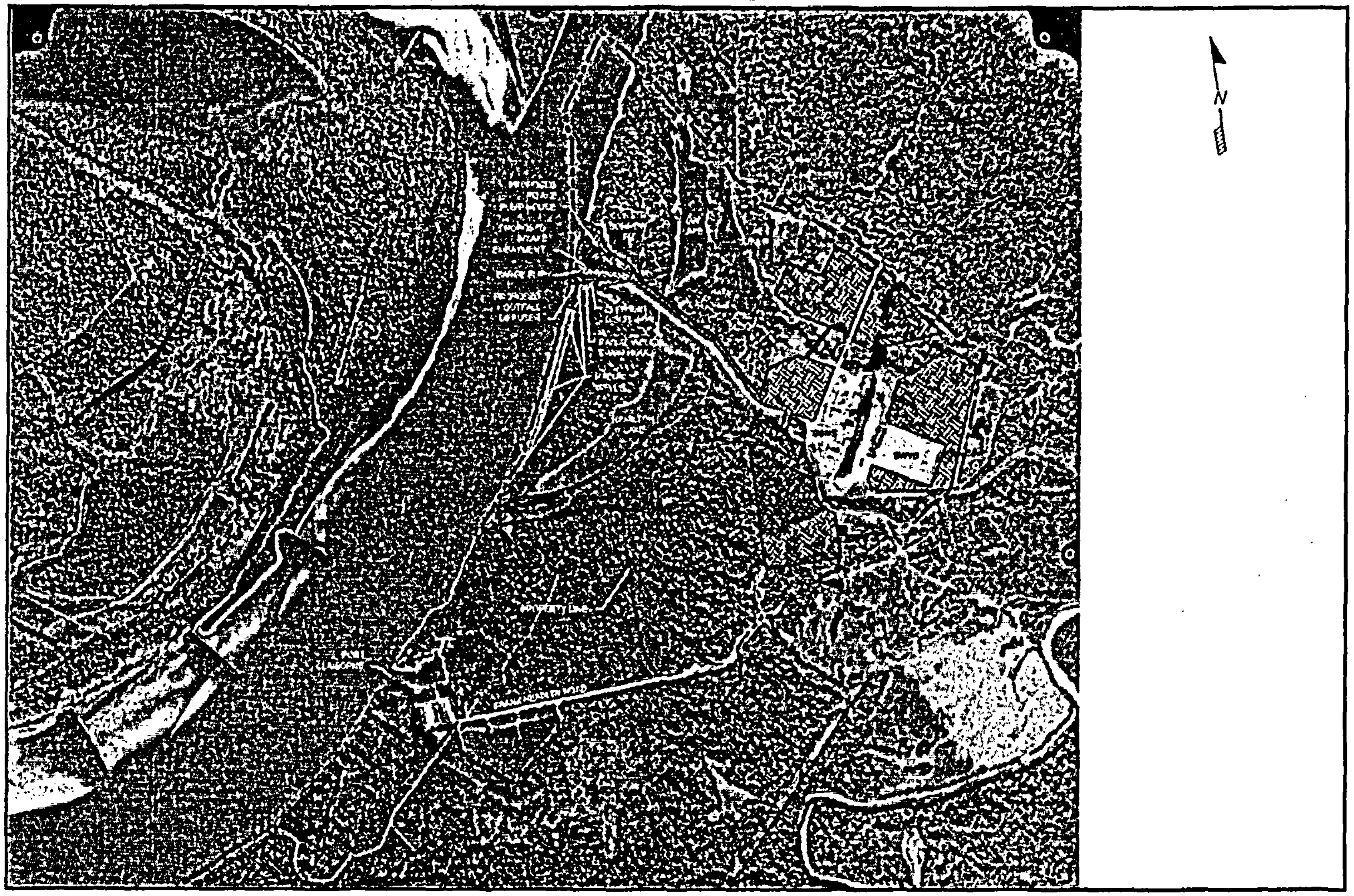

Figure 2-4. Aerial Photograph Depicting the Grand Gulf Nuclear Station Unit 1 (November 21, 2001) and Construction Areas for the Proposed Grand Gulf Early Site Permit Facility (SERI 2003c, Figure 2.4-2)

adequately describe current conditions at the Grand Gulf site (SERI 2003c). Consequently, the final environmental report descriptions (updated with information to indicate where biological conditions at the Grand Gulf site differ from those in existence prior to construction of GGNS Unit 1) were incorporated into the environmental report for the Grand Gulf ESP (SERI 2003c) and are extensively used for the following descriptions of terrestrial ecological resources.

2.7.1.1 Biological Communities

Vegetation on the Grand Gulf Site

About one-half of the Grand Gulf site is bottomland, including forested, shrub, and emergent marsh wetlands. The other half of the site supports upland habitat types, including forests, fields, and small wetlands, in areas that were not cleared during construction of the GGNS Unit 1 (SERI 2003c).

During 1972 and 1973, before the construction of the GGNS Unit 1, at least 420 species of vascular plants representing 285 genera and 105 families were observed on the site (MP&L 1973; SERI 2003c). Of the 64 tree species, all but three are deciduous (SERI 2003c). The composition of understory vegetation varied by location and season, with the largest number of plant taxa occurring in the uplands during the summer, and the smallest number of taxa in the bottomland during winter (SERI 2003c). The uplands are more diverse than the bottomland primarily because of the lack of Mississippi River inundation and its scouring effects on understory vegetation. Common plant taxa that were found in upland and bottomland forests are listed in Table 2-4.

Table 2-4. Common Plant Taxa in Bottomland and Upland Forests Prior to Construction of the Grand Gulf Nuclear Station Unit 1

Bottomland Forest		Upland Forest	
Common Name	**Scientific Name**	**Common Name**	**Scientific Name**
American buckwheat vine	*Brunnichia ovata*	American elm	*Ulmus americana*
asters	*Aster* spp.	asters	*Aster* spp.
bedstraw	*Galium* spp.	brittle bladderfern	*Cystopteris fragillis*
black willow	*Salix nigra*	crossvine	*Bignonia capreolata*
box elder	*Acer negundo*	eastern poison ivy	*Toxicodendron radicans*
chickweeds	*Stellaria* spp.	grasses	Family Poaceae
fleabanes	*Erigeron* spp.	greenbriars	*Smilax* spp.
dewberries	*Rubus* spp.	haircap moss	Family Musci
eastern poison ivy	*Toxicodendron radicans*	hickories	*Carya* spp.
false nettle	*Boehmeria cylindrica*	Japanese honeysuckle	*Lonicera japonica*
grasses	Family Poaceae	sedges	*Carex* spp., *Cyperus* spp.
green ash	*Fraxinus pennsylvanica*	smallflower baby blue eyes	*Nemophila aphylla*
Johnson grass	*Sorghum halepense*	southern red oak	*Quercus falcata*

Table 2-4. (contd)

Bottomland Forest		Upland Forest	
Common Name	**Scientific Name**	**Common Name**	**Scientific Name**
pecans	*Carya* spp.	swamp privet	*Forestiera acuminata*
peppervine	*Ampelopsis arborea*	sweetgum	*Liquidambar styraciflua*
sedges	*Carex* spp., *Cyperus* spp.	switchcane	*Arundinaria gigantea*
smallflower baby blue eyes	*Nemophila aphylla*	violets	*Viola* spp.
sugarberry	*Celtis laevigata*	Virginia creeper	*Parthenocissus cinquefolia*
trumpet creeper	*Campsis radicans*	water oak	*Quercus nigra*
vetches	*Vicia* spp.	winged elm	*Ulmus alata*
violets	*Viola* spp.		

Source: SERI 2003c

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 (since planted with loblolly pine [*Pinus taeda*] and American sycamore [*Platanus occidentalis*], respectively), and upland and bottomland wetlands. The distribution of these habitats, including areas currently developed for GGNS Unit 1 infrastructure and those proposed for construction of the Grand Gulf ESP facility, are shown in Figure 2-5. Most of the currently developed area is located in the uplands (SERI 2003c). The terrestrial habitats on the Grand Gulf site are described in the following paragraphs.

Bottomland Forest

Bottomland hardwood forests may be characterized as palustrine, seasonally flooded wetlands. This habitat covers approximately 358 ha (885 ac), most of the bottomland between the Mississippi River and the bluff line (Figure 2-5). Habitat characteristics of bottomland hardwood forests fluctuate seasonally with varying levels of inundation (SERI 2003c).

Herb, forb, and shrub layers are typically sparse because of the closed canopy and because the annual inundation by Mississippi River flood water retards vegetation growth. Opening the overstory canopy by means of storms, natural tree-fall, logging, or cultivation promotes the growth of sedges, grasses, and other low-growing vegetation, such as panicgrass (*Panicum* spp.), lizard's tail (*Saururus cernuus*), and trumpet creeper (*Campsis radicans*) (SERI 2003c).

Bottomland Emergent Wetlands

Bottomland emergent wetlands (dominated by plants that rise above the surface of the water) may be characterized as palustrine and seasonally flooded. These cover approximately 12 ha (30 ac) and are located at the south and north ends of Hamilton Lake (Figure 2-5). These wetlands are dominated by grasses, such as redtop panicgrass (*Panicum rigidulum*), and sedges (*Carex* spp.); their level of inundation varies seasonally and from year to year (SERI 2003c).

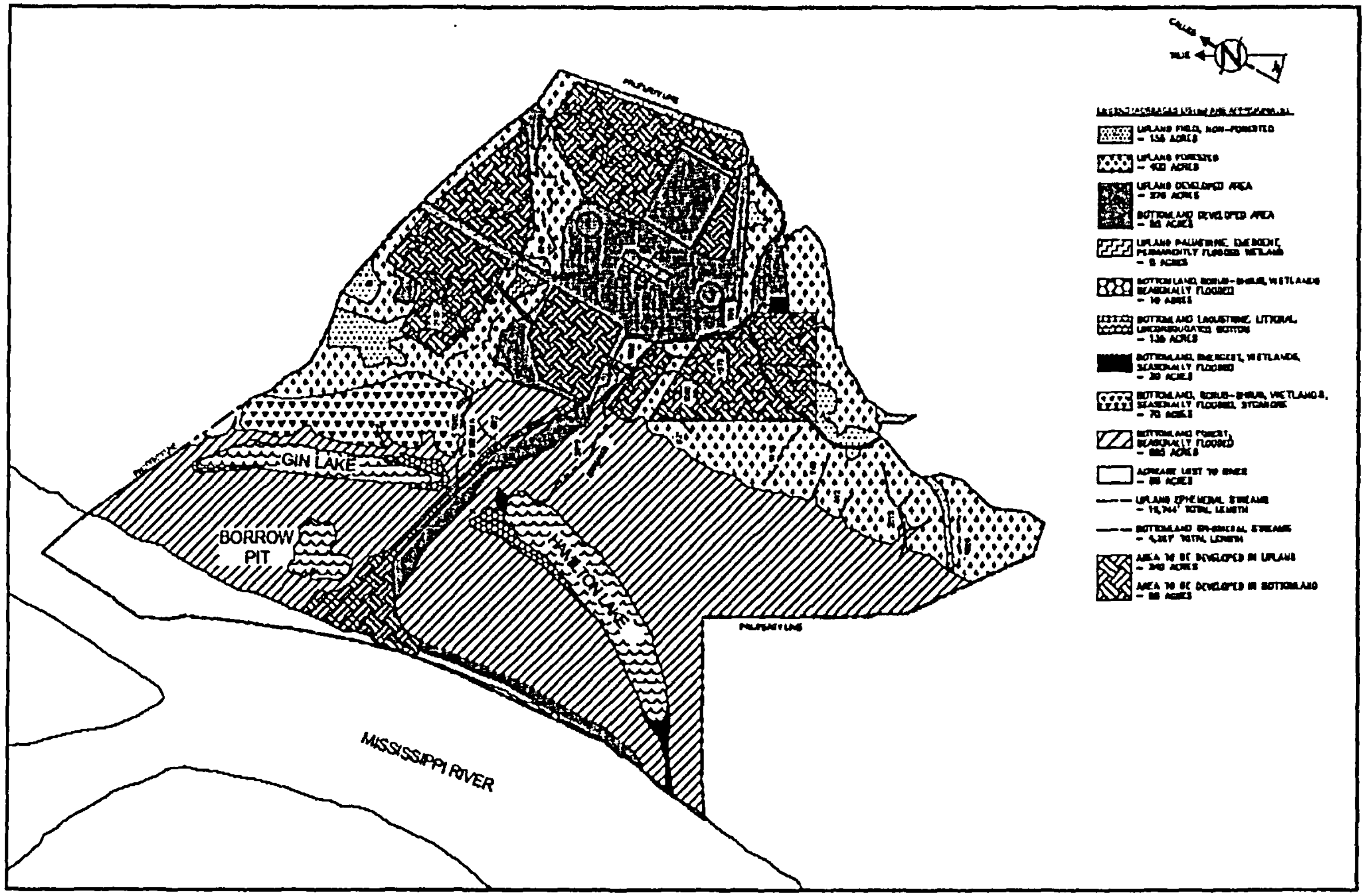

Figure 2-5. Terrestrial Habitat Types and Developed Areas on the Grand Gulf Site (SERI 2003c, Figure 2.4-3)

Bottomland Scrub-Shrub Wetlands

Bottomland scrub-shrub (dominated by sapling trees and shrubs) wetlands may also be characterized as palustrine and seasonally flooded. Those located east of Gin Lake (Figure 2-5) cover approximately 28 ha (70 ac) and most likely were a former bottomland field cultivated for forage that has been planted with American sycamore (SERI 2004i). The sycamores are probably fewer than 10 years old and are uniformly about 6 m (20 ft) in height. In November 2002, the perimeter of this area was found to have been recently cultivated to enhance deer habitat and attract deer to the area for hunting (SERI 2003c).

Other bottomland scrub-shrub wetlands are located on the north, northwest, and south ends of Gin Lake, and on the northwest bank of Hamilton Lake (Figure 2-5). These cover approximately 4 ha (10 ac) and are dominated by black willow (*Salix nigra*) and swamp privet (*Forestiera acuminata*). Little herbaceous understory vegetation occurs in these wetlands, probably because of recurrent flooding in spring. Commonbutton bush (*Cephalanthus occidentalis*) is found in these wetlands on the south end of Gin Lake (SERI 2003c).

Upland Forests

Upland hardwood forests are a combination of two forest community types, oak (*Quercus* spp.) American elm (*Ulmus americana*) and oak-sweetgum (*Liquidambar styraciflua*) deciduous forest. These dominate upland areas and cover approximately 162 ha (400 ac) (Figure 2-5). Like bottomland hardwood forests, the growth of understory vegetation in upland hardwood forests is limited by canopy closure. However, unlike bottomland forests, upland forests are rarely inundated for prolonged periods, so flooding is less a limiting factor on growth of understory vegetation. Consequently, upland forests exhibit a more diverse plant community than bottomland forests, both in structure and taxonomic composition (SERI 2003c).

Upland Fields

Upland fields cover approximately 63 ha (155 ac) (Figure 2-5). They have been planted with loblolly pine (SERI 2004i).

Vegetation along the Grand Gulf Nuclear Station Unit 1 Transmission Corridors

SERI did not indicate the vegetation communities (including wetland, floodplains, or special habitat areas) crossed by the GGNS Unit 1 transmission corridors (Baxter Wilson and Franklin lines) in its environmental report (SERI 2003c; SERI 2004d, Attachment 16). Further, no such information is available from the transmission and distribution system owner and operator (Entergy Mississippi, Inc.) (Entergy Services 2004a). SERI also did not indicate the power line right-of-way maintenance procedures in its environmental report (SERI 2003c; SERI 2004e). However, these generally consist of mechanical means (primarily bushhogging) that are performed on an as-needed basis (Entergy Services 2004b).

Wildlife on the Grand Gulf Site

Forests with diverse plant species and well-developed vertical structure provide many ecological niches that support diverse wildlife populations. The majority of the undeveloped portion of the Grand Gulf site consists of bottomland and upland hardwood forests. Hardwood forests, particularly those in the uplands, are diverse. Generally, as hardwood forests increase in age, the structure of their herb, forb, shrub, mid-story, and canopy layers also increases. Bottomland hardwood forests, while they may not be as rich in species as upland hardwood forests, can be highly productive in terms of wildlife, in part because of annual inundation that continually replenishes soil nutrients (SERI 2003c).

Hardwood forests provide the requirements of nesting birds, as well as migration corridors and stop-over habitat for neo-tropical and short-distance migrants. Likewise, hardwood forests provide travel corridors for mammals and habitat for other resident, ground-dwelling animals. Of special significance in hardwood forests is the production of beechnuts, acorns, and similar foodstuffs, collectively termed "mast." Mast is consumed by a variety of wildlife species. Older hardwood stands also feature trees with cavities of varying size that are important as wildlife dens and roosts (SERI 2003c).

<u>Mammals</u>

Table 2-5 lists the mammal species encountered on the Grand Gulf site in 1972 and 1973 prior to construction of the GGNS Unit 1 (SERI 2003c). The whitetail deer (*Odocoileus virginianus*) is the largest of these species. Based on the Enercon Services, Inc. (Enercon) October 2002 reconnaissance visit to the Grand Gulf site (SERI 2004d, Attachment 16), a substantial deer population continues to use both upland and bottomland forests. In October 2002, two areas were observed where a local archery hunting club comprising SERI employees had disked and seeded the ground with grass to attract wildlife. One area was in a natural clearing in a bottomland forest stand east of Radial Water Well No. 1. The other area was in a former bottomland field northwest of GGNS Unit 1 near Gin Lake. SERI (2003c) did not specify the sizes of the two treated areas, but they are on the order of several acres and thus comprise only a small portion of the Grand Gulf site.

Table 2-5. Mammals Collected or Observed Prior to Construction of Grand Gulf Nuclear Station Unit 1

Small Mammals		Large Mammals	
cotton mouse	*Peromyscus gossypinus*	armadillo	*Dasypus novemcinctus*
eastern chipmunk	*Tamias striatus*	beaver	*Castor canadensis*
eastern fox squirrel	*Sciurus niger*	bobcat	*Lynx rufus*
eastern gray squirrel	*Sciurus carolinensis*	eastern cottontail	*Sylvilagus floridanus*
fulvous harvest mouse	*Reithrodontomys fulvescens*	gray fox	*Urocyon cinereoargenteus*
golden mouse	*Ochrotomys nuttalli*	opossum	*Didelphis marsupialis*
hispid cotton rat	*Sigmodon hispidus*	raccoon	*Procyon lotor*
house mouse	*Mus musculus*	striped skunk	*Mephitis mephitis*
least shrew	*Cryptotis parva*	swamp rabbit	*Sylvilagus aquaticus*
woodland vole	*Microtus pinetorum*	whitetail deer	*Odocoileus virginianus*
marsh rice rat	*Oryzomys palustris*		
shorttail shrew	*Blarina brevicauda*		
white-footed mouse	*Peromyscus leucopus*		

Source: SERI 2003c

Based on the October 2002 Enercon reconnaissance visit to the Grand Gulf site (SERI 2004d, Attachment 16), beaver (*Castor canadensis*) use bottomlands and onsite streams, and raccoon (*Procyon lotor*), skunk (*Mephitis mephitis*), and various unidentified small mammals (for example, mice and shrews) use both uplands and bottomlands. Bottomlands are used by hogs. However, whether these are feral domestic hogs (*Sus scrofa*) or collared peccary (*Pecari tajacu*) is unknown (SERI 2003c).

Common Bird Species

The list of common bird species observed on or near the Grand Gulf site during the 1972 and 1973 censuses is too long to list here. A complete list can be found in SERI 2003c. Instead, groups of birds are discussed in the following paragraphs to provide an overview of the birds using the Grand Gulf site. The species discussed are considered common onsite, except where otherwise noted.

Forest Community Birds

Forest community birds include year-round, summer and winter residents. Examples include: the blue jay (*Cyanocitta cristata*) and northern cardinal (*Cardinalis cardinalis*), which are year-round residents); the Acadian flycatcher (*Empidonax virescens*) and yellow-billed cuckoo

(*Coccyzus americanus*), which are summer residents; and the American robin (*Turdus migratorius*) and ruby-crowned kinglet (*Regulus calendula*), which are winter residents. Field-forest community birds also include year-round, winter and summer residents. Examples include: the mourning dove (*Zenaida macroura*) and red-winged blackbird (*Agelaius phoeniceus*), which are year-round residents; the orchard oriole (*Icterus spurius*) and northern rough-winged swallow (Stelgidopterix serripennis), which are summer residents; and the field sparrow (*Spizella pusilla*) and lark sparrow (*Chondestes grammacus*), which are winter residents (SERI 2003c).

Water-Dependent Birds

Water-dependent birds observed on Hamilton and Gin Lakes include herons (for example, great blue heron [*Ardea herodias*], tricolored [Louisiana] heron [*Egretta tricolor*]), egrets (such as the cattle egret [*Bubulcus ibis*] and great [common] egret [*Ardea alba*]), ibis (such as the white ibis [*Eudocimus albus*]), wood stork or wood ibis (*Mycteria americana*), belted kingfisher (*Ceryle alcyon*), American coot (*Fulica americana*), pied-billed grebe (*Podilymbus podiceps*), and several waterfowl species (for example, the mallard [*Anas platyrhynchos*], northern pintail [*Anas acuta*], wood duck [*Aix sponsa*]). Use of the lakes by water-dependent species is seasonal. Of the water birds, only the wood duck, great blue heron, and belted kingfisher are permanent residents. The remaining species are primarily summer residents, with the exception of the American coot and pied-billed grebe, which occur in the area from fall through early spring (SERI 2003c).

Birds of Prey

Birds of prey include vultures (such as, the black vulture [*Coragyps atratus*] and turkey vulture [*Cathartes aura*]), hawks (for example the broad-winged hawk [*Buteo platypterus*], northern harrier [*Circus cyaneus*], red-shouldered hawk [*Buteo lineatus*], red-tailed hawk [*Buteo jamaicensis*], sharp-shinned hawk [*Accipiter striatus*]), falcons (such as the American kestrel [*Falco sparverius*]), kites (such as the Mississippi kite [*Ictinia mississippiensis*]), and owls (for example, the great horned owl [*Bubo virginianus*], and eastern screech-owl [*Otus asio*]). Black and turkey vultures, the red-tailed and red-shouldered hawks, and all the owl species are year-round residents. The broad-winged hawk and Mississippi kite are summer residents, and the northern harrier, American kestrel, and sharp-shinned hawk occur on site only during migration. With the exception of the northern harrier (an inhabitant of grasslands and marshes), woodlands and wooded margins are the preferred habitat for the birds of prey observed (SERI 2003c).

Upland Game Birds

Of the upland game birds observed, the mourning dove, northern bobwhite (*Colinus virginianus*), and wild turkey (*Meleagris gallopavo*) are year-round residents. The mourning dove is also the most abundant of the upland game birds onsite (SERI 2003c).

All the bird species noted above are considered to be common, with the exception of the wood stork and Louisiana heron (SERI 2003c).

Wildlife along the Grand Gulf Nuclear Station Unit 1 Transmission Corridors

SERI did not indicate wildlife or habitat within the GGNS Unit 1 transmission corridors (Baxter Wilson and Franklin lines) in its environmental report (SERI 2003c; SERI 2004d). Further, no such information is available from the transmission and distribution system owner and operator, Entergy Mississippi, Inc. (Entergy Services 2004a).

State-Listed Species

State-listed threatened and endangered terrestrial species that may occur in the vicinity of the Grand Gulf site are listed in Table 2-6. Location information for State-listed species within 3.2 km (2 mi) and 16 km (10 mi) of the Grand Gulf ESP site was obtained from the Mississippi Natural Heritage Program (MNHP) (MNHP 2004a; 2004b).

Animal Species

Three State-listed threatened and endangered terrestrial animal species are known to occur within 16 km (10 mi) of the Grand Gulf ESP site: the Florida panther (*Puma concolor coryi*), bald eagle (*Haliaeetus leucocephalus*), and least tern (*Sterna antillarum*). Two State-listed endangered terrestrial animal species are known to occur on the Grand Gulf site, the Louisiana black bear (*Ursus americanus luteolus*) and wood stork (*Mycteria americana*). The Florida panther, bald eagle, least tern, and Louisiana black bear are also Federally listed species and are described in Section 2.7.1.2.

The wood stork is a highly colonial species, usually nesting and feeding in flocks. The wood stork has been occasionally sighted in all states east of the Mississippi River, and sporadically sighted in some States west of the Mississippi River (FWS 1996). Breeding populations of the wood stork are Federally listed as endangered and currently occur or have recently occurred only in Alabama, Florida, Georgia, and South Carolina (49 FR 7332; FWS 1996). Thus, the above breeding populations are not considered in this environmental impact statement.

Non-breeding wood storks are known to occur within a 3.2-km (2-mi) radius of the Grand Gulf ESP site (MNHP 2004a). Wood storks were observed in summer on Gin and/or Hamilton lakes during 18 years prior to construction of the GGNS Unit 1 (AEC 1973). The wood stork should be considered a possible non-breeding transient to the Grand Gulf ESP site and vicinity (SERI 2003c; MNHP 2004a).

Table 2-6. State-Listed Terrestrial Species Occurring in the Vicinity of the Grand Gulf Early Site Permit Site

Scientific Name	Common Name	Status[(a)]	Distance from the Grand Gulf ESP Site[(b)]	Source
Mammals				
Puma concolor coryi	Florida panther	SE	>16 km (10 mi)	MNHP 2004b
Ursus americanus luteolus	Louisiana black bear	SE	onsite and <3.2 km (2 mi)	NRC 1981; MNHP 2004a
Birds				
Haliaeetus leucocephalus	bald eagle	ST	>16 km (10 mi)	MNHP 2004b
Mycteria americana	wood stork	SE	onsite and <3.2 km (2 mi)	AEC 1973; MNHP 2004a
Sterna antillarum	least tern	SE	>16 km (10 mi)	MNHP 2004b
Plants				
Mimulus ringens	Allegheny monkeyflower	S1-S2	17.6 km (11 mi)	SERI 2003c
Celastrus scandens	American bittersweet	S2-S3	3.2 km (2 mi) -- 16 km (10 mi)	MNHP 2004a; 2004b
Diplazium pycnocarpon	glade fern	S2-S3	3.2 km (2 mi) -- 16 km (10 mi)	MNHP 2004a; 2004b
Marsilea vestita	hairy waterclover	S1	3.2 km (2 mi) -- 16 km (10 mi)	MNHP 2004a; 2004b
Platythelys querceticola	jug orchid	S1?	3.2 km (2 mi) -- 16 km (10 mi)	MNHP 2004a; 2004b

(a) State status rankings developed by the MNHP; for animals SE = State endangered and ST = State threatened; for plants S1 = critically imperiled, S2 = imperiled, and S3 = rare (MNHP 2004a; 2004b). Hyphenated State ranks indicate a range in the status of the plant species based on insufficient data to make a determination. A question mark indicates uncertainty in the indicated status of the plant species.

(b) Species occurrences on the Grand Gulf site for the Louisiana black bear and wood stork are provided by NRC (1981) and AEC (1973), respectively. All distances are provided by MNHP (2004a; 2004b).

Plant Species

Four State-listed critically imperiled (endangered) or imperiled (threatened) plant species were identified through correspondence with the MNHP (2004a; 2004b). The two critically imperiled plant species are hairy waterclover (*Marsilea vestita*) and jug orchid (*Platythelys querceticola*). The two imperiled plant species are glade fern (*Diplazium pycnocarpon*) and American bittersweet (*Celastrus scandens*). All four species are known to occur beyond 3.2 km (2 mi) but within 16 km (10 mi) of the Grand Gulf ESP site (MNHP 2004a; 2004b). One State-listed critically imperiled/imperiled plant species, the Allegheny monkeyflower (*Mimulus ringens*), was mentioned in SERI's environmental report (SERI 2003c). The occurrence of the species nearest to the Grand Gulf ESP site is about 11 miles to the southwest along the west bank of the Mississippi River northeast of St. Joseph, Louisiana (SERI 2003c).

Hairy waterclover grows in creekbeds, wetlands, seasonal pools, ditches, flood basins, and on the shores of lakes and streams, and is adapted to fluctuating water levels (WSDOE 2004). In the southeast region of the United States, hairy waterclover is considered an obligate wetland plant, which occurs almost always under natural conditions in wetlands, per the Regional Interagency Review Panel Revision of the National List of Plant Species that Occur in Wetlands (NRCS 2004).

The jug orchid grows in the humus of swamps, hardwood forests, and hammocks (Garay 1977). In the southeast region of the United States, the jug orchid is considered a facultative wetland plant that usually occurs in wetlands, but occasionally is found in non-wetlands (NRCS 2004; USDA 2004c).

The glade fern grows in moist open woods, moist meadows, and swamps (Connecticut Botanical Society 2004). In the southeast region of the United States, the glade fern is considered a facultative plant that is equally likely to occur in wetlands or non-wetlands (NRCS 2004; USDA 2004c).

American bittersweet grows along roadsides, fence rows, and forest margins. In the southeast region of the United States, insufficient information is available to determine the status of this species as a wetland indicator (NRCS 2004; Oklahoma Biological Survey 2004; USDA 2004c).

The square-stemmed monkeyflower's preferred habitat consists of wet meadows, stream banks, and damp ditches (SERI 2003c).

2.7.1.2 Threatened and Endangered Terrestrial Species

This section describes Federally listed and proposed threatened and endangered terrestrial species and designated and proposed critical habitats that may occur on or in the vicinity of the Grand Gulf ESP site (Table 2-7). Information on Federally listed species, including their presence or absence in Claiborne County, was obtained from the U.S. Fish and Wildlife Service (FWS) (FWS 2004a; 2004b). Location information for Federally listed species within 3.2 km (2 mi) and 16 km (10 mi) of the Grand Gulf ESP site was obtained from the MNHP (2004a; 2004b).

Federally Listed Terrestrial Animal Species

Five Federally listed threatened or endangered terrestrial animal species that may occur on or in the vicinity of the Grand Gulf ESP site were identified through correspondence with FWS. These include the

- Florida panther (*Puma concolor coryi*) (SERI 2003c; MNHP 2004a, 2004b, and 2004c)

- American alligator (*Alligator mississippiensis*) (SERI 2003c; MNHP 2004a and 2004b), which is threatened based on similarity of appearance to the American crocodile (*Crocodylus acutus*) (52 FR 21059)

- Least tern (*Sterna antillarum*) (SERI 2003c; FWS 2004a) for the interior population only (FWS 1990b)

- Bald eagle (*Haliaeetus leucocephalus*) (SERI 2003c; FWS 2004a), which is threatened but currently proposed for delisting (64 FR 36454)

- Louisiana black bear (*Ursus americanus luteolus*) (SERI 2003c; FWS 2004a; MNHP 2004a and 2004b).

Two of these species, the American alligator and Louisiana black bear, are known to occur on the Grand Gulf site (SERI 2003c). No known activities by the Federal government that would change the list of species or add habitats to the list are under way (SERI 2003c; MNHP 2004a and 2004b; FWS 2004a).

<u>Florida Panther</u>

The historic range of the Florida panther was from Louisiana north and east to Tennessee and east to the Atlantic Ocean through most of the southeastern United States. Today only about 70 adult panthers remain in national and state parks and nearby private lands in southwest Florida (Florida Fish and Wildlife Conservation Commission 2004). The species is considered extirpated from the State of Mississippi.

Table 2-7. Federally Listed Terrestrial Species Occurring in the Vicinity of the Grand Gulf Early Site Permit Site

Scientific Name	Common Name	Status[a]	Distance from the Grand Gulf ESP Site[b]	Source
Mammals				
Puma concolor coryi	Florida panther	FE	>16 km (10 mi)	FWS 2004a
Ursus americanus luteolus	Louisiana black bear	FT	onsite and <3.2 km (2 mi)	FWS 2004a; NRC 1981
Birds				
Haliaeetus leucocephalus	bald eagle	FT	>16 km (10 mi)	FWS 2004a
Sterna antillarum	least tern	FE	>16 km (10 mi)	FWS 2004a
Reptiles				
Alligator mississippiensis	American alligator	FT (S/A)	onsite and <3.2 km (2 mi)	FWS 2004a; SERI 2003c

(a) Federal status rankings developed by the FWS under the Endangered Species Act (1973), FE = Federal endangered, FT = Federal threatened, FT (S/A) = Federal threatened by similarity of appearance (FWS 2004a).
(b) All distances provided by MNHP (2004a; 2004b).

The FWS has commented in the past on numerous sightings of the Florida panther "throughout its historic range," while stating that no viable populations of the Florida panther now occur outside of Florida (SERI 2003c). The MNHP has reported occurrences of the Florida panther within 3.2 km (2 mi) of the Grand Gulf ESP site (MNHP 2004c). However, this occurrence is from 1973 (MNHP 2004a) and is likely spurious because a viable population of Florida panthers has not been known in the state of Mississippi since the late 1800s (MNHP 2004d). Further, NRC recently requested that FWS provide information on Federally listed species that could occur on or in the vicinity of the Grand Gulf ESP site (NRC 2004b). The FWS response (FWS 2004a) did not include the Florida panther, indicating that it does not consider the species a possible resident in the area.

American Alligator

In 1967, the American alligator was classified as Federally endangered throughout its range, including Mississippi. By 1987, following several reclassification actions in other states, it was reclassified to "threatened based on similarity of appearance" to the American crocodile in the remainder of its range, including Mississippi (52 FR 21059). The alligator is no longer biologically imperiled in Mississippi. Its populations are considered disjunct, limited to available habitat, but stable. The declassification helps prevent excessive take of the alligator and protect the American crocodile (52 FR 21059).

During reconnaissance visits to the Grand Gulf site made by Enercon in August and October-November 2002, two alligators were observed, one in a small pond immediately adjacent to the waste water treatment facility on the site of GGNS Unit 1 and the other in the flooded borrow pit (SERI 2004d). Thus, alligators appear to be relatively common onsite. Because they pose a nuisance and safety hazard to site personnel, Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP) occasionally captures and relocates large alligators from the Grand Gulf site (SERI 2003c).

Bald Eagle

The bald eagle is a bird of aquatic ecosystems, frequenting major rivers, large lakes, reservoirs, estuaries, and some seacoast habitats. Fish are the major component of its diet, but waterfowl, seagulls, and carrion are also eaten. Bald eagles usually nest in large trees along shorelines in relatively remote areas that are free of disturbance (64 FR 36454). No critical habitat has been designated for this species (FWS 2004a).

In the region around the Grand Gulf ESP site, nest sites are usually in dominant living pine (*Pinus* spp.) or bald cypress trees (*Taxodium distichum*), and nesting activity usually occurs between September and January (FWS 2004a). Although a survey of the river shoreline at the Grand Gulf site has not been conducted, it appears to lack such trees. Bald eagles have been known to frequent Yucatan Lake, located across the Mississippi River west of the site (AEC 1973). However, there are currently no known bald eagle sightings within 16 km (10 mi) of the Grand Gulf ESP site (MNHP 2004b). Consequently, nesting on the Grand Gulf ESP site appears possible, though unlikely because of the apparent absence of suitable mature pine or cypress trees in the bottomland adjacent to the river. Bald eagle presence during the nesting season should be considered possible in the absence of an aerial or ground survey to confirm or deny the presence of nest trees.

Interior Least Tern

Interior least terns breed in the Mississippi and Rio Grande River Basins, from Montana to Texas, and from eastern New Mexico and Colorado to Indiana and Louisiana. From late April to August, they nest primarily on barren to sparsely vegetated sand and gravel riverine sandbars, dike field sandbar islands, sand and gravel pits, and shorelines of lakes and reservoirs. Interior least terns are colonial nesters with nests from a few meters to hundreds of meters apart. The wintering area of interior least terns is unknown (FWS 1990b).

Threats include the actual and functional loss of riverine sandbar habitat. Sandbars are not generally stable features of the natural river landscape, but are formed or enlarged, disappear or migrate depending on the dynamic forces of the river. River stabilization to achieve objectives for navigation, hydropower, irrigation, and flood control has destroyed the dynamic nature of these processes. Many remaining sandbars are unsuitable for nesting because of vegetation encroachment or are too low and subject to frequent inundation. Recreational use of sandbars during the breeding season has also contributed to the decline of the species (FWS 1990b).

On the Mississippi River, least terns use sandbars for nesting, foraging (primarily on shad [*Dorosoma* spp.]), and loafing when the river has receded and sandbars are exposed. On the Mississippi River, surveys for interior least terns have been conducted since 1986 over about 904 km (565 mi) from Cape Girardeau, Missouri (River Mile 1000) to Vicksburg, Mississippi (River Mile 435). The first intensive survey south of Vicksburg was conducted July 2004 (ACE 2004a). The nearest areas occupied by terns upstream and downstream of the Grand Gulf ESP site (River Mile 405 - see SERI 2003c) were

- Yucatan Dikes (River Mile 409.8), loafing area for 28 birds

- Togo Island Dikes (River Mile 413.6), nesting colony of 395 birds with confirmed chicks or eggs

- Below Bondurant Towhead Dikes (River Mile 393.0), nesting colony of 59 birds with confirmed chicks or eggs (ACE 2004b).

Sandbars develop on the inside bends of the Mississippi River where currents are slower. Sandbars do not develop on the outside bend of the river where currents are swifter and where the river shoreline has been revetted (rip-rap emplaced) to prevent erosion, such as is the case at the Grand Gulf site. The nearest potential tern nesting habitat is near River Mile 402 on the Louisiana side of the Mississippi River about 4.8 km (3 mi) south of the Grand Gulf ESP site (ACE 2004a).

Louisiana Black Bear

The historic range of the Louisiana black bear included southern Mississippi (south of and including Washington, Humphreys, Holmes, Attala, Neshoba, and Lauderdale counties), all of Louisiana, and eastern Texas. Two subspecies of black bear historically occupied Mississippi, the Louisiana black bear *(Ursus americanus luteolus)* in the south and the American black bear (*U. a. americanus*) in the north. Because the two subspecies are indistinguishable by sight, other free-living bears of the species *U. americanus* within the historic range of *U. a. luteolus* are designated Federally threatened by similarity of appearance (FWS 1995).

The historic habitat of the Louisiana black bear has suffered extensive modification, having been reduced by more than 80 percent as of 1980. The remaining habitat has been reduced in quality by fragmentation and conversion to agriculture. Habitat destruction or modification is the primary threat to the Louisiana black bear. Human-related mortality also continues to pose a threat to the subspecies (FWS 1995).

The key habitat requirements of black bears are food, water, cover, and den sites that are spatially arranged across sufficiently large, relatively remote blocks of land. Remoteness is relative to forest tract size and the presence of roads. Examples of remoteness relative to black bears include a tract of timberland 0.8 km (0.5 mi) from well maintained roads and development, a forested tract of more than 1000 ha (2500 ac), or a tract with 0.5 km (0.3 mi) or less of road per km^2 (0.4 mi^2) of forest (FWS 1995). A geographic information system analysis has not been conducted, but it is evident from Figure 2-4 that much of the Grand Gulf site and immediate environs to the north and south closely approach or satisfy one or more of these criteria.

Louisiana black bears typically inhabit heavily wooded bottomland hardwoods and swamps, although adjacent upland habitat types are also used (LDOTD 2003). Occupied Louisiana black bear habitat has been defined by the FWS (1995) as only those areas where there is evidence of reproduction, such as a female with cubs. Presently within the historic range of the Louisiana black bear, two known breeding bear populations occur in two Louisiana river basins (Figure 2-6). One range is the Tensas River Basin, consisting of Franklin, Madison, and Tensas parishes. The Tensas River Basin is located in rural northeastern Louisiana and contains an estimated 160 bears (Beausoleil 1999; Boersen 2001). Tensas Parish is located directly across the Mississippi River from Claiborne County and the Grand Gulf site. The other range is the Atchaflaya River Basin, located in south-central Louisiana and divided into two units: upper, and lower/coastal. The upper and coastal units support subpopulations of 52 and 92 bears, respectively (Triant 2001).

Bears have been sighted outside of the two areas, but it is unknown whether these bears are reproducing or are only wandering subadults and males. Additional areas possibly occupied are the Mississippi River corridor, including portions of the Loess Bluffs in southwestern Mississippi and the adjacent Tunica Hills of Louisiana (about 120 km [75 mi] south of the Grand Gulf ESP site), and smaller areas in the lower East Pearl River and lower Pascagoula River basins of southern Mississippi near the Gulf of Mexico (FWS 1995).

The FWS, Louisiana Department of Wildlife and Fisheries, and the Black Bear Conservation Committee began reintroducing Louisiana black bears into unoccupied habitat on publicly owned land in the Red River/Three Rivers area of east-central Louisiana in March 2001 (FWS 2004d). The northern boundary of the repatriation area is located about 88 km (55 mi) southwest of the Grand Gulf ESP site. To date, 16 adult females and 40 cubs have been reintroduced. These bears have dispersed throughout the repatriation area and beyond (FWS 2004d). Some have dispersed as far north as Vidalia, Louisiana (FWS 2004d), located just across the Mississippi River from Natchez, Mississippi, about 56 km (35 mi) southwest of the Grand Gulf site.

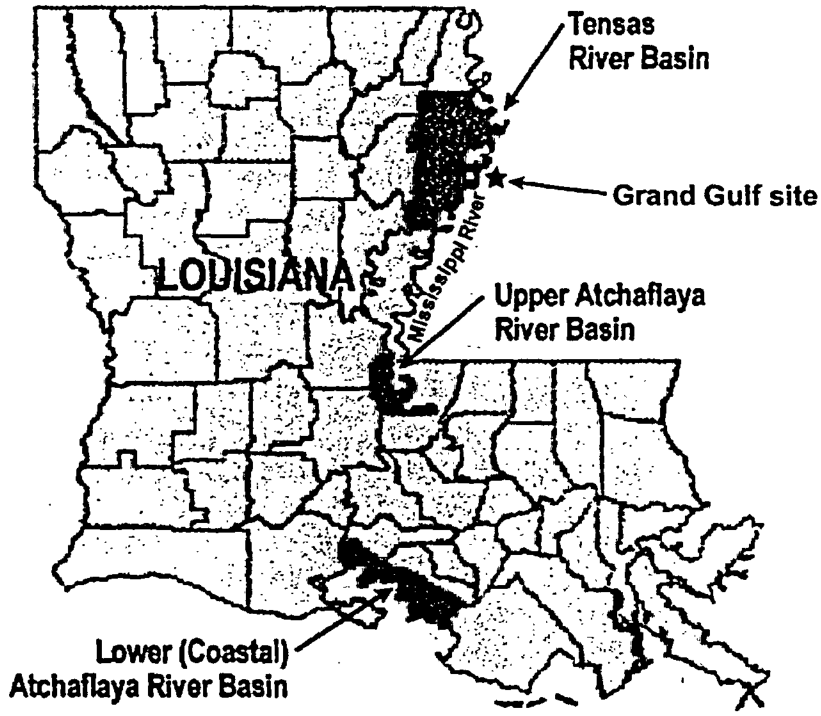

Figure 2-6. Louisiana Black Bear Breeding Subpopulations (U.S. Fish and Wildlife Service, Jackson, Mississippi Field Office)

Many bears have been sighted in the Mississippi River corridor within the last 8 years (Figure 2-7) (MNHP 2004e). The Louisiana black bear may use the Mississippi River environs as a travel corridor (SERI 2004d) between the Tensas River Basin and upper Atchaflaya River Basin, and it could thus serve as an important link between the two.

The MNHP has reported bear occurrences within 3.2 km (2 mi) of the Grand Gulf ESP site (MNHP 2004a), and bears have been observed on the Grand Gulf site (NRC 1981). Two bear cubs were reported onsite by a hunter in 1978. Afterward, bear tracks were observed on two occasions and one adult and one young bear were seen at separate times by the biologist onsite (NRC 1981). However, its occurrence onsite has not been documented recently (SERI 2004d). Because the two subspecies (*Ursus americanus luteolus* and *U. a. americanus*) are indistinguishable by sight, one must conservatively assume that all the sightings noted above were of the Louisiana black bear. Further, suitable den sites in fallen

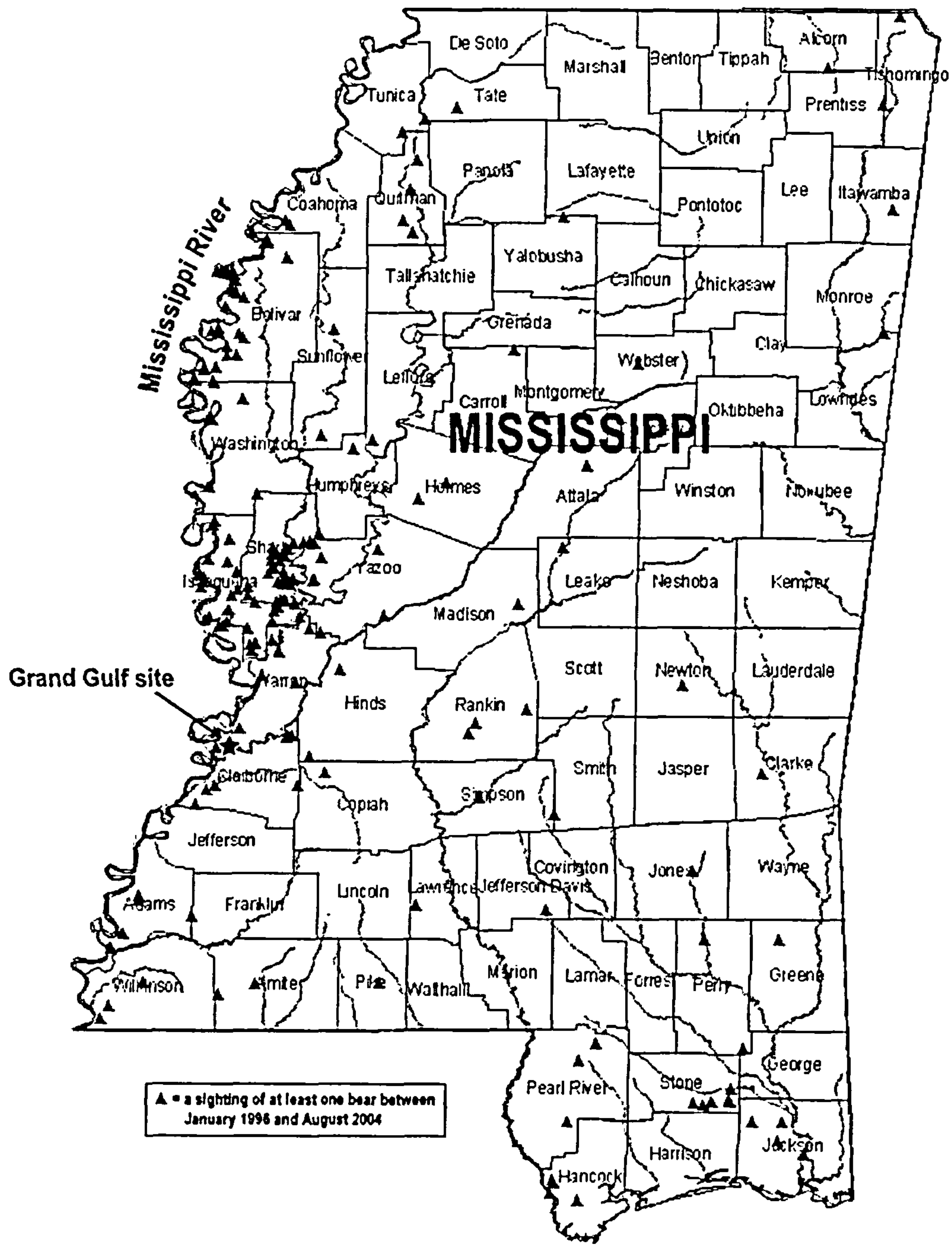

Figure 2-7. Black Bear Sightings from the State of Mississippi from 1996 to 2004 (U.S. Fish and Wildlife Service, Jackson, Mississippi Field Office)

trees have also been reported from onsite (SERI 2004d), although it is unknown if these trees satisfy the species, size, and location criteria specified in 57 FR 588.

The Grand Gulf site provides large tracts of bottomland and upland hardwood forests that are contiguous with other relatively large, adjacent expanses of hardwood forest. These are suitable for bears because they are relatively remote by the above standards and subject to relatively little human disturbance, particularly those on the Grand Gulf site, because of public access restrictions. Public access restrictions may protect bears from illegal hunting and collisions with cars because of the low traffic volume on roads in and around the site. Black bears are generally highly adaptable and tend to survive in a variety of situations where they are protected from over-harvesting and other negative interactions with humans. Because bears coexist readily with humans when provided areas in which they can avoid contact, the possibility that Louisiana black bears still inhabit the Grand Gulf site is high (SERI 2003c).

Three critical habitat areas totaling about 505,875 ha (1.25 million ac) have been proposed for the Louisiana black bear (58 FR 63560): Tensas River Basin, Atchaflaya River Basin Floodway, and lower Iberia-St. Mary Parish. The proposed critical habitat area nearest the Grand Gulf ESP site is the Tensas River Basin, which borders the west bank of the Mississippi River directly across from the site.

Because of their importance, actual den sites or candidate trees (bald cypress and tupelo gum [*Nyssa* sp.] with visible cavities, having a diameter at breast height of 0.9 m [3 ft] and occurring along rivers, lakes, streams, bayous, sloughs, or other water bodies) in occupied habitat may not be harvested (57 FR 588). However, this may not affect the Grand Gulf ESP site because it is currently unknown whether habitat in this area is occupied and whether bald cypress and/or tupelo gum trees of this stature exist onsite.

Federally Listed Terrestrial Plant Species

No Federally listed or proposed threatened or endangered terrestrial plant species or associated designated or proposed critical habitat were identified through consultation with the FWS as potentially occurring on or in the vicinity of the Grand ESP Gulf site (FWS 2004a).

2.7.1.3 Terrestrial Ecology Monitoring

Formal terrestrial ecological monitoring has not been conducted on the Grand Gulf site since construction of the GGNS Unit 1. However, reconnaissance visits to the site were made by Enercon on behalf of SERI during the weeks of August 19 to 24 and October 29 to November 1, 2002 (SERI 2004d). The purpose of these visits was to describe the wetlands and qualitatively compare existing ecological resources with descriptions provided in the MP&L final environmental report (1973). Information provided in the MP&L final environmental report was based on formal terrestrial ecological monitoring conducted from June 1972 to August 1973 prior to construction of the GGNS Unit 1 facility (SERI 2003c).

Descriptions of the various types of wetlands found on the Grand Gulf site based on these reconnaissance visits are provided in Section 2.7.1. There apparently have been no noteworthy environmental alterations on the Grand Gulf site since construction of the GGNS Unit 1 that contribute significantly to the existing patterns of plant and animal communities described in Section 2.7.1.

Terrestrial ecological monitoring may be performed in support of an application for an ESP. Monitoring primarily consists of collecting data used to describe the distribution and abundance of important species and habitats and environmental changes that may contribute to the existing patterns of plant and animal communities (NRC 2000).

As noted above, based on Enercon's 2002 reconnaissance visits (SERI 2004d), the vast majority of the Grand Gulf site has been left undisturbed since construction of the GGNS Unit 1. Thus, no monitoring of environmental changes that contribute to existing patterns of plant and animal communities is needed.

Wetlands are considered an important habitat (NRC 2000). Besides wetlands, no other important habitats are known to occur on the Grand Gulf ESP site or along its transmission corridors. Wetlands on the Grand Gulf ESP site would be minimally affected by construction (see Section 4.4.1) and then restored. Thus, no wetland monitoring is needed.

The only important species known to inhabit the Grand Gulf ESP site is the Federally threatened American alligator. However, the alligator is threatened only because of its similarity of appearance to the American crocodile. Thus, the threatened classification of the alligator helps protect the crocodile. American alligator populations are themselves considered disjunct, limited to available habitat, but stable (52 FR 21059). Consequently, it is of no particular interest for monitoring.

The Federally threatened Louisiana black bear is known to occur within 3.2 km (2 mi) (MNHP 2004a) of the Grand Gulf site and was documented from the site in the late 1970s (NRC 1981). Because the site and its immediate environs to the north and south provide a large block of remote habitat with relatively little human presence, it is very likely Louisiana black bears still exist onsite. However, its occurrence onsite has not been documented recently, and no monitoring via field surveys or other methods has been conducted on the Grand Gulf ESP site or in the near vicinity.

Use of the Grand Gulf ESP site and adjacent areas in upland hardwood forest and bottomland forested wetlands by Louisiana black bears should be established via field surveys prior to construction of the Grand Gulf ESP facility. The Louisiana black bear could be affected by construction if present in these areas. Consequently, a plan for pre-construction monitoring of use of the Grand Gulf ESP site and near vicinity by the Louisiana black bear should be established in consultation with the FWS, Jackson, Mississippi, Field Office.

2.7.2 Aquatic Ecology

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 (Figure 2-1 and 2-2). Also associated with the Grand Gulf site are a flooded, fabricated borrow pit, three small ponds, and two perennial streams. In addition, ephemeral drainages and wetlands are found around the site. The Grand Gulf site does not front on the Big Black River to the north or on the Bayou Pierre River to the south (MP&L 1973; SERI 2003c).

The habitat of the Mississippi River has the following features: backwater, river bank, and main channel. The backwater habitat is associated with the large bend in the river at the site, which creates slow moving, relatively shallow, quiet water. The substrate in the backwaters is loosely consolidated, silty clay sediment of low plasticity. The river bank habitat is steep with swift current, consolidated, high-plastic clay substrate, and eroding slopes. In 1979, the river bank downstream of the discharge structure and barge slip was stabilized with articulated concrete mats (NRC 1981). The main channel is deep with strong, turbulent currents and coarse-grained substrate (MP&L 1973; SERI 2003c).

Hamilton and Gin are oxbow lakes on the Grand Gulf site. These lakes are what remain of the former river channel after the Mississippi River moved to the west. Hamilton and Gin lakes are relatively small and shallow with characteristics similar to the backwater habitat. The surface area of these lakes has decreased since 1973, and the last estimates made in 2001 indicate the surface area of Hamilton Lake is 26 ha (64 ac) and Gin Lake is 22 ha (55 ac). The average depth of these lakes is approximately 2 to 3 m (8 to 10 ft). However, during high-water events, the Mississippi River submerges these lakes. Hamilton Lake receives water from two perennial streams, which carry storm water from the existing facility. Gin Lake is connected to Hamilton Lake via a culvert beneath Heavy Haul Road (MP&L 1973; SERI 2003c).

A flooded, fabricated borrow pit north of the barge slip was created in the 1970s when fill was excavated for use in the construction of GGNS Unit 1. The depth of the pit is not known. The surface area in 2001 was estimated to be 6.5 ha (16 ac) in size. The pit does not appear to be hydrologically connected to the lakes except during high water of the river (SERI 2003c).

Before the development of the Grand Gulf site, the three small ponds were constructed onsite to provide water for cattle stock. At the time of construction of Unit 1, five small ponds existed, each under 0.8 ha (2 ac) in size. Since 1973, two of the ponds have been filled and no longer exist (MP&L 1973; SERI 2003c).

The two perennial streams onsite are called Streams A and B. Stream A extends west from the site's sanitary waste water treatment facility. Currently, Stream A receives continual flow from facility storm water and processed discharge from the waste water treatment facility. Stream B extends west from the cooling towers on the south side of Heavy Haul Road. Flow in Stream B is intermittent, consisting mostly of storm runoff, and flows into Hamilton Lake. A sedimentation basin has been constructed on both Steam A and B, called Outfall 13 and 14, respectively (MP&L 1973; SERI 2003c).

Ephemeral drainages occur on the upland bluffs and eastern portions of the Grand Gulf site. These drainages are estimated to be approximately 7358 m (24,140 ft) in length (MP&L 1973; SERI 2003c).

2.7.2.1 Biological Communities

The staff evaluated the effect of construction and operation of the proposed Grand Gulf ESP facility on aquatic ecological resources (habitat and wildlife) existing at and within the vicinity of the site and along the transmission corridors. The last time the aquatic resources were extensively characterized was from September 1972 to August 1973 during the preconstruction studies for GGNS Unit 1 (MP&L 1973; SERI 2003c). In 2002, two reconnaissance surveys were made to qualitatively assess the ecological resources of the Grand Gulf site. Based on these surveys, staff concluded that the descriptions in the Final Environmental Report (MP&L 1973) adequately described the conditions for the aquatic resources (SERI 2003c).

The studies conducted prior to construction characterized the aquatic resources in the Mississippi River, Hamilton and Gin lakes, two ponds, and Stream A. A total of 86 fish species were collected, representing 20 families and 42 genera (MP&L 1973; SERI 2003c). The presence of other aquatic species was also reported (MP&L 1973).

Mississippi River

Preconstruction studies from 1972 to 1973 included collections of fish, benthic macroinvertebrates, and plankton. The characterization of the river was divided into several habitat types related to the flow rate and substrate: backwater, river bank, and main channel. A total of 69 fish species were caught. This was the same number of species found in the Mississippi River during the same time period at the River Bend Nuclear Station, 218 km (136 mi) downstream from GGNS. However, the fish species diversity was less than that characterized in the lower Mississippi River prior to the release of endrin (a pesticide) around Memphis in 1963 to 1964 that resulted in catastrophic fish kills (MP&L 1973).

The dominant species in the Mississippi River based on numbers and weight were gizzard shad (*Dorosoma cepedianum*), freshwater drum (*Aplodinotus grunniens*), blue catfish (*Ictalurus furcatus*), and flathead catfish (*Pylodictis olivaris*). These numbers did vary within the particular habitats of the river. In the backwater habitat, the dominant species were gizzard shad, blue catfish, river carpsucker (*Carpiodes carpio*), freshwater drum, and shovelnose sturgeon (*Scaphirhynchus platorynchus*). In the river bank, the dominant fish were gizzard shad, freshwater drum, silver chub (*Macrhybopsis storeriana*), flathead catfish, and blue catfish. The main channel was not easily characterized by dominant species because collection techniques were hampered by the currents, irregular bed configurations, and bottom associated debris (MP&L 1973).

Juvenile fish increased in numbers from March through July with a subsequent decrease through mid-July. The results indicated that shad spawned from March through June. Drum appeared to spawn over a shorter period and may have included two spawning periods. Young-of-the-year for gizzard shad and drum were highest in June and July. Larval fish were collected in early March. While catfish and suckers were prominent as adults, they were not among the larvae collected in the river because they are spawned in backwaters and do not enter the riverine environment until they are juveniles (MP&L 1973).

Benthic macroinvertebrate populations were most common in the backwaters of the riverine environment. Dipteran larvae (aquatic true fly larvae), tube-forming worms, and bivalves (mussels and clams) represented the dominant groups of macroinvertebrates. Where the river banks were stable (consolidated silt and clay), mayflies were the most common macroinvertebrate. The 1973 report stated that macroinvertebrates were found in areas where the river bank was stable, but few or no macroinvertebrates were found where the river bank was constantly eroding. In 1981, MP&L concluded that macroinvertebrates would not colonize areas where the banks were stabilized with articulated concrete mats (NRC 1981). Macro-invertebrates were also absent in the main channel of the river, probably because of strong currents and coarse, sand-gravel sediment (MP&L 1973).

Drifting benthic macroinvertebrates were also collected in the river and adjacent backwaters. The majority of the drifting macroinvertebrates was composed of dipteran pupae and larvae, predominantly of the genus *Chaoborus*. A total of 96 macroinvertebrate taxa were collected in drift samples (MP&L 1973).

Another predominant invertebrate included the river shrimp (*Macrobrachium ohione*). These shrimp were caught mainly along the river banks with their numbers peaking in October and dropping from November to April, when water temperatures were coldest (MP&L 1973).

Plankton in the Mississippi River were characterized as zooplankton and phytoplankton. The density of zooplankton ranged over two orders of magnitude during the study period. A total of 46 taxa were identified, and the dominant taxa changed over time. A stalked protozoan

(*Carchesium* sp.), various cladocerans, and a colonial rotifer were the dominant zooplankton. Fall and spring blooms of phytoplankton were observed. A total of 49 phytoplankton genera were identified, with centric diatoms being the most dominant (MP&L 1973).

Hamilton and Gin Lakes

Preconstruction studies from 1972 to 1973 included collections of fish, benthic macroinvertebrates, and plankton. Hamilton Lake had 46 fish species, and Gin Lake had 36 species. Several of the fish species in Hamilton and Gin lakes are thought to be from the Mississippi River. When the river floods the lakes, fish are brought into the area and then are trapped in the lakes when the flood waters recede. This relationship was demonstrated when large numbers of young-of-the-year paddlefish (*Polyodon spathula*) were observed in both lakes in July 1973, shortly after the river separated from the lakes. After another flood a month later, the number of paddlefish had decreased (MP&L 1973). The difference in fish diversity between the two lakes was attributed to the connection of Hamilton to the river during periods when the river is not at flood stage.

While more species were present in Hamilton Lake, the dominant fish were the same in both lakes. The top 80 percent of the population was made up of gizzard shad, bluegill (*Lepomis macrochirus*), threadfin shad (*Dorosoma petenense*), and largemouth bass (*Micropterus salmoides*). Several stragglers, fish that normally inhabit the river, were found in Hamilton and Gin lakes (MP&L 1973).

Benthic macroinvertebrates in Hamilton and Gin lakes more closely resembled the populations collected in the backwaters of the river. Chironomids, tubificid worms, and bivalves were the most dominant taxa (MP&L 1973).

The composition and abundance of plankton in Hamilton and Gin lakes varied based on the frequency and duration of flooding by the river. When the lakes were not flooded, they developed distinct plankton populations. However, during flood events, the populations more closely resembled those characterized in the river (MP&L 1973).

Hamilton and Gin lakes did not support vascular aquatic plants in the preconstruction studies. The only aquatic plant recorded in the lakes was the big duckweed, *Spirodela* spp. In reconnaissance visits in 2002, no emergent vegetation was found in the lakes except along the periphery (MP&L 1973; SERI 2003c).

Two Ponds and Stream A

Only fish were collected in two of the ponds and Stream A during the preconstruction studies. The source of fish in the ponds is thought to be recruitment from either Stream A or Stream B. One of the ponds (referred to as "bluff pond 1") contained only bluegill and mosquitofish

(*Gambusia affinis*). The other pond ("bluff pond 2") contained bluegill, mosquitofish, and a few channel catfish (*Ictalurus punctatus*) (MP&L 1973).

Stream A had 21 species, which consisted of resident fish and those that probably entered the stream during floods from the river and lakes. The dominant species included bluntnose minnow (*Pimephales notatus*), green sunfish (*Lepomis cyanellus*), longear sunfish (*Lepomis megalotis*), silvery minnow (*Hybognathus nuchalis*) and blackspotted topminnow (*Fundulus olivaceus*) (MP&L 1973).

Commercially Important Fisheries

Commercial fishing is limited in the area with most occurring on the Mississippi River near the Grand Gulf site and on the Big Black and Bayou Pierre rivers. Approximately twelve commercial fishing operations are in the area. They catch predominately catfish but also harvest bigmouth (*Ictiobus cyprinellus*) and smallmouth buffalo fish (*Ictiobus bubalus*) (SERI 2003c).

Recreationally Important Fisheries

Recreational fishing occurs on the Mississippi River and Hamilton and Gin lakes. Fishing is allowed on these lakes; however, access was denied briefly in 2001 to 2002. April through September are the most popular months for sport fishing with Saturday being the busiest day of the week. On the weekends from April through September, as many as 200-250 anglers may be in the vicinity. On the weekdays, the number of anglers may drop to fewer than 150 depending on weather conditions (SERI 2003c). Recreational fishing in the area is from boats and the bank as well as using trotlines in the lakes. The most common fish caught include catfish, bluegill, and bass (MP&L 1973; SERI 2003c).

Nuisance Species

No reports indicate aquatic nuisance species are in the waters associated with the Grand Gulf site (MP&L 1973; NRC 1981; SERI 2003c).

Aquatic Resources Associated with Transmission Corridors

Transmission corridors for GGNS Unit 1 cross waterways in Claiborne County. The Baxter-Wilson corridor crosses the Big Black River approximately 12 km (7.5 mi) to the northeast of the Grand Gulf site. Also, the Baxter-Wilson substation in Warren County is less than 0.75 km (0.47 mi) from the shores of the Mississippi River. The Franklin corridor crosses Bayou Pierre approximately 5.5 km (3.4 mi) to the south of the Grand Gulf site. SERI did not indicate the aquatic resources that could be associated with the waterways crossed by these transmission corridors (SERI 2003c). No information on aquatic resources was available from the transmission and distribution system owner and operator (Entergy Mississippi, Inc.) (Entergy Services 2004a). SERI did not indicate the powerline right-of-way maintenance procedures in its environmental report (SERI 2003c). However, Entergy Mississippi, Inc. indicated that the maintenance procedures consist of mechanical means (primarily bushhogging) that are performed on an as-needed basis (Energy Services 2004b).

State-Listed Species

State-listed threatened and endangered aquatic species that may occur in tne vicinity of the Grand Gulf ESP site are listed in Table 2-8 (MNHP 2004a; 2004b).

Animal Species

Two State-listed endangered aquatic species are known to occur within 3.2 km (2 mi) of the Grand Gulf ESP site: the pallid sturgeon (*Scaphirhynchus albus*) and crystal darter (*Crystallaria asprella*) (Table 2-8). One State-listed endangered aquatic animal species is known to occur between 3.2 km (2 mi) and 16 km (10 mi) of the Grand Gulf ESP site: the bayou darter (*Etheostoma rubrum*) (Table 2-8). The pallid sturgeon and bayou darter are also Federally listed species and are described in Section 2.7.2.2.

Table 2-8. State-Listed Aquatic Species Occurring in the Vicinity of the Grand Gulf Early Site Permit Site

Scientific Name	Common Name	Status[(a)]	Distance from the Grand Gulf ESP Site	Source
Fish				
Scaphirhynchus albus	pallid sturgeon	SE	<3.2 km (2 mi)	MNHP 2004a
Etheostoma rubrum	bayou darter	SE	<16 km (10 mi)	MNHP 2004a
Crystallaria asprella	crystal darter	SE	<3.2 km (2 mi)	MNHP 2004a

(a) State status rankings developed by the MNHP (2004a; 2004b) SE = State endangered - animals.

The endangered crystal darter has a historical range throughout the Mississippi, Missouri, and Ohio rivers. The crystal darter is a large, cigar-shaped fish, which is bi-colored with the lower half being white or silvery. These fish live in swift areas of sand and gravel raceways of large rivers. Crystal darters are found in the Bayou Pierre River and tributaries, which flow as close as 3 km (1.9 mi) east of the Grand Gulf ESP site (Ross 2001; MNHP 2004b; Katula 2004).

Plant Species

No State-listed or proposed threatened or endangered aquatic plant species are known to occur on or in the vicinity of the Grand Gulf ESP site (MNHP 2004a and 2004b; SERI 2003c).

2.7.2.2 Threatened and Endangered Aquatic Species

FWS and the National Oceanic and Atmospheric Administration (NOAA) Fisheries staff provided information on Federally listed species, including their presence or absence in Claiborne County and any proposed threatened and endangered aquatic species and designated and proposed critical habitats that may occur on or in the vicinity of the proposed Grand Gulf ESP site (FWS 2004a and 2004b; NMFS 2004). The location information for Federally listed species within 16 km (10 mi) of the Grand Gulf site was obtained from the MNHP (2004a; 2004b). Table 2-9 presents information on Federally listed aquatic species.

Table 2-9. Federally Listed Aquatic Species Occurring in the Vicinity of the Grand Gulf Early Site Permit Site

Scientific Name	Common Name	Status[a]	Distance from the Grand Gulf ESP Site	Source
Fish				
Acipenser oxyrinchus desotoi	Gulf sturgeon	FT	<16 km (10 mi)	NMFS 2004
Etheostoma rubrum	bayou darter	FT	<16 km (10 mi)	FWS 2004a
Scaphirhynchus albus	pallid sturgeon	FE	<3.2 km (2 mi)	FWS 2004a
Molluscs				
Potamilus capax	fat pocketbook mussel	FE	<16 km (10 mi)	FWS 2004b

(a) Federal status rankings developed by FWS and NOAA Fisheries under the Endangered Species Act (FWS 2004a and 2004b; NMFS 2004).
FE = Federal endangered
FT = Federal threatened.

Federally Listed Aquatic Animal Species

Four Federally listed threatened or endangered aquatic animal species may occur in the vicinity of the Grand Gulf ESP site. These include the

- pallid sturgeon (*Scaphirhynchus albus*) (FWS 2004a; SERI 2003c)
- bayou darter (*Etheostoma rubrum*) (FWS 2004a; SERI 2003c)
- fat pocketbook mussel (*Potamilus capax*) (FWS 2004b)
- Gulf sturgeon (*Acipenser oxyrinchus desotoi*), which has an historical range in the Mississippi River near the Grand Gulf ESP site (Ross 2001; NMFS 2004; SERI 2003c).

Of the Federally listed species mentioned above, only the pallid sturgeon was collected on the Grand Gulf site in the 1970s during the last effort to characterize aquatic resources. No known activities are underway by the Federal government that would change the list of species or add habitats to the list.

Pallid Sturgeon

The pallid sturgeon has a range of more than 5633 km (3500 mi) through the Missouri-Mississippi River drainage, including the lower Mississippi River. The species was designated as endangered throughout its entire range in 1990. Pallid sturgeon have a long, uniformly grayish-white body, flattened, shovel-shaped snout, with a long, slender completely armored caudal peduncle, and no spiracle. They are found in the main channels of large, highly turbid, free-flowing rivers with sand flats or gravel bars. Pallid sturgeon mainly feed on other fish. Little information is available on the spawning or migration habits of the pallid sturgeon except that they are likely to spawn in the spring and summer months, similar to other North American sturgeons (55 FR 36641; FWS 1993 and 2004a; Ross 2001; LDOTD 2003).

Pallid sturgeon have been collected in the region of the Grand Gulf ESP site. During the 1972 to 1973 preconstruction studies for the GGNS, a specimen was collected offshore of the site. In 2001, trawl surveys were conducted on the lower Mississippi River in the Vicksburg area, approximately 61 km (38 mi) upstream from the Grand Gulf ESP site. Several pallid sturgeon were caught in regions with moderate to strong currents, a sand or sand/gravel substrate, and areas with structure (for example, sand reefs, dunes, or secondary channel) (Ross 2001; SERI 2003c; Hartfield 2003).

Bayou Darter

The threatened bayou darter is endemic to the Bayou Pierre River and tributaries, approximately 20 km (12 mi) east of the Grand Gulf site. Bayou darters are small (57 mm [2.2 in.]), the smallest representative of the subgenus, *Nothonotus*. The darters live in swift, shallow riffles or runs over coarse gravel and pebbles. Loss of habitat through erosion of the tributaries has been a concern (40 FR 44149; FWS 1990a; FWS 2004a; Ross 2001; SERI 2003c).

Fat Pocketbook Mussel

The fat pocketbook mussel was historically found throughout the Mississippi River drainage from Minnesota to Louisiana. In 1976, the fat pocketbook mussel was designated as endangered throughout its entire range. The mussel has a shiny, thin to moderately thick, rounded shell. The shell has an S-shaped hinge and is tan or light brown with no rays. Fat pocketbook mussels prefer sand, mud, and fine gravel substrate of large rivers. The greatest impact to the mussel throughout its historical range is from habitat loss and reduction in water quality. In 2003, the mussel was found near Vicksburg in the Mississippi River, as well as south of the Grand Gulf ESP site (41 FR 24062; FWS 1989, 2004b, and 2004c).

Gulf Sturgeon

The gulf sturgeon has been jointly managed and listed as a threatened species by NOAA Fisheries and FWS. Historically, the range for this anadromous sturgeon has included the lower Mississippi, where it feeds in the Gulf of Mexico and returns to freshwater for spawning. They have a sub-cylindrical body with bony plates, and their snout is greatly extended and blade like, with four fleshy barbels in front of its mouth. Their bodies are gray-brown on the back and sides, grading to white on their belly. Critical habitat has not been designated for the Gulf sturgeon in the lower Mississippi River. Gulf sturgeon have not been collected in the region of the Grand Gulf ESP site; however, the species could be a transient or seasonal migrant (69 FR 13370; FWS MFC 1995; Ross 2001; SERI 2003c; NMFS 2004).

Federally Listed Aquatic Plant Species

No Federally listed or proposed threatened or endangered aquatic plant, species, or associated designated or proposed critical habitat are known to occur on or in the vicinity of the Grand Gulf ESP site (FWS 2004a; SERI 2003c).

2.7.2.3 Aquatic Ecology Monitoring

NRC does not impose conditions of operation, including monitoring requirements, in the water quality area. Regulation of water quality under the Federal Water Pollution Control Act (FWPCA 1972) is the responsibility of the U.S. Environmental Protection Agency (EPA). The EPA has delegated the NPDES permit program to the MDEQ. NRC's role in water quality is limited to assessing aquatic impacts as part of its National Environmental Policy Act (NEPA 1969) evaluation. The use of radial collector wells for current intake of Mississippi River water for operational use has not required the assessment or monitoring of the impacts to aquatic organisms under the NPDES permit. The last monitoring of aquatic ecology at the Grand Gulf site was part of pre-construction monitoring for GGNS Unit 1 (MP&L 1973; SERI 2003c).

NRC expects SERI to work with the State to develop and implement any required monitoring programs.

2.8 Socioeconomics

The population data for the area affected by the proposed Grand Gulf ESP site are primarily based on the 2000 U.S. Census, as mapped with the LandView 5 geographic information system by SERI (SERI 2003c). When economic, employment, or population trends were analyzed over time, comparisons were made between data from the 1990 U.S. Census and the

2000 U.S. Census. SERI used LandView 5 software to develop demographic data presented in this section of the report. SERI augmented the census data with information from other agencies and public organizations in the states of Mississippi and Louisiana (CPRP 2002; Irwin 1997). The area defined by an 80-km (50-mi) radius from the center of the proposed power block includes all or a portion of 25 counties and parishes in Mississippi and Louisiana. Table 2-10 identifies the counties and parishes.

Table 2-10. Counties and Parishes within 80 Kilometers (50 Miles) of the Grand Gulf Early Site Permit Site

Mississippi Counties			Louisiana Parishes	
Adams	Issaquena	Sharkey	Caldwell	Madison
Amite	Jefferson	Simpson	Catahoula	Richland
Claiborne	Lincoln	Warren	Concordia	Tensas
Copiah	Madison	Wilkinson	East Carroll	West Carroll
Franklin	Rankin	Yazoo	Franklin	
Hinds				

Source: SERI 2003c

2.8.1 Population Characteristics

Figure 2-8 shows the estimated population in 2002 within 16 km (10 mi) of the location for the Grand Gulf ESP facility. On this map, the power block for the proposed facility is located in the center with concentric circles in 1.6-km (1-mi) increments up to 8 km (5 mi) from the proposed location and then in one 8-km (5-mi) increment up to 16 km (10 mi) from the proposed location. 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 (USCB 2003). The majority of the population in this area is African American. Four larger towns are located within 80 km (50 mi) of the Grand Gulf ESP site. Vicksburg, Mississippi, located 40 km (25 mi) to the north-northeast, had a 2000 U.S. Census population of 26,407. 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.

Jackson, Mississippi, the largest nearby metropolitan area, located about 89 km (55 mi) northeast of the site, had a 2000 U.S. Census population of 184,256. The larger population centers to the north, northeast, and southwest provide employment, services and entertainment for the region. Rural communities, similar to Port Gibson, are located throughout the outlying areas and provide limited services (USCB 2003).

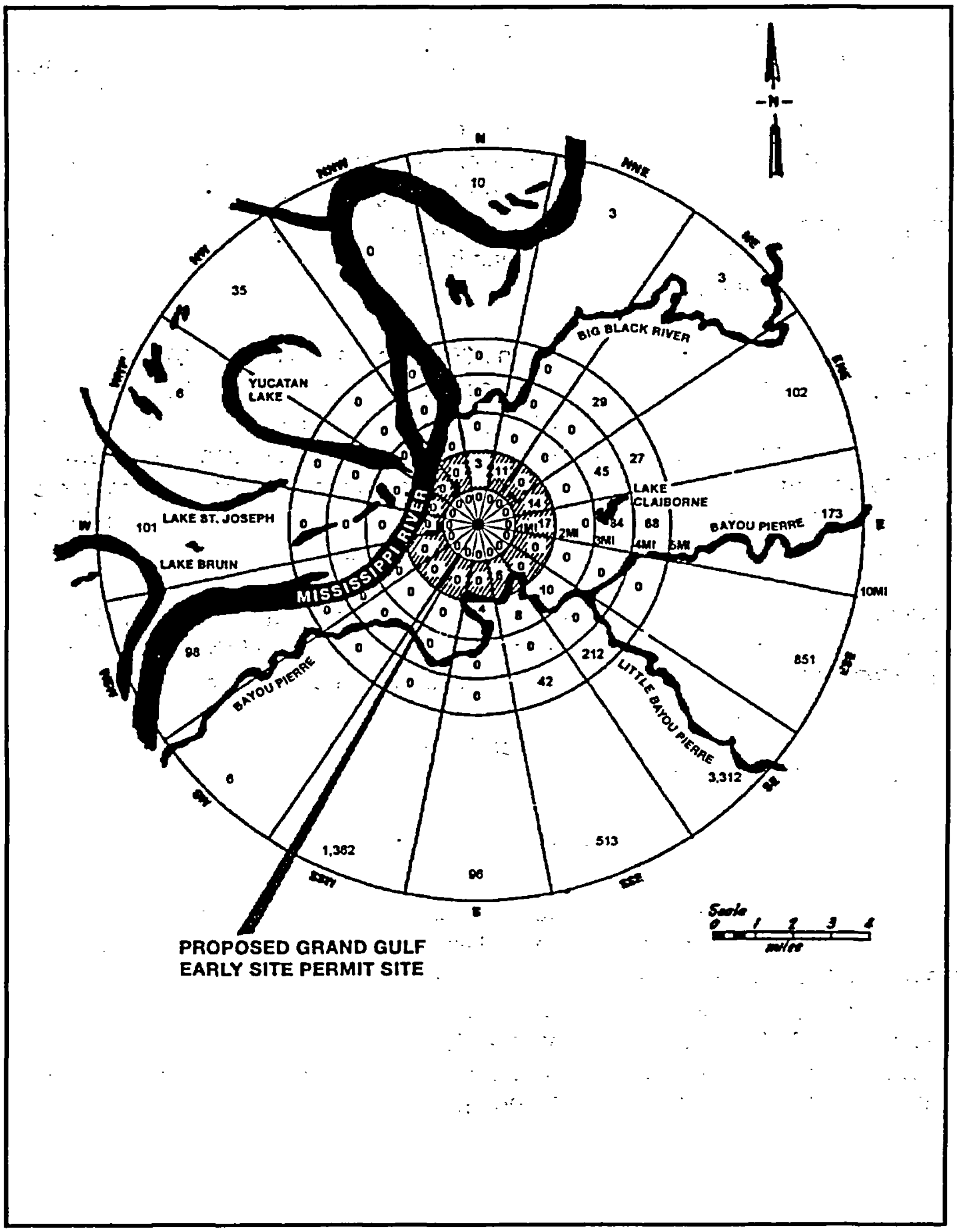

Figure 2-8. Estimated Population in 2002 within 16 Kilometers (10 Miles) of the Grand Gulf Early Site Permit Site (SERI 2003c, Figure 2.5-1)

The estimated population for 2002, the projected population 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 period) are based on the 2000 census (see Table H-1 in Appendix H). The projected populations for the years 2030 through 2070 for each segment are based on averages of the population growth projections obtained from the Louisiana State University and the Mississippi Center of Policy Research and Planning for the Louisiana parishes and Mississippi counties, respectively. Discussion regarding the population projection methodology used by the states of Mississippi and Louisiana is provided in Site Safety Analysis Report Section 2.1.3.1 (SERI 2003b).

Figure 2-9 shows the estimated population in 2002 within 16 to 80 km (10 to 50 mi) of the Grand Gulf ESP facility. The 2002 projected population and the population projection for each of five decades from 2030 (the projected first year of facility operation) to 2070 (the projected end of the initial license) are given in Table H-2 in Appendix H for each area shown in Figure 2-9 to be formed by the concentric circles (distance) and the radial lines (direction). The basis for estimating the projected population distributions is similar to that described for the population distribution within the 0- to16-km (0- to 10-mi) zone.

The resident and transient population is subject to seasonal variations (from visitors to the Grand Gulf Military Park and hunting camps and from visitors who fish) and daily workday variations (GGNS Unit 1 employment and other activities of an occasional nature, such as a the logging crews of forest product company, Anderson-Tully of Vicksburg, Mississippi, who occasionally work on the company's owned and leased land within 8 to 16 km (5 to 10 mi) of the Grand Gulf ESP site (SERI 2004a).

2.8.2 Community Characteristics

The community surrounding the Grand Gulf ESP site is rural and economically isolated. The county in which the proposed site is located (Claiborne County, Mississippi) and three of the counties next to the proposed site (Copiah and Jefferson Counties in Mississippi and Tensas Parish in Louisiana) are classified as persistent poverty counties (Tootle 1999). County poverty estimates in 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 (USCB 2004d).

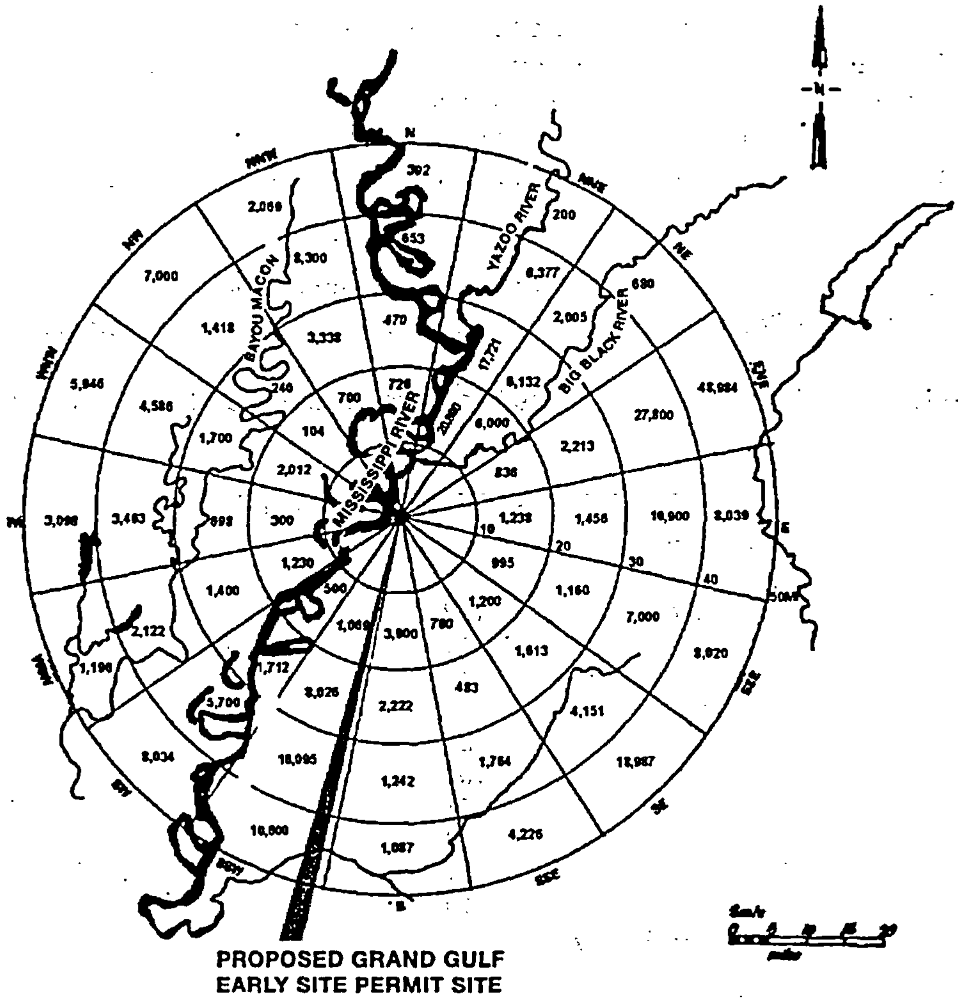

Figure 2-9. Estimated Population in 2002 within a 16- to 80-km (10- to 50-mi) Radius from the Grand Gulf Early Site Permit Site (SERI 2003c, Figure 2.5-2)

2.8.2.1 Economy

Approximately 750 people work at GGNS Unit 1, with up to 970 personnel on site during outages (SERI 2003c), making the site one of the large, stable employers in the four-county region. Table 2-11 shows an April 2003 distribution of residence locations of SERI's employees at GGNS. 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.

Comparisons of county employment statistics by industry type indicate that the total number of jobs for Claiborne County and the two adjacent Mississippi counties (Copiah and Jefferson)

Table 2-11. Residence Locations of the Workforce at the Grand Gulf Nuclear Station, April 2003

	Number[a]	Percent of Workforce
Claiborne County	**125**	**17.9%**
Port Gibson	102	14.6%
Pattison	12	1.7%
Hermanville	10	1.4%
Warren County	**325**	**46.4%**
Vicksburg	325	46.4%
Hinds County	**106**	**15.1%**
Clinton	51	7.3%
Jackson	19	2.7%
Raymond	11	1.6%
Utica	10	1.4%
Jefferson County	**40**	**5.7%**
Fayette	27	3.9%
Lorman	13	1.9%
Copiah County	**31**	**4.4%**
Wesson	16	2.3%
Hazelurst	12	1.7%
Franklin County	**30**	**4.3%**
Natchez	23	3.3%
Lincoln County	**20**	**2.9%**
Brookhaven	19	2.7%
Other	**23**	**3.3%**
Total	**700**	**100.0%**

(a) The cities listed are those with at least ten resident workers and are not all of the cities that make up the county total.

Source: SERI 2004a

decreased between 1990 and 2000, offset by gains in Hinds and Warren Counties (see Table 2-12). Several industries experienced severe job decline between 1990 and 2000, including agriculture, forestry, and fishing jobs (down almost 50 percent); manufacturing; professional, scientific, management, administrative, waste management, and other services jobs (each down almost 16 percent); wholesale trade (down 13 percent); finance, insurance, real estate, and rental and leasing (down 11 percent); and construction (down 2 percent) (USCB 2004a; 2004f). In contrast, employment in retail trade and entertainment services increased by 15 percent; public administration by over 14 percent; transportation and warehousing, utilities, and information services by 11 percent; and educational, health, and social services by 10 percent. A study conducted by the Rural Health Works in Mississippi estimates that employment in the health care sector represents 5.3 percent of the total workforce within Claiborne County. The study also concludes that local health care services typically represents a much larger sector of rural economies than for urban communities (Berry and Schmidt 2002).

The December 2002 labor force data show Claiborne County had an unemployment rate of 12.4 percent as compared to the surrounding four contiguous counties in Mississippi (Copiah, Hinds, Jefferson, and Warren) and Tensas Parish, Louisiana. The surrounding counties had an average unemployment rate of 8.3 percent, and the state of Mississippi had an unemployment rate of 6.1 percent (SERI 2004a).

Table 2-12. Employment Changes in the Five Mississippi Counties Nearest to the Grand Gulf Early Site Permit Site (Claiborne, Copiah, Hinds, Jefferson, and Warren), 1990 to 2000

Mississippi County	Workers Employed 1990	Workers Employed 2000	Percentage Change in Workers Employed 1990-2000	Unemployment Rate 1990	Unemployment Rate 2000
Claiborne	3490	2990	-14.3%	15.3%	11.8%
Copiah	10,540	10,420	-1.1%	9.4%	7.7%
Hinds	121,360	125,340	3.3%	5.6%	4.7%
Jefferson	2300	2230	-3.0%	22.8%	19.5%
Warren	20,780	25,630	23.3%	7.5%	5.0%
Totals	**158,470**	**166,610**	**5.1%**	**6.6%**	**5.3%**

Source: SERI 2004a

2.8.2.2 Transportation

Transportation routes are limited in the vicinity of the Grand Gulf ESP site. The major highway in the vicinity is U.S. Highway 61 that passes by the existing GGNS to the east-southeast. U.S. Highway 61 parallels the Mississippi River from New Orleans, Louisiana to St. Louis, Missouri. This highway runs through Port Gibson and is approximately 7 km (4.5 mi) from the Grand Gulf ESP site at the closest point. From the town of Port Gibson, the highway goes north to Vicksburg, Mississippi, and runs southwest to Natchez, Mississippi.

The Natchez Trace Parkway lies east of Port Gibson and runs southeast to Natchez and northeast to Clinton, Mississippi. Figure 2-10 shows the estimated average daily traffic count in 2000 on roads in the vicinity of the Grand Gulf ESP site. Bald Hill Road is scheduled for reconstruction from Grand Gulf Road to Headly Road to accommodate commercial traffic to/from Port Claiborne. A highway construction plan to extend the present path of Highway 18 is in the early planning stages (see Figure 2-11). This proposed extension will connect Highway 18 to Grand Gulf Road, providing additional access to the Grand Gulf ESP site (SERI 2004a).

A Kansas City Southern freight train passes within 45 km (28 mi) to the north-northeast of the site twice daily. The train runs from Vicksburg to Meridian, Mississippi, then returns to Vicksburg (KCS 2002). No rail line serves Claiborne County or the Grand Gulf site directly (MDOT 2004b). An active spur line from the Kansas City Southern line runs south from Vicksburg about 11 km (7 mi).

2.8.2.3 Taxes

Mississippi Code Title 27 addresses taxation of nuclear generating plants and the distribution of tax revenues from nuclear plants (Mississippi Tax Code 2003). This code states that any nuclear generating plant located in the State, which is owned or operated by a public utility, is exempt from county, municipal, and district ad valorem taxes. In lieu of the payment of county, municipal, and district ad valorem taxes, the nuclear power plant pays the State Tax Commission a sum based on the assessed value of the nuclear generating plant.

GGNS is taxed by the State for a sum equal to 2 percent of the assessed value but not less than $20 million annually. At least $7.8 million goes to Clairborne County (SERI 2004c). Of this amount, $3 million is allocated contingent upon Claiborne County upholding its commitment to the GGNS offsite emergency plan. The $7.8 million represents roughly 83 percent of all Claiborne County revenues (Mississippi State 2002).

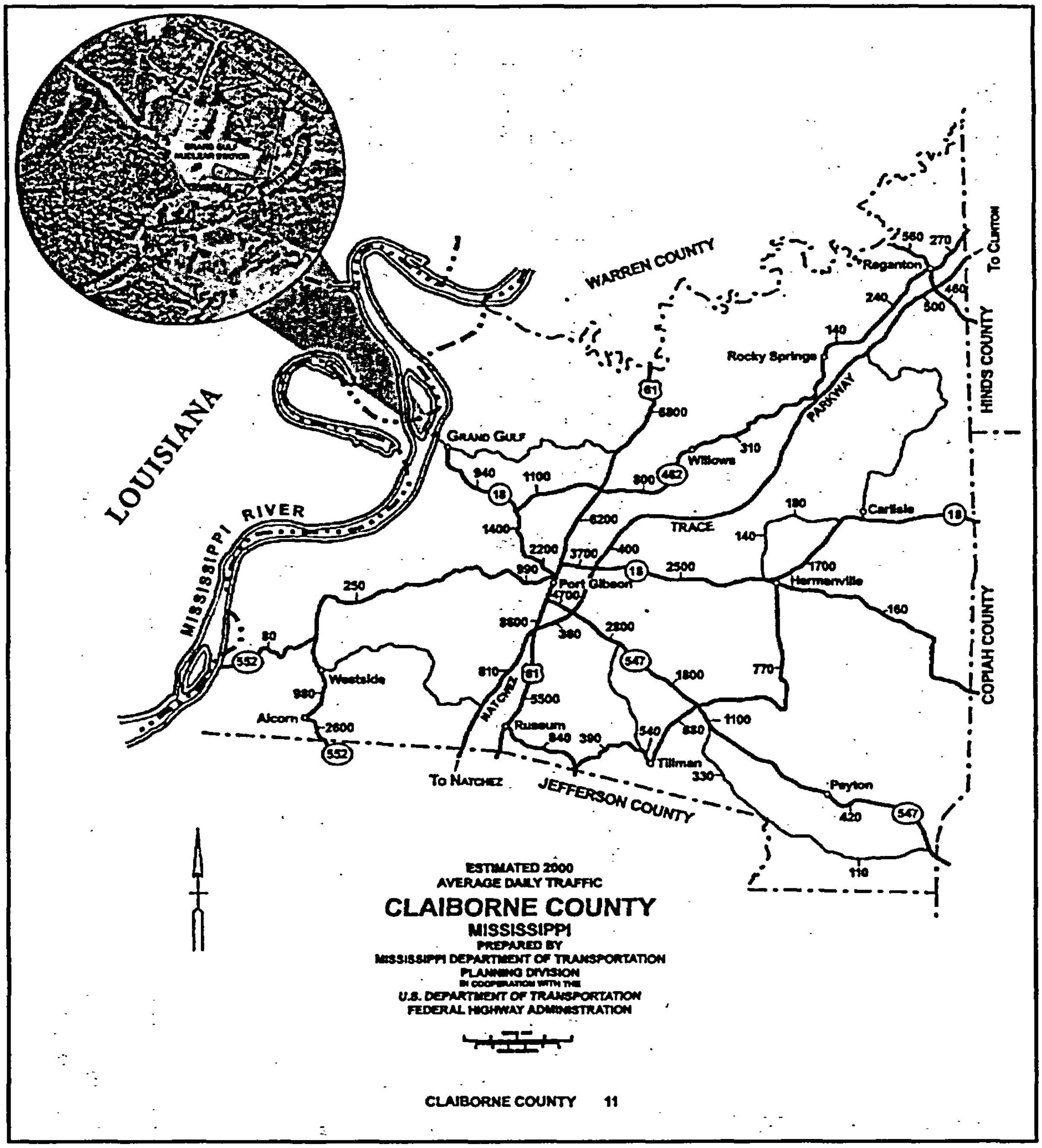

Figure 2-10. Estimated Average Daily Traffic in Claiborne County, Mississippi in 2000 (adapted from SERI 2003c, Figure 2.5-3)

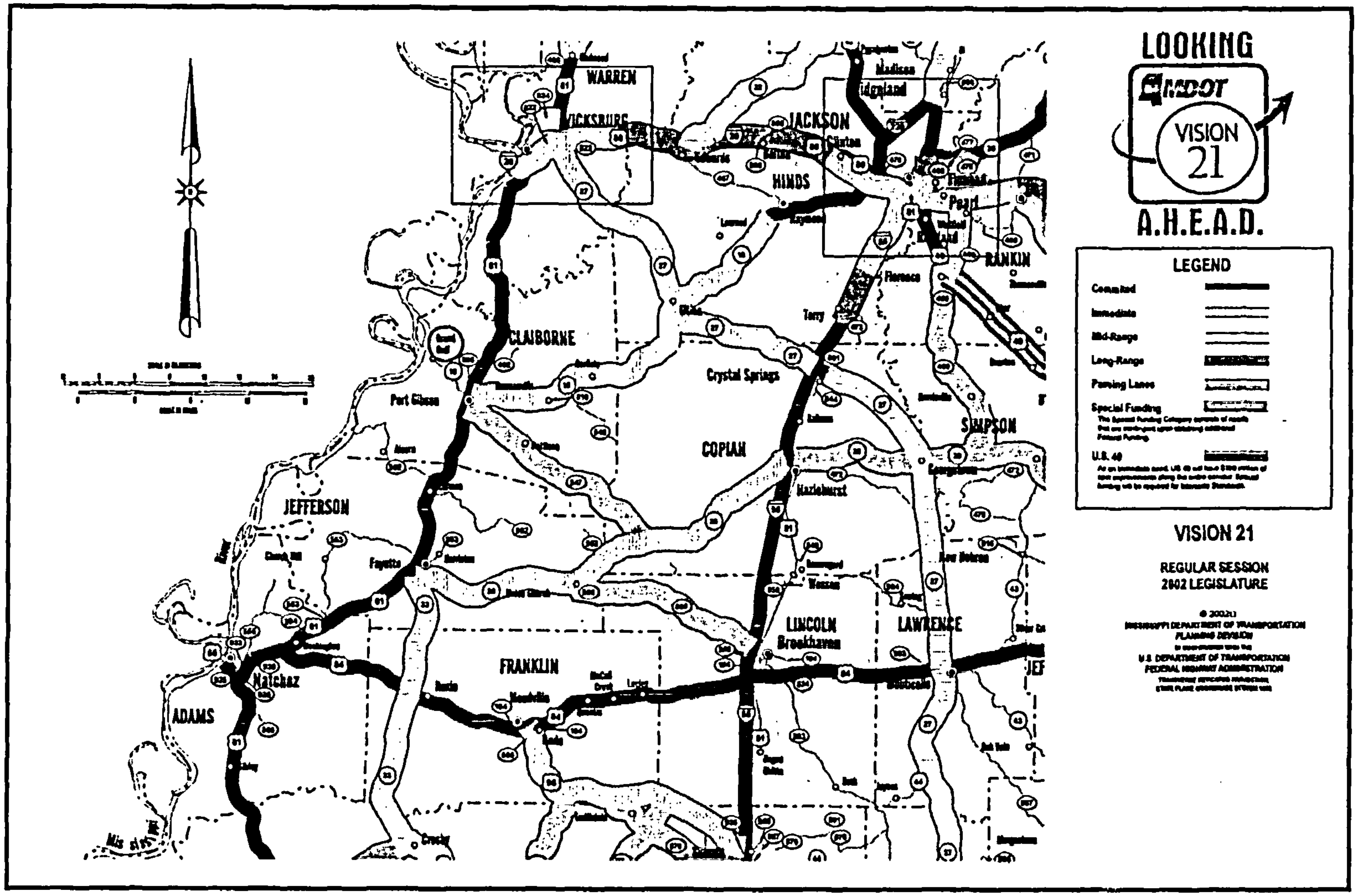

Figure 2-11. Mississippi Department of Transportation 2002 Road Development Plan (adapted from SERI 2003c, Figure 2.5-4)

The State Tax Commission transfers $160,000 annually to the city of Port Gibson provided that the city maintains its commitment to the GGNS offsite emergency plan. Ten percent of the remainder of the payments are transferred from the Mississippi Tax Commission to the General Fund of the State. 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. The tax revenues are distributed in proportion to the amount of electric energy consumed by the retail customers in each county, with no county receiving an excess of 20 percent of the funds (Mississippi Tax Code 2003). This distribution, based on energy consumed, also includes Claiborne County.

Depending on the type of facility (unregulated merchant facility or a facility regulated by the Public Service Commissions of Mississippi and Louisiana), the tax structure of the Grand Gulf ESP facility may be similar to the above for GGNS (a regulated facility), or may be some mutually agreeable amount for an unregulated merchant facility.

2.8.2.4 Aesthetics and Recreation

The Grand Gulf Military Park is located approximately 3 km (2 mi) north of the location proposed for the Grand Gulf ESP power block and is contiguous to the GGNS site. The park is open daily and had over 88,000 visitors in 2001. The highest volume of guests visit the park on Sundays while Saturday is typically the second largest attendance day. The park is most heavily used during the months of June and July when 250 to 300 people visit the site per day, depending on the weather conditions (SERI 2004a).

The Warner-Tully YMCA Camp consists of 43.7 ha (108 ac) of land located approximately 6 km (3 mi) north of the Grand Gulf ESP site. Approximately 800 campers use the Warner-Tully Camp facilities each year. The YMCA camp is open from late May to the end of August (SERI 2004a).

Lake Claiborne is a private development of residential and recreational facilities, located approximately 6 km (3 mi) east of the Grand Gulf ESP site. Lake Claiborne, Inc., has a total of about 450 members who have access to the lake and picnic area. There are 51 permanent residents in the development. A maximum of 200 people use these facilities on a summer weekend (SERI 2003c).

Lake Bruin State Park consists of 53 acres located on the shore of Lake Bruin, Louisiana, approximately 15 km (9.5 mi) southwest of the proposed site. From July 2001 to June 2002, the park had approximately 36,000 visitors (SERI 2004a).

There are approximately 150 hunting camps within Claiborne County. These camps are primarily used for deer hunting and other types of hunting as well as sport fishing. The camps are too numerous to estimate an accurate number of people who use them. Each camp, depending on the size of the camp, could have up to 20-30 hunters on a weekend day during hunting season (SERI 2004a).

Several hunting clubs are located across the Mississippi River from the Grand Gulf ESP site in Tensas Parish, Louisiana. About 300 to 400 deer and duck hunters are members of these clubs (SERI 2004a).

Deer season in Mississippi traditionally opens early in October for archery and late November for guns. The season continues through early January. The greatest number of hunters, approximately 500 to 600, is invariably on the first day of gun season. After the opening weekend, approximately 70 percent of the hunting population use the camps until the end of the season in early January (SERI 2004a). Louisiana deer season is similar in duration to that of Mississippi, beginning in early October and ending in late January (LFWS 2004).

Sport fishing in the area occurs in the months of April through September with Saturday being the busiest day of the week. As many as 200 to 250 anglers may be within the vicinity on weekends during the months noted. The number of anglers may drop to fewer than 150 during the week, depending on the weather conditions (SERI 2004a).

The Delta Queen Steamboat Company operates three paddle wheel tour boats on the Mississippi River: the Delta Queen (174 passengers), the Mississippi Queen (416 passengers), and the American Queen (436 passengers) (DQSC 2004a). Scheduled departures and ports of call indicate that these vessels pass the Grand Gulf ESP site several times during the season, from April through November (DQSC 2004b).

The GGNS site is visible from Grand Gulf Military Park and the existing cooling tower is visible from the Mississippi River. Otherwise, the site is well screened by topography and forested areas surrounding it. The Grand Gulf ESP site is therefore already aesthetically altered by the presence of an existing nuclear power plant with a natural draft cooling tower.

2.8.2.5 Housing

There were 226,000 occupied housing units reported in the 2000 U.S. Census for the counties that currently supply workers to the GGNS. Table 2-13 provides regional housing information by county/parish for these counties. 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 (USCB 2000e). In the ten-county area, 21,760 housing units were reported as vacant for the 2000 U.S. Census. Based on the vacancy numbers, no overall housing shortage appears to exist in the region, although availability is more limited in Claiborne County and Jefferson County.

Table 2-13. Regional Housing Information by County for the Year 2000

Mississippi County	Total Housing Unit	Occupied	Owner Occupied	Renter Occupied	Vacant Housing	Seasonal/ Recreational
Adams	15,175	13,677	9615	4062	1498	176
Claiborne	4252	3685	2956	729	567	149
Copiah	11,101	10,142	8107	2035	959	176
Franklin	4119	3211	2764	447	908	434
Hinds	100,287	91,030	58,131	32,899	9257	421
Jefferson	3819	3308	2658	650	511	169
Lincoln	14,052	12,538	9788	2750	1514	205
Madison	28,781	27,219	19,288	7931	1532	203
Rankin	45,070	42,089	32,471	9618	2981	393
Warren	20,789	18,756	12,785	5971	2033	199
Total	**247,445**	**225,655**	**158,563**	**67,092**	**21,760**	**2525**

Source: USCB 2004e

2.8.2.6 Public Services

Water Supply and Waste Treatment

Port Gibson Water Works supplies Port Gibson with municipal water and sewer services. Approximately 95 percent of Port Gibson's population is connected to the municipal water and sewer system, which is presently at 90 percent capacity. Operational averages for the water and sewer services provided by Port Gibson Water Works are provided in Table 2-14.

GGNS has its own water and sewage facility. The GGNS currently operates at about one-third capacity during normal operation and two-thirds capacity during outages. The facility consumes

Table 2-14. Capacity and Use of Port Gibson Water and Sewer Systems

Units	Maximum Well Water Capacity	Average Well Water Consumption	Peak Well Water Consumption	Water Storage Capacity	Sewer Capacity
Liters/Day	3.8 million	3,000,000	3,600,000	2,840,000	760,000
Gallons/Day	1 million	800,000	950,000	750,000	200,000

Source: SERI 2003c

379,000 L/d (100,000 gpd) of water for general operations and separately uses 189,000 L/day (50,000 gpd) for the activated sludge system (SERI 2003c).

Police, Fire, and Medical

The Claiborne County Sheriff's department handles the present duties for law enforcement within the immediate (8-km [5-mi]) area of the Grand Gulf ESP site. Additional law enforcement resources from the town of Port Gibson assist when needed. GGNS maintains its own security force to handle the security within the GGNS site property boundaries.

Fire capabilities are maintained by Claiborne County Fire Department along with the volunteer fire department from the town of Port Gibson. GGNS Unit 1 maintains an emergency response team onsite, including a fire brigade to respond to fires within the facility buildings and structures.

Emergency planning responsibilities are assigned to a number of departments and agencies. Federal, state and local officials will implement appropriate protective actions in case of an emergency (MDOT 2004a; Scott 2004). The Claiborne County Sheriff's Department has performed adequately in all of its offsite emergency responsibilities in Federal Emergency Management Agency emergency planning exercises. However, with a staff of only nine deputies, the department has concerns about the adequacy of its staffing to cover simultaneously its emergency responsibilities at GGNS as well as offsite evacuation in the event of actual emergencies (Scott 2004).

The Claiborne County Hospital has 32 beds. The staff consists of five doctors, ten registered nurses, six nurse's aides, and three X-ray technicians (SERI 2004a). Information for hospitals located in the adjoining counties is listed in Table 2-15 (SERI 2004a). The local hospital does not have the full range of services available all of the time. In an emergency, the Claiborne County Hospital has the space, equipment, and staff to handle about 3 to 4 casualties at a time. It has one decontamination room (14 years old) that is not co-located with the emergency room. Claiborne County officials are concerned this is not sufficient should there be an emergency at the Grand Gulf ESP facility. They believe their communications and transportation capability to evacuate patients is not adequate. County officials do have verbal agreements and are in contact with other licensed facilities within 97 km (60 mi) and believe that emergency responders would come to help from other counties, but they would like to have much more capability under local control (Scott 2004).

Table 2-15. Hospitals in the Vicinity of the Grand Gulf Early Site Permit Site

County	Number of Hospitals	Number of Beds
Claiborne	1	32
Copiah	1	49
Hinds	6	2468
Jefferson	1	30
Warren	2	354
Total	**11**	**2933**

Source: SERI 2004a

2.8.2.7 Education

Claiborne County and the four adjacent counties in Mississippi contain 114 primary and secondary schools with a student population of 60,281 (see Table 2-16).

Table 2-16. Number of Students, Primary and Secondary Schools in Mississippi Counties Surrounding the Grand Gulf Early Site Permit Site

Mississippi County	Number of Schools	Student Population
Claiborne	4	1195
Copiah	6	4911
Hinds	85	43,281
Jefferson	5	1714
Warren	14	9180
Total	**114**	**60,281**

Source: NCES 2002

2.9 Historic and Cultural Resources

This section discusses the cultural background and the known and potential historic and cultural resources at the Grand Gulf ESP site and surrounding environs of Claiborne County.

2.9.1 Cultural Background

The area in and around the Grand Gulf ESP site has a rich history and has demonstrated the presence of significant prehistoric and historic cultural resources. Thirty-five sites in Claiborne County are eligible for listing on the National Register of Historic Places, some of which are located within 16-km (10-mi) of the Grand Gulf ESP site (SERI 2003c). These are mostly historic buildings, homes, churches, and cemeteries.

One site, the Grand Gulf Military Park, a 162-ha (400-ac) park listed on the National Register of Historic Places, is located adjacent to the GGNS. Within the park are archaeological deposits, standing structures, objects, and artifacts from the historic town of Grand Gulf and from Civil War events that occurred in the area. Files at the Mississippi Department of Archives and History indicate that a total of 12 archaeological sites, in addition to the park site, are within 3 km (2 mi) of the Grand Gulf ESP site, none of which are eligible for listing on the National Register of Historic Places.

Although no prehistoric sequence has been published for the immediate area, the general sequence for the region can be described as follows:

- 10,000 - 8000 B.C. During this period, Mississippi was sparsely inhabited by peoples typically referred to as big-game hunters.

- 8000 - 2000 B.C. People developed a more generalized hunting and gathering economy and spread throughout the Mississippi valley. People would move from place to place, obtaining foods and other items as they became seasonally available.

- 2000 B.C. - A.D. 1000. The economy changed from seasonal food gathering to settled life. Small villages developed around mounds of earth constructed by the people to bury their dead.

- A.D 1000 - 1542. The economy added farming crops, such as corn, beans, and squash. Earth mounds developed into flat-topped "temple" mounds as population densities increased.

- A.D. 1542 - ca.1650. Diseases brought on by contact with Europeans led to massive epidemics, decimating the local American Indian populations.

Settlement by non-Indians increased throughout the 1700s as settlers moved into the frontier. American Indian groups such as the Choctaw, Chickasaw, Natchez, Tunica, and others resisted the new inhabitants but eventually abandoned traditional lands, moving to areas where they were less threatened by the dominant population. During this time, Mississippi went from being a French possession to an English possession in 1763, to a Spanish possession in 1781, and eventually to the United States in 1795. Mississippi became a U.S. Territory in 1798, and achieved statehood in 1817 (Headley 1996).

Port Gibson was founded in 1783 as the first settlement in the general area, serving the surrounding rural farms, where the main crops grown were cotton, corn, field peas, oats, and sweet potatoes (Hendrickson and McKeehen 1926). In 1802, the residents organized Claiborne County, which became the second area in Mississippi to achieve this status. By this time, the area was populated mainly by Anglo-Americans from the east and peoples of African descent. A second shipping point, Grand Gulf, formed in 1833. Grand Gulf eventually decreased in importance and faced heavy erosion in later years. An important Civil War battle occurred there in 1861 (Bearss 1989).

2.9.2 Historic and Cultural Resources at the Grand Gulf ESP Site

When the original GGNS site was planned, an archaeological survey of the 850-ha (2200-ac) proposed facility was commissioned by MP&L. The survey, performed by the Mississippi Department of Archives and History, identified eight prehistoric sites on the GGNS site (Brookes and Inmon 1973). Seven of the sites were scatters of lithic and ceramic debris and were not considered important enough for inclusion in the National Register of Historic Places. These sites are designated 22-Cb-523 though 22-Cb-529, using the Smithsonian archaeological site numbering system. These sites were located in the zone of construction and were likely destroyed or are located outside the Grand Gulf ESP site.

One site, Grand Gulf Mound (22-Cb-522), was considered important enough to excavate. This was a burial mound located on a terrace on the bluffs overlooking the Mississippi River. More than half the mound had been bulldozed and damaged by artifact collectors when the Mississippi Department of Archives and History visited it in 1972 (Brookes 1976). The Department persuaded MP&L to fence the mound and then commenced excavation soon thereafter. The investigators concluded this was an early Marksville burial mound dating from approximately A.D. 50 to A.D. 200. Evidence indicated an affinity to peoples in the north, probably the Illinois Valley. Today the fence is still standing, but little remains of the mound.

In addition to the archaeological work conducted prior to construction of GGNS, Mississippi Power & Light Company commissioned a survey of the existing architectural resources of Claiborne County (Douglas 1974). One such resource, the Callendar House, a mid-19th century simple Greek Revival house unique to the county, was located on the eastern portion of the GGNS (Douglas 1974). The house was built by C.D. and Lizzie Hamilton about 1866 and later owned by the Maxwell brothers and finally the Callendar family (Headley 1996). In the early 1970s, the house was in poor condition, and despite a desire to preserve the house, it did not survive. The house location inspection by NRC staff on April 13, 2004 (Stapp 2004) indicated portions of the Callendar House site were subsequently quarried for soil and today no evidence of the house is found on the surface. A barn, ca. 1920s, is still standing and evidence of roads and fields do remain. The Callendar House site is considered an unrecorded archaeological resource, as subsurface archaeological deposits probably exist. However, with the removal of the area where the house stood, the site likely would not be considered eligible for listing on the National Register of Historic Places because of a lack of integrity. It is not located in an area of proposed construction.

Finally, a 100-m segment of an important 19th century historic railroad, known as the Grand Gulf and Port Gibson Railroad, still exists within the site boundary and was inspected by NRC staff on April 13, 2004 (Stapp 2004). The steel rails are gone, but the railroad bed exists in good condition; it is not located in an area proposed for new construction. Discussions with Mississippi Department of Archives and History personnel indicate this would not be the best representative portion of the railroad to preserve and, therefore, no mitigation would likely be required should this portion be affected during facility construction (Stapp 2004).

2.9.3 Historic and Cultural Resources Consultation

To meet consultation requirements found in the National Historic Preservation Act of 1966, as amended, and the National Environmental Policy Act of 1969, NRC made a good faith effort to inform the public about the undertaking and consult with various entities. A public meeting on the ESP process was held on January 21, 2004, in Port Gibson. No comments specific to cultural or historic resources were made.

As part of the National Environmental Policy Act/National Historic Preservation Act integration, the NRC staff initiated consultation with the Advisory Council on Historic Preservation, the Mississippi Department of Archives and History, the Mississippi Band of Choctaw Indians, the Choctaw Nation of Oklahoma, and the Tunika Biloxi Indian Tribe of Louisiana (NRC 2004q; 2004r; 2004s; 2004t; 2004u, respectively). No responses to these letters have been received. A public scoping meeting on the proposed project was held on January 21, 2004.

On April 14, 2004, the NRC staff met with staff from the Grand Gulf Military Park to discuss potential visual effects of the proposed cooling tower and any other issues of concern; no concerns were identified (Stapp 2004).

NRC staff also initiated discussions with the Mississippi Department of Archives and History and the Vicksburg National Military Park to understand potential impacts on historic and cultural resources. The Mississippi Department of Archives and History recommended that if construction efforts were to occur in two specific areas of the Grand Gulf site, archaeological investigations should be undertaken prior to construction (SERI 2003c) (see Section 4.6). Staff affiliated with the Vicksburg National Military Park indicated that it was unlikely any significant Civil War-era resources would be affected by the planned activities (SERI 2003c).

The consultation process continues with the issuance of this EIS.

2.10 Environmental Justice

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[a] or low-income populations. Executive Order 12898 (59 FR 7629) directs Federal executive agencies to consider environmental justice under the National Environmental Policy Act of 1969. The Council on Environmental Quality (CEQ) has provided guidance for addressing environmental justice (CEQ 1997). Although it is not subject to the Executive Order, the Commission has voluntarily committed to undertake environmental justice reviews. The staff uses as guidance the NRC Office of Nuclear Reactor Regulation office instruction number LIC-203 (NRC 2001[b]).

The staff examined the geographic distribution of minority and low-income populations within 80 km (50 mi) of the Grand Gulf ESP site, employing the 2000 census for low-income and minority populations (USCB 2004c). The populations within 80 km (50 mi) of the Grand Gulf ESP site encompassed parts of sixteen counties in Mississippi and nine parishes in Louisiana. The staff supplemented its analysis by field inquires to county planning departments, social service agencies, personnel in Claiborne County, Mississippi, and a private social service agency in Claiborne County. NRC guidance encourages supplemental inquiries to ensure that minority and low-income groups are not overlooked.

(a) Minority categories are defined as: American Indian or Alaskan Native; Asian; Native Hawaiian or other Pacific Islander; Black races; Hispanic ethnicity; and "other," considered a separate minority category. The 2000 Census included multi-racial data. Some minority populations can be composed of one or more minority races (USCB 2005).

(b) NRC also issued a policy statement on Environmental Justice and an update to LIC 203 (see 69 FR 52040 and NRC 2004a, respectively).

For the purpose of the staff's review, a minority population is defined to exist if the percentage of each minority, or aggregated minority category within the census block groups[c] potentially affected by the ESP for the Grand Gulf ESP site, exceeds the corresponding percentage of minorities in the entire state of Mississippi or Louisiana by 20 percent, or if the corresponding percentage of minorities within the census block group is at least 50 percent. A low-income population is defined to exist if the percentage of low-income population within a census block group exceeds the corresponding percentage of low-income population in the entire state of Mississippi or Louisiana (as applicable) by 20 percent, or if the corresponding percentage of low-income population within a census block group is at least 50 percent.[d]

The staff followed the convention of employing 2000 census block group data to identify minority and low-income block groups within the 80-km (50-mi) radius of the Grand Gulf ESP site. Using this convention, the 80-km (50-mi) radius includes 129 census block groups for minority populations and 34 census block groups for low-income populations. Both Mississippi and Louisiana have relatively large percentages of low-income and minority persons. Figures 2-12 and 2-13 (which are based on the 20 percent and 50 percent rules described in this section) show those areas that have exceptionally high minority populations and exceptionally high proportions of low-income households within the 80-km (50-mi) radius of 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. Claiborne County is entirely composed of minority block groups and contains 10 of the 129 block groups containing exceptionally significant minority populations.

Data from the 2000 census characterize low-income populations within the 80-km (50-mi) radius of the Grand Gulf ESP site. The United States' percentage of low income population was 12.4 percent in the 2000 Census, while in Louisiana it was 19.2 percent and in Mississippi 19.9 percent (USCB 2004g). Applying the NRC criterion of "more than 20 percent greater than the state" yields the census block groups containing exceptionally high percentages of low-income households. Figure 2-13 shows these locations of the exceptionally high percentages of low-income populations within 80 km (50 mi) of the Grand Gulf ESP site. In fact, most of the area near the proposed site, especially Claiborne and Jefferson counties, has

(c) A census block group is a combination of census blocks, which are statistical subdivisions of a census tract. A census block is the smallest geographic entity for which the U.S. Census Bureau (USCB) collects and tabulates decennial census information. A census tract is a small, relatively permanent statistical subdivision of counties delineated by local committees of census data users in accordance with USCB guidelines for the purpose of collecting and presenting decennial census data. Census block groups are subsets of census tracts (USCB 2004e).

(d) Low-income households should be identified using the annual statistical poverty threshold from the U.S. Census Bureau (NRC 2004a).

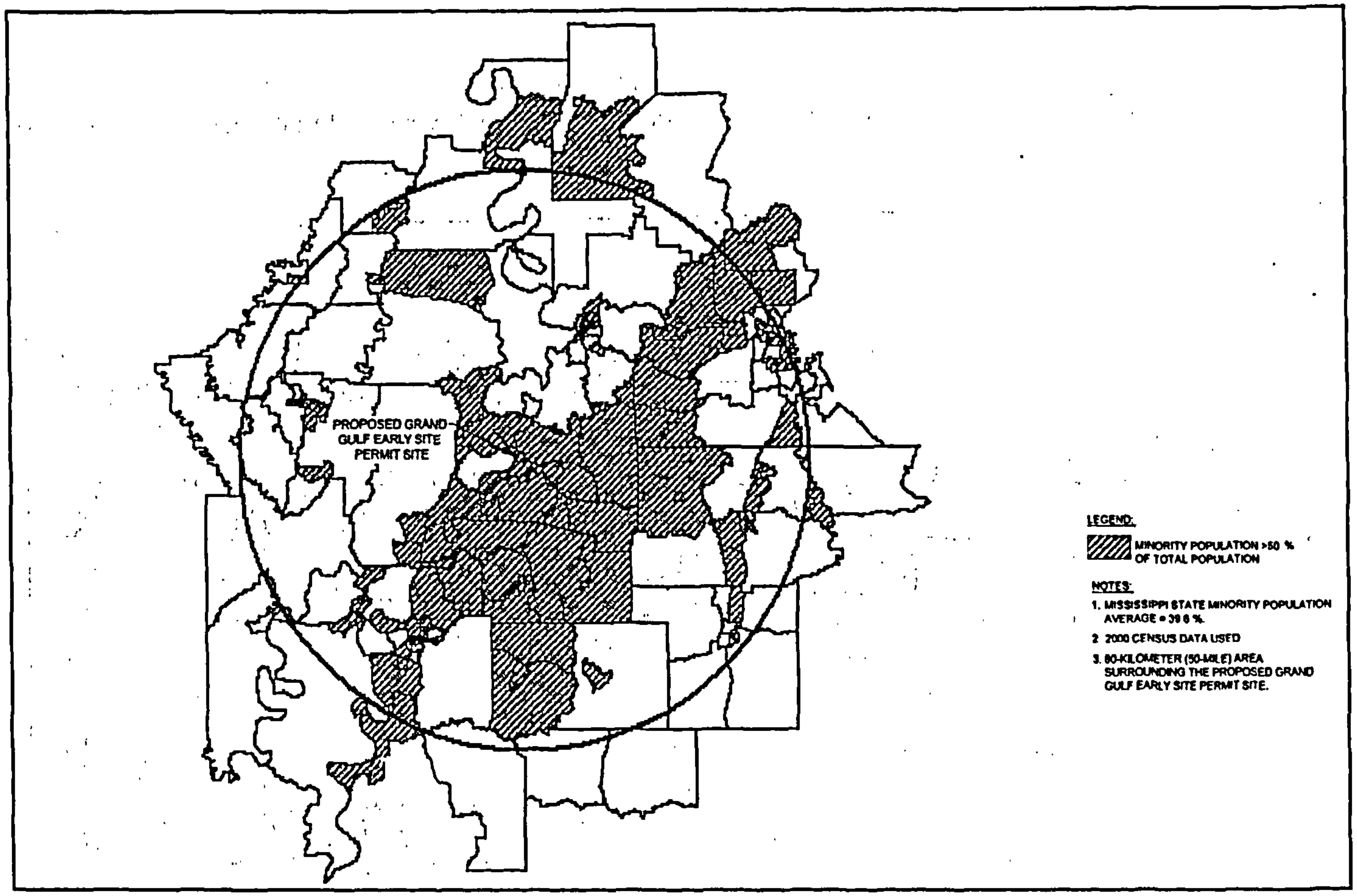

Figure 2-12. Minority Populations within 80 Kilometers (50 Miles) of the Grand Gulf Early Site Permit Site (adapted from SERI 2003c, Figures 2.5-6, 2.5-7)

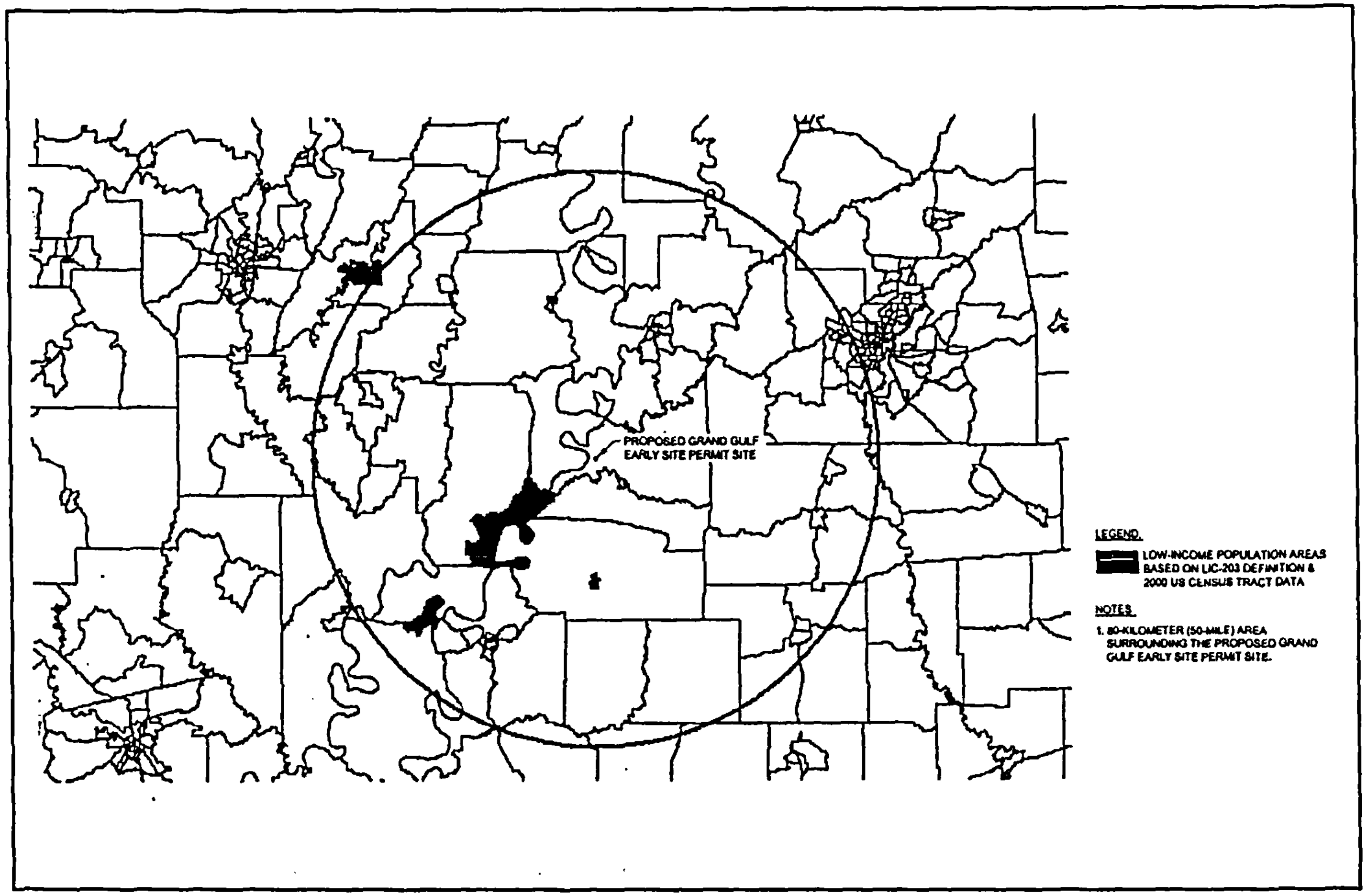

Figure 2-13. Low Income Populations within 80 Kilometers (50 Miles) of the Grand Gulf Early Site Permit Site (adapted from SERI 2003c, Figures 2.5-8, 2.5-9)

percentages of low-income populations in the range of 20 to 30 percent of the population. Nine out of 10 Census block groups in Claiborne County, 17 out of 24 in Copiah County, 5 out of 6 in Jefferson County, 12 out of 18 in Concordia Parish, and 6 out of 7 in Tensas Parish have low-income persons making up more than 20 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 (USCB 2004g).

2.11 Related Federal Projects

The staff reviewed the possibility that activities of other Federal agencies might affect the granting of an ESP to SERI. Any such activities could result in cumulative environmental impacts and the possible need for a Federal agency to become a cooperating agency for preparation of the EIS (10 CFR 51.10(b)(2)).

After reviewing the Federal activities in the vicinity of the Grand Gulf ESP site, the staff determined that there were no Federal project activities that would make it desirable for another Federal agency to become a cooperating agency for preparation of this EIS. Future Federal actions related to this project include permits and licenses that may be required at the time of the CP or COL application. Other Federal projects may be required at the CP or COL stage, such as transmission-related studies by FERC and related studies by the Homochitto National Forest. However, these activities do not relate to the ESP and have not been started. In summary, no other Federal activities or projects are associated with the permitting of this ESP site.

This review identifies any related federal activities that may, by granting the ESP, contribute to potential commutative effects within the site, vicinity, or region. In the case of the proposed Grand Gulf ESP, an additional nuclear facility at the GGNS site would create a situation where the potential for cumulative effects might increase when considering the overlap of the affected regions of the ESP facility, GGNS Unit 1, and River Bend Nuclear Station. As such, the 80-km (50-mi) region for the ESP site would encompass portions of Adams, Amite, Franklin, and Wilkinson counties in Mississippi, and Concordia Parish in Louisiana. These areas would be within the 80-km (50-mi) region of 3 nuclear power stations if a new nuclear facility was constructed at the Grand Gulf ESP site. Similar overlaps of regions exist at the alternative sites considered. No other related federal activities or cooperating agencies that affect facility siting or water supply have been identified.

2.12 References

10 CFR Part 20. Code of Federal Regulations, Title 10, *Energy*, Part 20, "Standards for Protection Against Radiation."

10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities," 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."

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 100. Code of Federal Regulations, Title 10, *Energy*, Part 100, "Reactor Site Criteria."

18 CFR Part 35. Code of Federal Regulations, Title 18, *Conservation of Power and Water Resources*, Part 35, "Filing of Rate Schedules and Tariffs," Section 28(f), "Standardization of Generator Interconnection Agreements and Procedures." Federal Energy Regulatory Commission.

40 CFR Part 81. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 81, "Designation of Areas for Air Quality Planning Purposes."

40 CFR Part 190. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations."

40 FR 44149. September 25, 1975. "Lists of Endangered and Threatened Fauna; Final Listing." *Federal Register*.

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3.0 Site Layout and Plant Parameter Envelope

The proposed Grand Gulf early site permit (ESP) site is located within the current boundaries of the Grand Gulf site, which contains Grand Gulf Nuclear Station (GGNS), Unit 1. As noted in Chapter 1, System Energy Resources, Inc. (SERI), did not define a particular reactor design and facilities layout in its application and environmental report. Instead, SERI used a plant parameter envelope (PPE) to provide bounds for assessing the environmental impact and determining site suitability. The PPE encompasses construction and operation of one or two new nuclear units generating as much as 8600 megawatts thermal (MW(t)) or 3000 megawatts electric (MW(e)) output. The site layout and existing facilities are discussed in Section 3.1. The PPE itself is presented in Appendix I and discussed in Section 3.2. The electrical transmission system is discussed in Section 3.3.

3.1 External Appearance and Site Layout

The Grand Gulf ESP site, which lies within the 850-ha (2100-ac) confines of the Grand Gulf site, is situated on the eastern shore of the Mississippi River (Figure 2-1). The existing reactor unit at the GGNS (Unit 1) is a boiling-water reactor that went on line in 1985. The reactor unit generates 3898 MW(t) or 1353 MW(e). It is cooled by a natural draft cooling tower and auxiliary mechanical draft tower located to the southwest of the containment and powerblock buildings. 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. The switchyard, which was originally constructed to support power from two units, lies to the east of the reactor and powerblock buildings.

Originally, the Grand Gulf site was approved for the construction of two units, although only one unit was completed and is currently operating. A portion of the containment building for Unit 2 was built before that unit was abandoned. This structure is located north of Unit 1. An area adjacent to Unit 1 was cleared and excavated for construction of a cooling tower for Unit 2, but it also was abandoned. These features are visible in the aerial view of the facilities shown in Figure 3-1, which also shows the main features of the GGNS facilities and the pipeline route to the Mississippi River. The existing facilities and structures of the GGNS facility cover 68.4 ha (169 ac) of the Grand Gulf site (SERI 2003c). The Grand Gulf ESP site, much of which has been disturbed previously, is located outside the area occupied by the existing GGNS facility and its support structures.

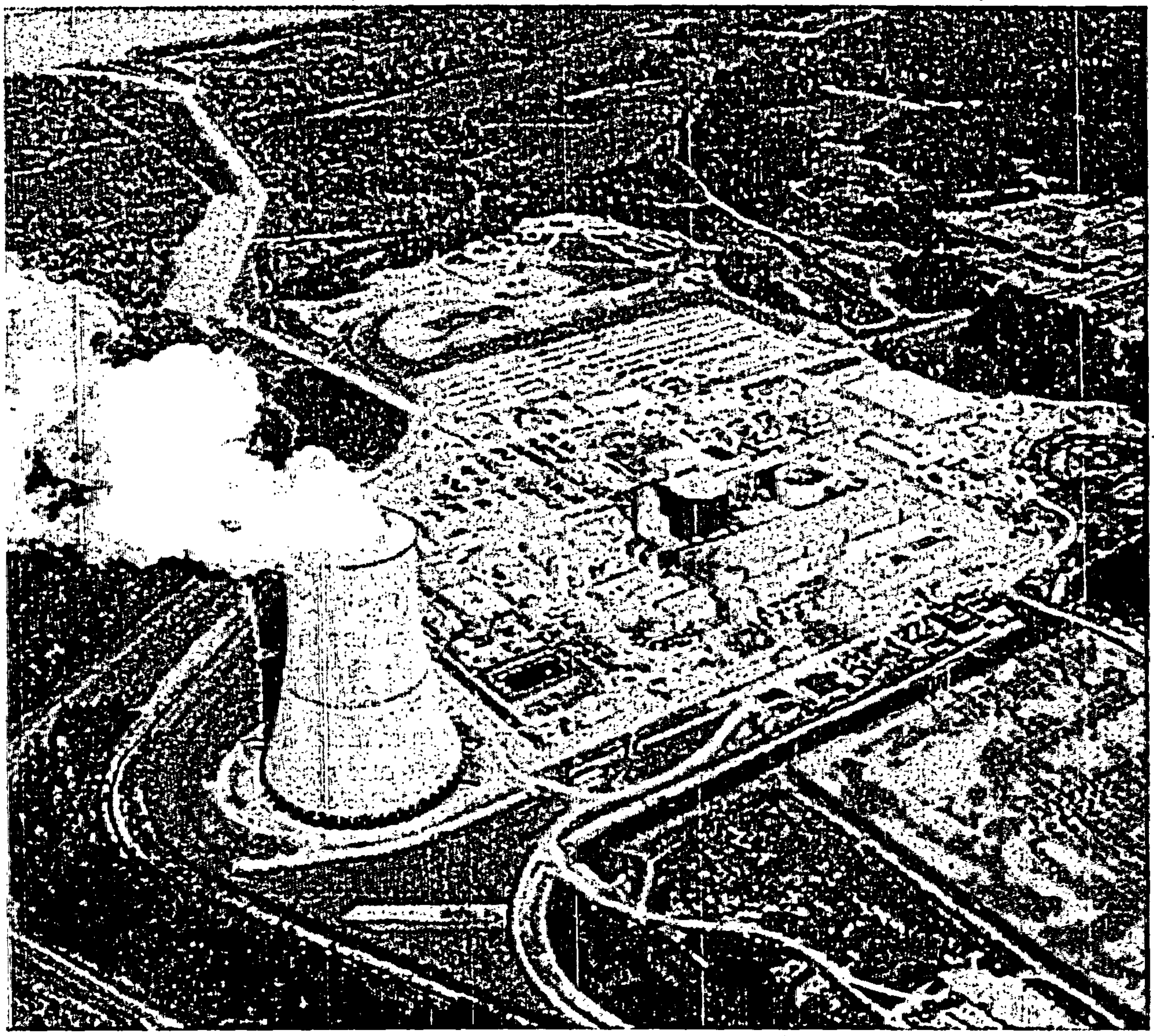

Figure 3-1. Aerial Photo of the Grand Gulf Nuclear Station

3.2 Plant Parameter Envelope

As described in Subpart A of Title 10 of the Code for Federal Regulations (CFR), Part 52, the applicant for an ESP need not provide a detailed design of a reactor or reactors and the associated facilities, but must provide sufficient bounding parameters and characteristics of the reactor or reactors and the associated facilities so that an assessment of site suitability can be made. Consequently, the ESP application may refer to a PPE as a surrogate for a nuclear power unit and its associated facilities.

A PPE is a set of values of plant design parameters that an ESP applicant expects will bound the design characteristics of the reactor or reactors that might be constructed at a given site. The PPE values are a surrogate for actual reactor design information. Analysis of environmental impacts based on a PPE approach permits an ESP applicant to defer the selection of a reactor design until the construction permit (CP) or combined construction permit and operating license (combined license or COL) stage. The PPE reflects upper or lower bounds of the values for each parameter that it encompasses rather than the characteristics of any specific reactor design. Appendix I lists the complete PPE values that are provided in the SERI ESP application.

Reactor Designs Considered in the PPE

In its ESP application, SERI used a composite of values from seven reactor designs to develop the bounds of their PPE (SERI 2003c). The values in this EIS are not design-specific. Rather, they are used to determine the environmental impact of any reactor design that falls within the values used in this EIS. These reactor designs include the following five light water reactor and two gas-cooled reactor types:

- Advanced Canada Deuterium Uranium Reactor (ACR-700) – This reactor, developed by Atomic Energy Canada Limited, is an evolutionary extension of CANDU 6 plant using very slightly enriched uranium fuel and light water coolant.

- Advanced Boiling Water Reactor (ABWR) – This reactor, developed by General Electric Company, is a standardized plant that has been certified under the U.S. Nuclear Regulatory Commission (NRC) requirements in 10 CFR Part 52. The ABWR is fueled with slightly enriched uranium and uses a light water cooling system.

- Advanced Pressurized Water Reactor (AP1000) – This is earlier version of the AP1000 reactor final design developed by Westinghouse Electric Company and subsequently approved by the NRC, using slightly enriched uranium and a light water cooling system. This design is not the AP1000 that has received final design approval from the NRC; therefore, this design will be referred to as the "surrogate AP1000."

- Economic Simplified Boiling Water Reactor (ESBWR) – This reactor, developed by General Electric Company, is fueled with slightly enriched uranium and uses a light water cooling system.

- International Reactor Innovative and Secure (IRIS) next-generation pressurized water reactor (PWR) – This reactor, under development by a consortium led by Westinghouse Electric Company, is a modular light water reactor.

- Gas Turbine Modular Helium Reactor (GT-MHR) – This reactor, developed by General Atomics, is a modular helium-cooled graphite-moderated reactor.

- Pebble Bed Modular Reactor (PBMR) – This reactor, developed by PBMR (Pty) Ltd., is a modular graphite-moderated helium-cooled gas turbine reactor.

The ABWR design has been certified by the NRC in accordance with 10 CFR Part 52. Certification of the surrogate AP1000 reactor design is pending. The other designs are in the pre-application stage.

SERI would not be required to use any of these designs if it chooses to go forward with a CP or COL, but the characteristics of the reactor ultimately chosen would have to be demonstrated to be within the bounds of the PPE for the assessment contained in this environmental impact statement (EIS) to be applicable.

Review Approach

NUREG-1555, *Environmental Standard Review Plan* (ESRP) (NRC 2000), and review standard RS-002, *Processing Applications for Early Site Permits* (NRC 2004), provide guidance to the NRC staff to help ensure a thorough, consistent, and disciplined review of any ESP application. The staff's June 23, 2003 response to comments received on draft RS-002 (NRC 2003) provide additional insights on the staff's expectations and approach to the review of an application employing the PPE approach.

If PPE values are used as a surrogate for design-specific values, the staff expects SERI to provide sufficient information for the staff to develop a reasonable independent assessment of potential impacts to specific environmental resources. In some cases, the design-specific information called for in the ESRP may not have been provided in the SERI ESP application because it did not exist or was not available. Therefore, the NRC staff could not apply the ESRP guidance in those review areas. In those cases, the NRC 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 this missing information. These assumptions are discussed in the appropriate sections of this EIS.

Because the SERI PPE values do not reflect a specific design, they were not reviewed by the NRC staff for correctness. However, the NRC staff made a determination that the 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 in accordance with 10 CFR 52.18. 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. The staff considered the PPE values to be bounding parameters. Therefore, the staff's evaluation serves as a bounding estimate of the potential environmental impacts resulting from constructing and operating up to two new nuclear units.

Throughout the Grand Gulf ESP environmental report, SERI (2003c) provides:

(1) commitments to address certain issues in the design, construction, and operation of the facility

(2) statements of planned compliance with current laws, regulations, and requirements

(3) commitments to future activities and actions that it will take should it decide to apply for a CP or COL

(4) descriptions of SERI's estimate of the environmental impacts resulting from the construction and operation of a new nuclear unit or units on the Grand Gulf ESP site

(5) descriptions of SERI's estimates of future activities and actions of others and the likely environmental impacts of those activities and actions that would be expected should SERI decide to apply for a CP or COL.

The activities described include, but are not limited to, such actions as:

- considering the results of testing and monitoring during the development of the COL application
- complying with NRC and other agency regulations, including obtaining appropriate permits from other agencies
- taking actions to mitigate adverse environmental impacts, including following industry or company standards, practices, or protocols
- addressing certain issues at the COL stage that were not addressed in the ESP application.

Some of these future actions are those that SERI would be required to implement because they are currently required by law, and others are actions that SERI has indicated that they would implement without the legal obligation to take such actions. Those matters considered by the staff in determining the level of impacts to a resource are discussed throughout this EIS and are listed in Appendix J.[a]

The staff performed its evaluation of the impacts of constructing and operating up to two new nuclear units at the ESP site assuming that these commitments, activities, and actions would be undertaken by SERI and others during future licensing activities.[b] As discussed previously, the staff developed assumptions necessary to evaluate impacts to certain environmental resources to account for missing detailed information. In addition to other sources of information obtained independently, the staff considered the commitments, future activities and actions, and estimates of expected environmental impacts that were identified by SERI in its environmental report and listed in Appendix J, as well as the PPE values listed in Appendix I, when developing the inputs and assumptions used in the staff's own independent evaluation of the environmental impacts of constructing and operating one or two new units on the Grand Gulf ESP site.

In addition, as a result of the staff's environmental review of the SERI ESP application, the staff determined that conditions or limitations on the ESP may be necessary in specific areas, as set forth in 10 CFR 52.24. Therefore, the staff identified when and how assumptions and bounding values limit its conclusions on the environmental impacts to a particular resource, where appropriate.

During the review of a COL application referencing an ESP, the staff will assess the environmental impacts of the construction and operation of a specific plant design. If the environmental impacts addressed in the ESP EIS are found to be bounding by the staff, no additional analysis of these impacts will be required, even if the ESP applicant employed the PPE approach. However, environmental impacts not considered or not bounded at the ESP stage will be assessed at the COL stage. The inputs and assumptions that were used or considered during the staff's evaluation of the ESP application (listed in Appendices I and J) will provide the basis for the staff's verification review in which the staff must determine whether or not a specific design in a COL application falls within the PPE.

(a) The listing is not intended to be a complete list of the commitments described in the environmental report.

(b) Those actions required to be undertaken by current law could change through the passage of future laws and regulations, and therefore, are listed in Appendix J to provide a listing of those laws and regulations considered during the staff's ESP environmental review.

3.2.1 Facility Water Use

Raw water would be needed to support construction and operation of the Grand Gulf ESP facility. The installation of an additional well would likely be required for construction purposes, such as concrete batch facility operation, dust suppression, and sanitary needs. The normal heat sink (NHS), service water system (SWS), and ultimate heat sink (UHS) have operational water needs, that would be met using raw water withdrawn from the Mississippi River. Other water sources, such as wells, may be used to supply water for general site purposes including potable, sanitary, and landscape maintenance.

In the PPE (see Appendix I), SERI specified average and maximum raw water makeup for the Grand Gulf ESP facility. The PPE provides bounding constraints on portions of facility water use. Other constraints on facility water use are based on site-specific information. This EIS assesses the impact of facility water use bounded by the PPE and site-specific constraints. The following sections describe the water uses of the Grand Gulf ESP facility and the associated facility water treatment systems. The cooling systems are described in more detail in Section 3.2.2.

3.2.1.1 Facility Water Consumption

The dominant water use is makeup water for the NHS. That makeup water replaces water lost by evaporation, drift, and blowdown. The PPE (see Appendix I) 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). Average and maximum blowdown are listed as 807 L/s (12,800 gpm) and 2500 L/s (39,000 gpm). SERI proposes to discharge the NHS blowdown to the Mississippi River. The SWS water obtained from the Mississippi River will be routed to the NHS system for reuse, and the flows are therefore bounded by the flows identified for the NHS. The UHS supplies cooling water to safely shut down and cool down the facility in the event of an emergency. SERI's proposed UHS design is an engineered water basin with mechanical draft cooling towers. During emergency conditions the UHS would draw water from that water basin and there would not be a demand for water from the local environment.

3.2.1.2 Facility Water Treatment

SERI discusses facility water treatment in Section 3.3.2 of the environmental report (SERI 2003c). The water supply system would provide water for the circulating water system, NHS, SWS, UHS, demineralized water system, fire protection system, and other miscellaneous raw water supply needs. 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. Filtration equipment, such as clarifiers, would remove suspended solids from the river water. Clarified, filtered, and chemically treated water would be required. The specific methods and chemicals required for the prevention of corrosion, biological fouling, and for process-water treatment are not known at this time. Discharge of chemical effluents from water treatment processes would be limited by the National Pollutant Discharge Elimination System (NPDES) permit issued by the Mississippi Department of Environmental Quality (MDEQ).

3.2.2 Cooling System

The Grand Gulf ESP facility would have several different cooling systems. The largest heat load is dissipated by the NHS. The SWS has a far smaller heat rejection load, and the UHS designed heat rejection load is only required to safely shut down the facility. SERI has not yet finalized a detailed design for the cooling water systems. However, based on the location of the proposed site, SERI has considered the potential for three cooling system designs for the NHS: mechanical draft, natural draft, and a wet-dry hybrid design. While it can be expected that 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 (Appendix I) and were not considered further in the staff's review. The staff's discussion of the various heat dissipation alternatives at the Grand Gulf ESP site is provided in Section 8.3.1 of this environmental impact statement.

3.2.2.1 Description and Operational Modes

Waste heat is a by-product of power generation at a nuclear power plant. The NHS is an integral part of such power generation. The NHS comprises a closed-loop circulating water system, pumps, water basin, and cooling towers. The circulating water system pumps water through the main condenser and then to the cooling towers. Heat is transferred to the water in the condenser and is dissipated to the atmosphere by evaporation. 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 x 10^9 Btu/hr) during normal full-power operation, according to the PPE (see Appendix I).

During the heat-dissipation process, evaporation of water increases the dissolved solids in the NHS cooling water. To limit the concentration of solids in the NHS cooling water, a portion of the water is discharged from the NHS system as blowdown. In addition to the blowdown and evaporative losses, a small percentage of water in the form of droplets (drift) is lost from the cooling towers. SERI states that water pumped from the Mississippi River would be used to replace water lost by evaporation, drift, and blowdown. Blowdown water would be returned to the Mississippi River via a new outfall, thereby dissipating a small portion of the rejected heat to the Mississippi River. In the PPE (see Appendix I), SERI provides bounding values for water and energy fluxes for the NHS. The NHS values follow:

- Maximum blowdown flow is 2500 L/s (39,000 gpm).
- Maximum blowdown temperature is 38°C (100°F).

- Maximum evaporation rate is 2500 L/s (39,000 gpm).
- Maximum makeup flow value is 5000 L/s (78,000 gpm).

According to SERI, the SWS represents less than 1 percent of the NHS heat rejection load and is included in the NHS bounding values in the PPE.

SERI proposes 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. The basin is required to maintain an adequate supply of water for 30 days of emergency operation. The UHS supplies the cooling water to structures, systems, and components required to safely shut down and cool down the nuclear power plant under normal operations, anticipated operational occurrences, and accident conditions. SERI (2003c) has provided bounding values for water and energy fluxes for the UHS. The UHS values follow:

- Maximum blowdown flow is 110 L/s (1700 gpm).
- Maximum blowdown temperature is 35°C (95°F).
- Maximum evaporation rate is 110 L/s (1700 gpm).

According to these values, the UHS represents less than 1 percent of the NHS heat rejection load.

3.2.2.2 Component Descriptions

The following sections describe the intake, discharge, and heat dissipation systems.

Intake System

SERI (2003c) states that 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. 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. Dredging would be required to form the embayment. The environmental report (SERI 2003c) shows the location of proposed intake, suction pipelines, and intake screens. 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. Screens would be mounted at the entrance to each suction pipeline to minimize uptake of aquatic biota and river debris. The intake 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 the Clean Water Act (CWA 1977), to limit organism mortality from impingement and entrainment. SERI would design the embayment to limit the amount and rate of sediment deposition and littoral debris carried into the embayment.

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) will be combined with the existing discharges from GGNS Unit 1 facility downstream from the embayment and intake. SERI (2003c) states that 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. SERI (2003c) states that 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. The maximum discharge from all sources is 2630 L/s (41,700 gpm). The NHS cooling tower blowdown would be the major contributor to the total discharge flow, and its return temperature is estimated at 38°C (100°F).

Heat Dissipation Systems

Heat dissipation from the NHS, SWS, and UHS would occur through the use of cooling towers and blowdown to the Mississippi River. Wet cooling towers were proposed by SERI (2003c) for the NHS and UHS. The SWS heat dissipation was incorporated into the NHS. 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. 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 (Appendix I).

3.2.3 Radioactive Waste Management System

Liquid, gaseous, and solid radioactive waste management systems will be used to collect and treat the radioactive materials that are produced as a by-product of operating the proposed unit on the Grand Gulf ESP site. These systems would process radioactive liquid, gaseous, and solid effluents to maintain releases within regulatory limits and to levels as low as is reasonably achievable (ALARA) before being released to the environment. Waste processing systems would be designed to meet the design objectives of 10 CFR Part 50, 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*). Radioactive material in the reactor coolant would be the primary source of gaseous, liquid, and solid radioactive wastes in light water reactors. Radioactive fission products build up within the fuel as a consequence of the fission process. These fission products are contained largely in the sealed fuel rods, but small quantities escape the fuel rods and contaminate the reactor coolant. Neutron activation of the primary coolant system would also be responsible for coolant contamination.

SERI did not identify specific radioactive waste management systems for new facilities constructed at the Grand Gulf ESP site. The PPE concept was used to provide an upper bound on liquid radioactive effluents, gaseous radioactive effluents, and solid radioactive waste releases (SERI 2003c). Bounding effluent concentrations were determined, based on a composite of the highest activity content of the individual isotopes from two surrogate AP1000 reactors (6400 MW(t)), three IRIS reactors (3000 MW(t)), one ABWR reactor (3926 MW(t)), one ESBWR reactor (4000 MW(t)), four GT-MHR modules (2400 MW(t)), and eight PBMR modules (3200 MW(t)). Bounding gaseous effluent releases are found in Table 3.0-7 of the Grand Gulf ESP environmental report (SERI 2003c). Bounding liquid effluent releases are found in Table 3.0-8 of the environmental report (SERI 2003c).

The bounding total annual volume of solid radioactive waste is estimated at 530 m^3/yr (1.9×10^4 ft^3/yr) with a bounding total amount of radioactive material of 2×10^{14} Bq/yr (5400 Ci/yr) as found in the PPE (SERI 2003c).

3.2.4 Nonradioactive Waste Management

SERI has not finalized design of nonradioactive waste management systems yet. These 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. Nonradioactive waste effluents are regulated under the NPDES permit process and would require a permit from the MDEQ.

3.2.4.1 Effluents Containing Chemicals or Biocides

Chemicals are typically used to control water quality, scale, corrosion, and biological fouling. The chemical concentrations within effluent streams from a new facility would be controlled through engineering, operational, and administrative controls in order to meet NPDES requirements at the time of construction and operation.

3.2.4.2 Sanitary System Effluents

SERI (2003c) states that a permanent sanitary waste system would be provided for the operational phase of the Grand Gulf ESP facility. Industrial materials, such as chemistry laboratory waste, would be excluded from the sanitary waste system. The chosen sanitary waste system design would incorporate state-of-the-art sewage treatment and disposal technologies to treat domestic waste only and it would comply with future expected NPDES permit requirements.

3.2.4.3 Other Effluents

Nonradioactive gaseous emission results from operating auxiliary boilers and from testing and operating the standby power system, which may use diesel and/or gas turbine generators. These emissions commonly include particulates, sulfur oxides, carbon monoxide, hydrocarbons and nitrogen oxides. Gaseous releases would comply with Federal, State, and local emissions standards.

Chemical waste from laboratory drains, equipment decontamination, and chemical additives would be collected in chemical waste sumps or approved chemical storage units. Chemical drainage system waste would be monitored, treated, and released in accordance with an approved NPDES permit, or otherwise disposed. Discharges from the chemical drainage system would comply with applicable Federal, State, and local standards in place during operation of a new facility. Hazardous nonradioactive waste would be treated and disposed of in accordance with all applicable Federal, State, and local regulations.

Storm water from structures constructed at the Grand Gulf ESP site would typically flow into major drainage courses and finally to Hamilton Lake, which is hydraulically connected to the Mississippi River. The design of the storm water systems for a new facility would comply with NPDES storm water regulations administered by MDEQ.

Other nonradioactive waste (such as paper, metals, and garbage) would be disposed in accordance with applicable regulations. Nonradioactive effluent would be treated, controlled, and discharged or disposed as required to meet Federal, State, and local regulations and guidelines.

3.3 Transmission System

The ESP site facility is adjacent to the GGNS Unit 1 facility and wholly contained within the property boundary of the GGNS site. The GGNS site is linked to load centers by a system of transmission lines in the Entergy Mississippi, Inc. (EMI) electric system. The EMI electric system consists of interconnected hydro, fossil-fuel, and nuclear power plants that supply electrical energy over a 500/230/115 kV transmission system. EMI owns the GGNS switchyard where the GGNS Unit 1 facility is connected to two transmission lines. The two lines are the

- 40.6-km (25.2-mi) long, single-circuit 500 kV line that connects to the Baxter Wilson Extra High Voltage Substation

- 70.1-km (43.6-mi) long, single-circuit 500-kV line that connects to the Franklin Extra High Voltage Substation.

In addition to the length, the power transmission corridor widths and areas of these transmission lines are listed in Table 3-1. Electrical energy from the GGNS Unit 1 facility is transmitted by the 500 kV lines, which existed when the GGNS Unit 1 facility was built (SERI 2003c). A separate distribution line (single-circuit 115 kV) runs from the Port Gibson substation to the GGNS switchyard to provide offsite power to GGNS. The staff assumes that this line would be sufficient to service any new units at the ESP site without modification. Therefore, this line and its corridor are not considered further.

Table 3-1. Existing Transmission Corridors to the Grand Gulf Nuclear Station Site

Corridor	Voltage	Length km (mi)	Average Width m (ft)	Area ha (ac)
Baxter Wilson	500 kV	40.6 (25.2)	61 (200)	248 (612)
Franklin	500 kV	70.1 (43.6)	61 (200)	428 (1057)
Total		**110.7 (68.8)**		**676 (1669)**

Source: SERI 2003c.

SERI (2003c) states that the power transmission and distribution system existing at the time of startup and operation of new facility would be relied upon to distribute the power generated by the facility. A study of the existing system conducted by SERI concluded that the existing system is adequate for an additional 1311 MW(e) generating capacity assuming that modifications and upgrades are made to equipment in the GGNS switchyard (SERI 2003c).

SERI (2003c) states that the maximum generating capacity is approximately 3000 MW(e). If 3000 MW(e) generating capacity were installed, the existing transmission lines would have to be upgraded or additional transmission lines would required. Assuming that a new facility at the Grand Gulf ESP site would be a merchant generator, procedures for requesting connection to the transmission system are set forth in the Federal Energy Regulatory Commission (FERC) standard interconnection procedures and agreement called out in 18 CFR 35.28(f), "Standard Generator Interconnection Procedures and Agreement," as described below.

The FERC process starts when the interconnection customer, in this case SERI, submits an interconnection request to the transmission provider (Entergy Mississippi [EMI]). When the interconnection request is determined to be valid, the transmission provider and interconnection customer have a scoping meeting to discuss alternative interconnection options and exchange information. On the basis of this meeting, the interconnection customer designates its point of interconnection, and one or more alternative point(s) of interconnection.

Following the scoping meeting, the transmission provider conducts an interconnection feasibility study to evaluate the feasibility of the proposed interconnection to the transmission system.

This study includes a power flow and short circuit analysis. The interconnection feasibility study is followed by an interconnection system impact study that focuses on the impact of the interconnection on the reliability of the transmission system.

Finally, the transmission provider conducts an interconnection facilities study to specify and estimate the cost of the equipment, engineering, procurement, and construction work needed to implement the conclusions of the interconnection system impact study in accordance with good utility practice to physically and electrically connect the interconnection facility to the transmission system. These studies are conducted by the transmission provider, but the interconnection customer pays for the studies.

SERI has not submitted an interconnection request to EMI. However, the staff assumes that the process for obtaining any additional transmission services required would be completed prior to submission of an application for construction and operation of a new facility at the Grand Gulf ESP site. In addition, the staff assumes 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 corridors to the extent possible. Additional rights-of-way might be required, if only to widen existing rights-of-way. Land use in the existing transmission corridors is described in Table 3-2.

Table 3-2. Land Use in the Existing Transmission Corridors to the Grand Gulf Nuclear Station Site

Corridor	Agriculture	Developed Nonresidential	Residential	Undeveloped	Water or Wetlands
Baxter Wilson	23.9%	0.4%	4.5%	62.8%	8.3%
Franklin	9.4%	0.0%	0.0%	86.3%	4.3%
Total	**14.7%**	**0.2%**	**1.7%**	**77.7%**	**5.8%**

Notes: U.S. Geological Survey land-cover classes have been aggregated for presentation purposes. Rounding may affect totals.
Source: USGS 2000.

3.4 References

10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy,* Part 50, "Domestic Licensing of Production and Utilization Facilities."

10 CFR Part 52. Code of Federal Regulations, Title 10, *Energy*, Part 52, "Early Site Permits, Standard Design Certifications, and Combined Licenses for Nuclear Power Plants."

18 CFR Part 35. Code of Federal Regulations, Title 18, *Conservation of Power and Water Resources*, Part 35, "Filing of Rate Schedules and Tariffs," Section 28(f), "Standard Generator Interconnection Procedures and Agreement."

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4.0 Construction Impacts at the Proposed Site

This chapter examines the environmental issues associated with the potential construction of one or more additional nuclear power units at the proposed Grand Gulf early site permit (ESP) site as described in the application for an ESP submitted by System Energy Resources, Inc. (SERI). As part of this application, SERI submitted an environmental report (SERI 2003c) that provides the plant parameter envelope (see Appendix I) as the basis for the environmental review. Although certain site preparation activities are permitted by Title 10 of the Code of Federal Regulations (CFR) 52.25(a) and 10 CFR 50.10(e)(1) under an ESP, SERI has chosen not to include a site redress plan in its application and, therefore, would not be permitted to undertake site preparation activities, including transmission corridors, prior to obtaining a *construction permit (CP) or combined license (COL).*

Sections 4.1 through 4.9 of this chapter discuss 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. In accordance with 10 CFR Part 51, the impacts are analyzed and a single significance level of potential adverse impact (either SMALL, MODERATE, or LARGE) is assigned to each analysis. Measures and controls to limit adverse impact are presented in Section 4.10. A summary of construction impacts is presented in Section 4.11. Section 4.12 lists the references cited in this chapter.

The staff relied on the mitigation measures and the required Federal, State, and local permits and authorizations presented in the environmental report in reaching its conclusion on the significance level of the adverse impacts. The staff relied on the infrastructure upgrades planned by the counties, cities, and towns, such as road and school expansions, in assigning significance levels to the impacts.

4.1 Land-Use Impacts

This section provides information regarding land-use impacts associated with site preparation activities and construction of a new nuclear facility at the Grand Gulf ESP site. Topics discussed include land-use impacts at the site and in the vicinity of the site and land-use impacts in transmission line rights-of-way and offsite areas.

4.1.1 Site and Vicinity

The Grand Gulf site property boundary encompasses approximately 850 ha (2100 ac). Figure 2-4 indicates the areas likely to be affected by ESP site preparation and construction activities. Construction of a new facility would result in some alterations of current land use. Much of the area for a new facility within the proposed construction area footprint was altered as a result of the construction and operation of Grand Gulf Nuclear Station (GGNS).

An estimated 160 ha (400 ac) of the 850-ha (2100-ac) Grand Gulf site would be affected by construction of a new facility (SERI 2003c). The principal impacts during site preparation and construction of the Grand Gulf ESP site would include clearing, dredging, grading, excavation, spoil deposition, and dewatering. Based on the information provided by SERI (2003c; 2004e), the staff estimates that approximately 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. These land areas primarily consist of forested tracts left intact during the GGNS construction.

An estimated 50.6 ha (125 ac) would contain permanent structures (primarily a power block area, cooling tower area, and bottomland pipeline and intake areas) (SERI 2003c). Acreage not containing permanent structures would be reclaimed to the maximum extent possible (SERI 2003c).

Construction activities would be conducted within the Mississippi River floodplain. These include dredging at the existing barge slip area and proposed water intake structure and embayment, along with construction of other items that are part of that water intake facility. Additionally, trenching from the intake to the proposed power block on the bluffs east of the river would be required to lay supply and discharge piping from the Grand Gulf ESP facility. The water intake for the Grand Gulf ESP facility would be located at or near the existing barge slip area (SERI 2003c). Dredging of the new intake areas would have some impact as the dredge material will most likely be deposited on the Grand Gulf ESP site. Excavation and construction of the intake structure along the river bank in the flood plain areas would have some impact on land use, but the impact is expected to be temporary. 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 COL stage.

Based on information provided by SERI and its own independent review, the staff concludes that there are no significant environmental impacts related to land use that would influence the granting of an ESP to SERI. The staff concludes that, based on the expected conditions outlined by SERI and the assumptions and estimates made by the staff, the land-use impacts of site preparation and construction activities that can be identified would be SMALL, and additional mitigation activities beyond those outlined by SERI (2003c) are not warranted.

4.1.2 Transmission Corridors and Offsite Areas

Implementing the Grand Gulf ESP plant parameter envelope would require additional transmission capacity to serve consumers with power. SERI has indicated that as a result of receiving an ESP, agreements would be made with the regional transmission operator, and, if required, transmission lines would be upgraded in the event that the power demands and power production exceed the line capabilities. The full extent of potential land-use impacts in the transmission line corridors can be estimated only after following the Federal Energy Regulatory Commission process for connecting new large generation plants to the grid. In general, the process is designed to determine the optimal routing of new transmission service by performing studies of feasibility, impact, and facilities associated with the transmission request. This process is discussed in Section 3.3.

About 14.4 km (9 mi) of the Franklin transmission line corridor traverses the Homochitto National Forest, which includes a mix of public and private land ownership (USFS 1989). SERI, the transmission line owner, and the U.S. Forest Service would need to coordinate processes in order to follow the procedures the U.S. Forest Service requires to effect changes, upgrades, or other significant modifications to these transmission line rights-of-way. Any upgrading to the transmission line is likely be accomplished using existing rights-of-way, as described in Section 2.2.2.

Based on this information, the staff concludes that the impact to land use in the transmission corridors would be SMALL and may involve temporary disruption of access or other uses of the rights-of-way.

4.2 Meteorological and Air Quality Impacts

Sections 2.3.1 and 2.3.2 describe the meteorological characteristics and air quality of the Grand Gulf ESP site. 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 would be the primary impacts of construction of the Grand Gulf ESP facility on local meteorology and air quality.

4.2.1 Construction Activities

Activities associated with construction of the Grand Gulf ESP facility would be similar to the activities associated with construction of any large industrial complex. There will be ground-clearing, grading, excavation, and movement of materials and machinery.

Ground-clearing, grading, and excavation activities will raise dust, as will the movement of materials and machinery. Fugitive dust may also rise from cleared areas during windy periods. SERI has stated in its environmental report (SERI 2003c) that dust from construction activities would be mitigated to the extent possible. Mitigation measures would include wetting of unpaved roads and construction areas during dry periods and seeding or mulching bare areas. The concrete batch plant would be equipped with a dust-control system that would be checked and maintained on a routine basis.

Construction equipment burning gasoline or diesel fuel would be inspected and maintained to prevent excessive exhaust emissions. SERI states (SERI 2000c) that equipment that does not meet air quality regulations and permits in place at the time of construction would be repaired or replaced.

SERI stated (SERI 2003c) that open burning would be conducted in a burn pit using technology to increase combustion efficiency and reduce smoke level in compliance with applicable air-permit requirements established by the Mississippi Department of Environmental Quality (MDEQ). Procedures would be established to prevent brush and forest fires initiated by open burning.

Construction activities take place for a limited duration. Any impacts on meteorology and air quality that might occur would be temporary. The staff concludes that the impacts of construction activities on air quality would be SMALL, based on mitigation identified in SERI's environmental report (SERI 2003c).

4.2.2 Transportation

SERI estimates that the maximum construction workforce would be approximately 3150 (SERI 2003c). Exhaust from the vehicles required to transport this workforce would decrease air quality somewhat, but it is unlikely that air quality would be degraded sufficiently to be noticeable beyond the immediate vicinity of Grand Gulf Road and State Highway 18 and U.S. Highway 61. Mitigation of potential air quality impacts of increased traffic could be achieved by arranging shift changes for construction workers so they do not coincide with shift changes for GGNS Unit 1 personnel.

The effects of vehicle exhaust from 2300 cars (4600 trips per day) were considered by the U.S. Nuclear Regulatory Commission (NRC) in NUREG-1437 (NRC 1996) and found to be of potential concern if the trips were made in an area where air quality does not meet the National Ambient Air Quality Standards. Air quality in Mississippi and nearby counties in Louisiana is consistent with all Standards. Therefore, the staff concludes that the impact on air quality of increased traffic associated with construction of the Grand Gulf ESP facility would be SMALL, and additional mitigation is not warranted.

4.3 Water-Related Impacts

Water-related impacts involved in the construction of a nuclear power plant are similar to impacts that would be associated with any large industrial construction project. Likewise, an applicant must obtain the same certifications, and determinations and follow the best management practices as at any other large industrial facility. Prior to issuance of a CP or COL, an applicant is required to obtain permits, certificates, and determinations regulating water use and water quality. These permits, certificates, and determinations would likely include:

- *Clean Water Act Section 404 permit. This permit would be issued by the U.S. Army* Corps of Engineers (ACE) and regulates the impacts of construction activities on wetlands and management of dredged material.

- Clean Water Act Section 401 certification. This certification would be issued by MDEQ and ensures that projects do not conflict with state water quality management programs.

- Clean Water Act Section 402(p) National Pollutant Discharge Elimination System (NPDES) storm water permit. This permit would be issued by MDEQ and regulates point source storm water discharges. U.S. Environmental Protection Agency's (EPA) 1990 Phase 1 Storm Water Regulation established requirements for storm water discharges from various activities including construction activities disturbing an area of at least 2.0 ha (5.0 ac). EPA has delegated the responsibility for administering the NPDES *program* in Mississippi to MDEQ.

- Section 10 of the Rivers and Harbors Act of 1899. This section prohibits the obstruction or alteration of navigable waters of the United States without a permit. Appropriate ACE permits would be obtained for construction in the floodplain.

- Section 1424(e) of the Safe Drinking Water Act of 1974. This section prohibits any commitment for federal financial assistance (through a grant, contract, load guarantee, or otherwise) for any project which the EPA Administrator determines may contaminate an aquifer designated by the Administrator to be a sole-source aquifer. EPA had identified the Southern Hills Aquifer, which includes the Catahoula formation beneath the Grand Gulf site, to be a sole-source aquifer (EPA 1998).

4.3.1 Water Use Impacts

SERI stated (2003c) that construction activities at the Grand Gulf ESP site would not be expected to use surface water. Based on this commitment by SERI, the staff concludes that there would be no water use related impacts of construction on surface water.

SERI stated that additional groundwater wells would be required for construction purposes such as concrete batch plant operation, dust suppression, and sanitary needs (SERI 2003c). SERI also stated that the use of the additional wells installed in the Catahoula formation for construction water needs would not significantly affect the groundwater water surface elevation in the vicinity (SERI 2003c). However, the staff concluded that the characterization of the Catahoula aquifer was inadequate to support such a conclusion, particularly given the significance of the aquifer for local domestic water supplies and its designation by EPA as a sole-source aquifer. Because of the limited number of borings into the Catahoula formation, limited hydraulic conductivity measurements, and limited long-term pump tests, the staff was unable to assess reliably the impact of a significant increase in the groundwater withdrawal at the site. Prior to issuance of a CP or COL, an applicant would need to provide better characterization of the Catahoula formation and its associated aquifers. The staff concluded that, because the construction water needs could be met by treated water from the Mississippi River, even if the Catahoula formation were to prove unsuitable at the CP or COL stage, the facility could use Mississippi River water because of the negligible construction water requirements relative to the flow in the Mississippi River.

Dewatering at the new ESP power block excavation would likely be required during construction. Specific dewatering requirements, dewatering well locations, and well design details would be determined when the detailed facility design and layout are finalized. Construction standards for temporary construction dewatering wells and for permanent dewatering wells would be in accordance with applicable standards published in the MDEQ groundwater use and protection regulations (MDEQ 1994), and necessary permits would be obtained from the MDEQ. MDEQ regulations allow for permit denial or reduction of withdrawal rate if such a withdrawal is expected to interfere with existing permitted uses or if it conflicts with the public interest. Therefore, the staff concludes that the impact of construction dewatering would be small, temporary, and localized.

Based on the above, the staff concludes that the water use impacts associated with the construction of the ESP facility would be SMALL. However, at the CP or COL stage, SERI would need to demonstrate that the Catahoula formation could support the additional groundwater withdrawals.

4.3.2 Water-Quality Impacts

Erosion of exposed and poorly graded soil during construction activities can result in a significant increase in the sediment load to nearby water bodies. Based on the location of the proposed facility, Stream A is most likely to represent a significant sediment concern. The application (SERI 2000a) proposed that the intake and discharge pipelines would follow the path of the existing haul roads for approximately 1.8 km (1.1 mi) to the uplands. Pipelines would also be required to cross Stream A to reach the proposed cooling tower area. This would either involve crossing Sediment Basin A or crossing upstream of Sediment Basin A adjacent to the existing roadway to the northern end of the ESP site. The excavations associated with these pipelines, as well as the reactor block(s) excavation and site grading for the cooling towers and other buildings, represent an opportunity for the region's frequent storms to mobilize a considerable amount of sediment into the streams. SERI would be regulated by a NPDES storm water permit issued by MDEQ to employ erosion-prevention practices such as vegetation buffers, temporary sedimentation basins, and silt fences within a storm water pollution prevention plan. The staff concludes that, because the lowlands environment naturally experiences high sediment loads during the annual flooding of the Mississippi River, current best management practices for storm water management would be adequate to ensure that the impacts to water quality from the erosion of sediment would be small.

Federal financially assisted projects that have potential to contaminate a designated sole source aquifer are subject to EPA review. Federal financial assistance is defined as any financial benefits provided directly as aid to a project by a department, agency or instrumentality of the Federal government in any form, including contracts, grants, and loan guarantee. The CP or COL applicant would be required to obtain an EPA determination that construction (and operational) activities would not adversely impact the groundwater quality at the facility.

Dredging and shoreline construction would be required to expand and deepen the shoreline embayment and to improve the barge slip or unloading facility. During these activities, turbidity in the Mississippi River would be expected to increase in the immediate vicinity. Dredging operations would be regulated by the ACE to protect navigation and habitat. SERI has committed to restrict shoreline construction of the intake and discharge structures to periods when river water level would be low to minimize the impacts to the river. Based on the above, and the large assimilative capacity of the Mississippi River, the staff concludes the impacts would be negligible.

Based on the above, the staff concludes that the impacts on water quality during construction would be SMALL at the Grand Gulf ESP site.

4.4 Ecological Impacts

This section describes the potential impacts of construction on the ecological resources at the Grand Gulf ESP site. The section is divided into three subsections: Terrestrial Ecosystems, Aquatic Ecosystems, and Threatened and Endangered Species.

4.4.1 Terrestrial Ecosystems

The NRC staff evaluated the potential impacts to wildlife and their habitat from construction of the Grand Gulf ESP facility and potential expansion of the existing transmission corridors on terrestrial ecosystems.

4.4.1.1 Wildlife Habitat on the Grand Gulf Site

The construction associated with the GGNS Unit 1 and subsequent vegetation succession is relevant to the potential impact of construction on wildlife habitat at the Grand Gulf ESP site.

A total of 850 ha (2100 ac) is located within the Grand Gulf site boundary (NRC 1996; SERI 2003c). The site was originally intended to contain two nuclear units. GGNS Unit 1 was completed and the second unit was only partially completed. Approximately 188 ha (465 ac) of the site were affected by construction of the existing GGNS Unit 1 facility and partial completion of Unit 2. Currently, developed land occupies a total of about 132 ha (325 ac) or about 15 percent of the total site area, 109 ha (270 ac) in the uplands and 22 ha (55 ac) in the bottomlands (Figure 2-5). About half of this total consists of permanent structures and facilities (68 ha [169 ac]) (SERI 2003c).

Of the total area disturbed by construction of the GGNS facility, the portions not currently occupied by permanent structures and facilities and those not artificially maintained in an herbaceous state (for example, via herbicide applications) have been allowed to revegetate naturally. In the 30 years since construction of GGNS Unit 1, these areas have largely become colonized by invasive weedy plant species and have not succeeded to hardwood forest communities (SERI 2004f). Lack of hardwood forest succession in previously disturbed areas has also been documented from old fields in the uplands (presumably former grazing land) and bottomlands (presumably former crop land). According to SERI (2004d), upland and bottomland old fields were succeeding to loblolly pine (*Pinus taeda*) and American sycamore (*Platanus occidentalis*) stands, respectively. However, in reality, hardwood forest succession was not taking place in these areas. Instead, Entergy had replanted these forest stands (SERI 2004f).

Most of the footprint of the proposed Grand Gulf ESP facility consists of power block, cooling towers, new intake and discharge, pipelines, and associated equipment staging areas and borrow sites. However, the specific locations of many of these permanent structures and facilities and equipment staging and borrow areas are currently unknown. Specific locations would be determined definitively before the CP or COL phase.

Construction of the Grand Gulf ESP facility would disturb a total of about 160 ha (400 ac) of the Grand Gulf site: 138 ha (340 ac) in the uplands (hardwood forests, fields, and previously disturbed areas) and 22 ha (55 ac) in the bottomlands (palustrine, forested, seasonally flooded wetland) (Figure 2-5). Disturbance would result from construction of permanent structures and facilities and temporary equipment staging and borrow areas. About 50 ha (125 ac) or 32 percent of the total 160 ha (400 ac) of disturbed area would be occupied by permanent structures and facilities, 40 ha (100 ac) in the uplands and 10 ha (25 ac) in the bottomlands (SERI 2003c).

SERI did not indicate in its environmental report (SERI 2003c) the quantity of upland hardwood forest, upland field, and previously disturbed area in the uplands that would be occupied by permanent structures and facilities. Therefore, these quantities were estimated as follows. It is known that disturbance of a total of 59 ha (145 ac) of upland hardwood forests, 43 ha (105 ac) of upland fields, and 36 ha (90 ac) of previously disturbed areas in the uplands would occur (SERI 2003c), totaling 138 ha (340 ac). Thus, the proportions of total disturbance in upland hardwood forests, upland fields, and previously disturbed areas in the uplands would be 43 percent, 31 percent, and 26 percent, respectively. These percentages were applied to the total amount of disturbance in the uplands that would be dedicated to permanent structures and facilities (40 ha [100 ac]). This yielded 17 ha (43 ac) of upland hardwood forests, 13 ha (31 ac) of upland fields, and 11 ha (26 ac) previously disturbed areas in the uplands that would be occupied by permanent structures and facilities. This assumes the amount of total disturbance is related 1:1 to the amount of disturbance dedicated to permanent structures and facilities.

The remaining 109 ha (270 ac) that would be disturbed on the Grand Gulf site (98 ha [240 ac] in the uplands and 12 ha [30 ac] in the bottomlands) would be for equipment staging and borrow areas and the associated impact is expected to be temporary (SERI 2003c). However, such areas would likely become colonized by invasive weedy plant species. Based on the lack of hardwood forest succession in areas disturbed during construction of the GGNS facility and in old fields (SERI 2004f), as noted above, weedy plant species invasion would likely decelerate or entirely prevent hardwood forest succession. Without implementing proactive restoration plans, such areas would be unlikely to succeed to hardwood forest and wetland communities in the foreseeable future. Hardwood forest and wetland restoration plans would be developed by the CP or COL phase. Wetlands could be restored or created anew, as would be specified in the ACE Section 404 permit (for excavation or clearing in jurisdictional wetlands) that would by obtained by SERI prior to beginning construction.

An embayment intake structure, located on the east bank of the Mississippi River north of the existing barge slip, would be constructed to provide makeup water for the Grand Gulf ESP facility. A new shoreline discharge structure would be constructed just downstream of the entrance of the embayment. The river shoreline has been revetted (rip-rap emplaced for bank stabilization) by the ACE to stabilize the course of the river. Bank stabilization measures would be restored and preserved following any construction on the shore.

4.4.1.2 Wildlife Habitat along the Grand Gulf Nuclear Station Unit 1 Transmission Corridors

The transmission and distribution system existing at the time of startup and operation of the Grand Gulf ESP facility would be relied upon to distribute the power generated (SERI 2003c). A study conducted by SERI concluded that the existing system would be adequate for an additional 1311 MW(e) generating capacity, assuming that modifications and upgrades are made to equipment in the switchyard of the GGNS Unit 1 facility. However, the maximum generating capacity identified in the PPE is approximately 3000 MW(e) (SERI 2003c). If 3000 MW(e) generating capacity is installed, the existing transmission lines would have to be upgraded or additional transmission lines would be required.

If the Grand Gulf ESP facility is constructed, the actual need for and type of transmission system improvements would be determined definitively by the transmission and distribution system owner and operator (currently Entergy Mississippi, Inc.) under Federal Energy Regulatory Commission rules as described in Section 3.3. The location, nature, and magnitude of the environmental impacts associated with the construction of any transmission system improvements would be established definitively by the transmission and distribution system owner and operator prior to or during the CP or COL phase. The remainder of this section describes the kinds of construction impacts that could be incurred should new transmission lines be added to the existing system.

Transmission system modifications would likely be located within or along the existing 40.6-km (25.2-mi) Baxter Wilson and 70.1-km (43.6-mi) Franklin 500-kV power transmission corridors, because these currently transmit electricity from GGNS Unit 1 (see Section 3.3), and no new rights-of-way would be needed. Transmission line improvements, such as the addition of new lines and support structures, for example, would be sited within the existing utility rights-of-way to the greatest extent possible. However, it is likely that widening the existing rights-of-way would also be required, which could double the corridor area. The areas of the corridors that are forested are 136 ha (337 ac) for the Baxter Wilson line and 291 ha (719 ac) for the Franklin line, for a combined total of about 427 ha (1056 ac). Consequently, although cutting forests could be accomplished in such a manner as to minimize disturbance, a substantial quantity of hardwood forest habitat (about 427 ha [1056 ac]) would likely be lost by doubling the width of the Baxter Wilson and Franklin transmission corridors. The staff also assumed that temporary construction areas in forest habitat would be reforested/restored as nearly as possible to preconstruction conditions.

SERI did not indicate in its environmental report (SERI 2003c) whether any wetlands, flood-plains, or other special habitat areas are crossed by the Baxter Wilson and Franklin power transmission corridors, and no such information is available from the transmission and distribution system owner and operator, Entergy Mississippi, Inc., (Entergy Services 2004).

Right-of-way clearing and waste disposal methods would likely be dictated in large part by land owner requirements. However, absent direction from the property owner(s), clearing and waste disposal would be done in accordance with industry guidelines and best management practices.

4.4.1.3 Wildlife Habitat Impact Summary

In summary, an estimated 17 ha (43 ac) of upland hardwood forest habitat on the Grand Gulf site would be lost to permanent structures and facilities associated with construction of the proposed facility. This represents about 11 percent of the total 162 ha (400 ac) of upland hardwood forest habitat currently available onsite (Figure 2-5). An estimated 13 ha (31 ac) of upland field habitat would be lost to permanent structures and facilities, representing about 20 percent of the total 63 ha (155 ac) of upland field habitat currently available onsite (Figure 2-5). An estimated 11 ha (26 ac) of previously disturbed area in the uplands would be lost to permanent structures and facilities. The total amount of previously disturbed area currently available in the uplands is unknown. Ten hectares (25 ac) of bottomland palustrine, forested, seasonally flooded wetland would be lost to permanent structures and facilities, representing about 3 percent of the 358 ha (885 ac) of bottomland forested wetland currently available onsite (Figure 2-5). Upland hardwood forests and bottomland wetlands have much greater plant species and structural diversity than upland fields and previously disturbed areas, and are thus assumed to be much more important as wildlife habitat. Previously disturbed areas have minimal wildlife habitat value. Because the combined upland hardwood forest and bottomland forested wetland lost to permanent structures and facilities represents only about 5 percent of the total of these available onsite, this impact would be negligible and further mitigation is not warranted.

Impacts to the 109 ha (270 ac) of the Grand Gulf site that would be disturbed for equipment staging and borrow areas is expected to be temporary (SERI 2003c) because SERI intends to restore the hardwood forest and wetland. With the assumption that temporary construction areas in forest habitat would be reforested/restored, the impacts, being temporary in nature, would also be minimal and further mitigation is not warranted.

If transmission system improvements (for example, addition of new transmission lines) require right-of-way expansion along the Baxter Wilson and Franklin corridors, it is conservatively assumed that about 427 ha (1056 ac) of hardwood forest habitat would be lost. It is also assumed that any temporary construction areas in forest habitat along the rights-of-way would be reforested/restored. Because a relatively large area of forest habitat would be lost in right-of-way widening, the associated construction impact would be considered modest.

4.4.1.4 Wildlife

During construction of the Grand Gulf ESP facility, wildlife may be destroyed or displaced, primarily as a result of operating heavy equipment (during land clearing, for example). Less mobile animals, such as reptiles, amphibians, small mammals, are expected to incur greater mortality than more mobile animals, such as birds. Ample undisturbed forested wetland habitat onsite would be available to displaced animals during construction. Species that can adapt to disturbed or developed areas such as raccoon (*Procyon lotor*), opossum (*Didelphis virginiana*), and northern cardinal (*Cardinalis cardinalis*), may readily recolonize portions of the disturbed area where suitable habitat remains or is replanted or restored. All forested or wetland areas that are disturbed and replanted or restored would likely be recolonized by wildlife communities similar to those that currently occupy these areas. The destruction, displacement, and recolonization of wildlife also apply to offsite disturbances in forest habitat that could result if the transmission system improvements described above were undertaken. To minimize construction-related impact to wildlife, such as the destruction of nests and eggs of migratory birds, SERI would adhere to permit conditions that may restrict the timing of construction activities based on important biological periods (the nesting of migratory birds, for example).

Construction of the Grand Gulf ESP facility would be done according to Federal and State regulations, permit conditions, existing procedures, good construction practices, and established best management practices (for example, directed drainage ditches, and silt fencing would be used). Fugitive dust would be minimized by watering the access roads and construction site as necessary. Thus, the impact from dust would be negligible and further mitigation is not warranted. Emissions from heavy construction equipment would be minimal because of scheduled equipment maintenance procedures.

Construction activities would generate noise resulting from the movement of workers, materials, and equipment, and the operation of construction equipment (such as earth-moving equipment, portable generators, pile drivers, pneumatic equipment, and hand tools). Noise from construction can affect wildlife by inducing physiological changes, nest or habitat abandonment, behavioral modifications, or it may disrupt communications required for breeding or defense (Larkin 1996). However, it is not unusual for wildlife to habituate to such noise (Larkin 1996). Continuous noise levels from construction activities would range from 69 to 98 decibels at 15 m

(50 ft) from the source (SERI 2003c). At 732 m (2400 ft), this noise level would be reduced to 65 decibels (SERI 2003c), well below the 80- to 85-decibel threshold at which birds and small mammals are startled or frightened (Golden et al. 1980). Additionally, construction would occur near the GGNS Unit 1 facility, where wildlife have presumably become accustomed to typical operating facility noise levels. Thus, impacts to wildlife from construction noise are expected to be negligible.

Avian collisions with fabricated structures are a result of numerous factors related to species' characteristics such as flight behavior, age, habitat use, seasonal habits, and diurnal habitats; and to environmental characteristics such as weather, topography, land use, and orientation of the structures. Most authors on the subject of avian collisions with utility structures agree that collisions are not a significant source of mortality for thriving populations of birds with good reproductive potential (EPRI 1993). The NRC (1996) reviewed monitoring data concerning avian collisions at nuclear power plants with large cooling towers and determined that overall avian mortality is low. No avian collisions with existing structures at the Grand Gulf site have been noted (SERI 2003c), although no plan is in place to monitor avian mortality. Nevertheless, the number of construction-related bird collisions with structures is expected to be negligible.

Grand Gulf Road off U.S. Highway 61 currently provides the only road access to the Grand Gulf site. The most recent daily traffic count on the segment of Grand Gulf Road nearest to the site is 940 vehicles per day for the year 2000 (SERI 2003c). This number is projected to increase during construction of the Grand Gulf ESP facility by 1100 vehicles per day (SERI 2003c), which would likely increase traffic-related wildlife mortalities. Local wildlife populations could suffer declines if roadkill rates were to exceed the rates of reproduction and immigration. However, while roadkills are a premiere source of wildlife mortality, except for local situations not applicable to the Grand Gulf site (e.g., ponds and wetlands crossed by roads where large numbers of migrating amphibians and reptiles would be susceptible), traffic mortality rates rarely limit population size (Forman and Alexander 1998). Consequently, the overall impact on local wildlife populations from increased vehicular traffic on Grand Gulf Road during construction would be expected to be negligible.

State-Listed Species

<u>Animal Species</u>

The endangered wood stork (*Mycteria americana*) was observed in summer on Gin and/or Hamilton Lakes during 18 years prior to construction of the GGNS Unit 1 facility (AEC 1973). The wood stork should thus still be considered a possible non-breeding transient to the Grand Gulf site and vicinity (SERI 2003c; MNHP 2004a and 2004b). Consequently, it is possible that construction activities could disturb non-breeding storks and that such disturbance could result in feeding and associated energetic losses. However, because wood storks are present only for a short duration in the area, any disturbance due to construction would be considered negligible in terms of its effects on population viability, which is largely determined by the success of the species on its breeding grounds in Alabama, Florida, Georgia, and South Carolina (49 FR 7332; FWS 1996).

Plant Species

The critically imperiled hairy water clover (*Marsilea vestita*), the jug orchid *(Platythelys querceticola*), the imperiled glade fern (*Diplazium pycnocarpon*), and the American bittersweet (*Celastrus scandens*) are known to occur beyond 3.2 km (2 mi) but within 16 km (10 mi) of the Grand Gulf site (MNHP 2004b). The critically imperiled/imperiled Allegheny monkeyflower (*Mimulus ringens*) is known to occur about 17.6 km (11 mi) from the Grand Gulf site (SERI 2003c). Based on these distances, these five species would not be affected by construction activities. However, the range of habitat affinities of these species spans hardwood forest, roadsides, forest margins, and wetlands, all general habitat types that occur in relative abundance on the Grand Gulf site. Thus, although they are not known to occur in close proximity to the site, these five species could yet occur on the Grand Gulf ESP site and along its power transmission corridors. Consequently, upland and bottomland areas on the Grand Gulf ESP site that would be disturbed by construction (for example, land clearing, staging of equipment, excavation of borrow sites, etc.) should undergo a botanical survey prior to initiating such activities.

In summary, the impact to wildlife, including State-listed species, from construction of the Grand Gulf ESP facility and construction associated with any transmission system improvements, including land clearing, noise, bird collisions, and traffic-related mortality, is expected to be negligible and further mitigation is not warranted.

4.4.1.5 Terrestrial Ecosystems Impact Summary

The impact of construction to wildlife habitat on the Grand Gulf site (including permanent and temporary losses of upland hardwood forest and bottomland forested wetlands) would be minimal. The impact on wildlife populations, including State-listed species, onsite and along the transmission corridors would also be minimal. However, the impact to wildlife habitat along the transmission corridors (including permanent and temporary losses of hardwood forest) could be considered modest because of the relatively large area of hardwood forest that would be affected. Thus, the combined impact to wildlife habitat and wildlife on- and offsite would be considered noticeable but not destabilizing. Consequently, the staff concludes that the overall impact of construction to terrestrial ecosystems would be MODERATE, and that hardwood forest and wetland restoration is warranted in temporary construction areas.

This determination is largely based on the assumption of doubling the size of the existing transmission corridors. In reality, forest habitat destruction could be much more (one or more new corridors required) or much less (siting all upgrades within the existing corridors with no corridor expansion required). This will be determined in a conclusive evaluation of the need for and nature of transmission line improvements and associated impacts by the transmission and distribution system owner and operator prior to or during the CP or COL phase, as indicated in Section 4.4.1.2.

4.4.2 Aquatic Ecosystems

Impacts to the aquatic ecosystem from construction of the Grand Gulf ESP facility would mainly be associated with construction of new cooling water intake and discharge structures and widening of transmission corridors. Construction along the Mississippi River would result in the removal or reshaping of the shoreline. These activities would likely lead to loss of benthic macroinvertebrates and some shoreline habitat along the Mississippi River, as well as temporary displacement of other aquatic species (SERI 2003c). Construction of the trenches for the intake and discharge pipelines from the bank of the Mississippi River to the Grand Gulf ESP facility site could lead to temporary soil erosion and increased turbidity for the streams, lakes, and ponds onsite.

The proposed location for a new intake structure is at or near the north side entrance of the existing barge slip. Water from the Mississippi would be used as makeup water to the cooling towers and service water system, and other miscellaneous water uses. The structure would be located at Mississippi River Mile 406.4. Water would be withdrawn from an embayment through piping connected to pumps and equipment housed in an intake pumping station located on shore. During construction, the existing riprap along the barge slip would be removed and dredging would be required to excavate the embayment for the location of the intake screens. Construction activities would be restricted to periods when river water level was low. The exposed areas are expected to be sandy, based on information obtained during construction of GGNS Unit 1. Very little turbidity and siltation is expected from construction activities at the shoreline through the use of standard construction practices (SERI 2003c).

The construction activities for a new cooling water intake, discharge structures, and a transmission corridor that could affect the river are described below.

- Dredging. Dredging impacts to the banks of the Mississippi River would be minimal because of the localized area and the temporary nature of construction of the intake and discharge structures. Temporary increase in turbidity may occur in the river near the

Grand Gulf ESP site during dredging; however, dredging operations would be in compliance with ACE and MDEQ requirements so that long-term water quality is not degraded.

- Construction of Cooling Towers and Onsite Impacts to Water Sources. These activities could lead to soil erosion into streams. During construction, the river may also receive dewatering effluent from trenching in the floodplain, or runoff from the bluff area via onsite streams and Hamilton Lake. Site runoff reaching the Mississippi River via Hamilton Lake is buffered by the lake and the sedimentation ponds. Any water quality impacts to the Mississippi River during construction of a new facility would be similar to the impact during the construction of GGNS Unit 1. Construction of GGNS Unit 1 did not result in any significant impacts to the water quality of the Mississippi River (MP&L 1973).

- Construction for Pipelines. Excavation for burial of approximately 1.8 km (1.1 mi) of intake and discharge pipelines would directly affect wetlands in the floodplain. Construction would be primarily along the existing haul road for GGNS Unit 1, leading to minimal incremental impacts to the wetland. The pipes would be buried, so there would be no permanent alteration of water flow patterns in the floodplain. Construction of the pipeline connecting the power block to the cooling tower area would need to cross a small existing wetland. This would require approval from the ACE, and all work would be performed in strict accordance with the permit.

The construction activities for widening the transmission corridors would affect several waterways. The Baxter-Wilson corridor will cross the Big Black River, and the substation in Warren County is within 0.75 km (0.47 mi) of the Mississippi River. The Franklin corridor crosses Bayou Pierre approximately 5.5 km (3.4 mi) to the south of the Grand Gulf site. Plans for widening the corridor have not been developed. NRC expects that SERI will work with the appropriate Federal and State agencies to develop and implement the plans for widening the transmission corridors that will have minimal impacts on the aquatic ecosystems.

State-Listed Species

<u>Animal Species</u>

The endangered crystal darter (*Crystallaria asprella*) is found in Bayou Pierre and its tributaries, which flow as close as 3 km (1.9 mi) east of the Grand Gulf site (Ross 2001; MNHP 2004b; Katula 2004). The construction activities of the Grand Gulf ESP site will not affect the regions where the crystal darter is found. The Franklin transmission corridor crosses Bayou Pierre approximately 5.5 km (3.4 mi) to the south of the Grand Gulf site. NRC expects that SERI will work with the appropriate State agencies to develop and implement the plans for widening the transmission corridors that will have minimal impacts on Bayou Pierre and the crystal darter.

Plant Species

No State-listed aquatic plant species are known to occur within 16 km (10 mi) of the Grand Gulf site (MNHP 2004b).

After reviewing these construction activities and their potential impacts on aquatic ecological resources, the staff concludes that the overall impacts would be SMALL because these activities would take place for a limited time and could be readily mitigated (SERI 2003c). Appropriate construction mitigation would include instituting best management practices for erosion control into the Mississippi and Big Black rivers and other potentially affected streams.

4.4.3 Threatened and Endangered Species

The potential impact of construction of the Grand Gulf ESP facility and possible expansion of the transmission corridors on terrestrial and aquatic Federally listed species was evaluated. These species were identified through correspondence with the U.S. Fish and Wildlife Service (FWS 2004a; 2004b).

4.4.3.1 Federally Listed Animal Species

The potential impacts of construction activities on Federally listed animal species are described below.

Florida Panther - Endangered

Currently no viable populations of the Florida panther occur outside of Florida (SERI 2003c). Reports of Florida panthers (*Puma concolor coryi*) seen within 3.2 km (2 mi) of the Grand Gulf site are from 1973 (MNHP 2004c) and are suspect because a viable population of Florida panthers has not been known in the State of Mississippi since the late 1800s (MNHP 2004d). Therefore, the potential impact to Florida panthers from construction at the Grand Gulf ESP site would be considered minimal.

American Alligator - Threatened

The American alligator (*Alligator mississippiensis*) is currently classified as "threatened based on similarity of appearance" to the American crocodile (*Crocodylus acutus*) throughout its range, including Mississippi. The classification helps prevent excessive hunting of the alligator and protects the American crocodile (52 FR 21059). Alligator populations are considered disjunct, limited to available habitat, but stable. Because wetlands would be minimally affected by construction at the Grand Gulf ESP site (see Section 4.4.1.1), impacts to alligators would be considered negligible.

Bald Eagle - Threatened

The Grand Gulf ESP site lacks dominant living pine (*Pinus* spp.) or bald cypress (*Taxodium distichum*), the trees in which bald eagle nest (FWS 2004a). Eagle occurrences have not been reported within 16 km (10 mi) of the Grand Gulf site (MNHP 2004b). Consequently, bald eagles are unlikely to be affected by construction at the Grand Gulf ESP site. However, because bald eagles are highly mobile and utilize large bodies of water for nesting and foraging, the species could use the site and its immediate environs. Consequently, the adjacent Mississippi River shoreline onsite should be surveyed for potential nest trees and nesting eagles during the nesting season (September to January) prior to beginning any construction activities, particularly those that would occur in the bottomlands (e.g., for pipeline and intake structures).

Interior Least Tern - Endangered

The nearest areas occupied by least terns (*Sterna antillarum*) upstream and downstream of the Grand Gulf ESP site (River Mile [RM] 405 [SERI 2003c]) were at Yucatan Dikes (RM 409.8) (loafing area for 28 birds), Togo Island Dikes (RM 413.6) (nesting colony of 395 birds with confirmed chicks or eggs), and Below Bondurant Towhead Dikes (RM 393.0) (nesting colony of 59 birds with confirmed chicks or eggs) (ACE 2004a).

Least terns on the Mississippi River (whether nesting, foraging, or loafing) generally are not disturbed by operation of machinery (including dredges, tow boats, etc.) in the near vicinity. Generally, least terns are disturbed only by activities that take place on the sand bar they occupy (ACE 2004b).

All three of the above areas occupied by least terns are located on the west side of the Mississippi River at least 6.4 km (4 mi) from the Grand Gulf ESP site, far enough distant to preclude disturbance from construction activities at the Grand Gulf ESP site. Further, sandbars develop on the inside bends of the Mississippi River where currents are slower. Sandbars do not develop on the outside bend of the river where currents are swifter and where the river shoreline has been revetted (rip rap emplaced) to prevent erosion, such as is the case at the Grand Gulf site. Thus, the nearest potential tern nesting habitat is at about RM 402 on the Louisiana side of the Mississippi River, about 4.8 km (3 mi) south of the Grand Gulf site, well outside the range of disturbance from construction activities at the proposed Grand Gulf ESP site (ACE 2004b).

Consequently, any impact to interior least terns that could result from construction at the Grand Gulf ESP site would be considered negligible.

Louisiana Black Bear - Threatened

The Louisiana black bear (*Ursus americanus luteolus*) is known to occur within 3.2 km (2mi) of the Grand Gulf site (MNHP 2004a). The Louisiana black bear was reported on the Grand Gulf site in the late 1970s (NRC 1981) (see Section 2.7.1.2), but has not been documented from there since that time (SERI 2004d). However, because the site and its immediate environs to the north and south provide a large block of remote habitat with relatively little human presence, Louisiana black bears may still exist onsite.

Preferred habitat for Louisiana black bears consists of bottomland hardwood forests. Upland forests generally are not considered preferred habitat for the subspecies. Hence, the significant population decline in Louisiana black bears is largely because of past conversion of bottomland hardwood forests to agriculture. However, bears are somewhat nomadic (with very large home ranges), and it is reasonable to assume they periodically use upland forests that are adjacent to bottomland hardwoods (FWS 2004b).

Consequently, the impacts of construction to bottomland forested wetland and upland hardwood forest on the Grand Gulf ESP site are integral to the evaluation of the potential impacts to the Louisiana black bear. Seventeen hectares (43 ac) or 11 percent of the 162 ha (400 ac) of upland hardwood forest currently available onsite could be lost to permanent structures for the Grand Gulf ESP facility. An estimated additional 41 ha (102 ac) of upland hardwood forest (see Section 4.1.1) would be temporarily disturbed for equipment staging and borrow areas (Figure 2-5).

Approximately 10 ha (25 ac) of bottomland palustrine, forested, seasonally flooded wetland would be displaced by permanent structures. An additional 12 ha (30 ac) of bottomland palustrine, forested, seasonally flooded wetland would be temporarily disturbed for equipment staging and borrow areas. This disturbance would widen a band of currently developed land that stretches from the periphery of the upland forest habitat onsite to the Mississippi River (Figure 2-5) and would not result in any further fragmentation of bottomland hardwood forest. This would not be expected to pose a barrier to potential bear movements in the bottomlands along the river.

A relatively small amount of hardwood forest, particularly bottomland hardwood forest, would be affected by construction. Consequently, impacts to the subspecies from habitat loss and fragmentation are considered negligible, as long as this does not result in the destruction of individual bears. If denning bears are present, construction activities should be prohibited during the denning season (from December through April) in order to avoid disturbance of bears and possible abandonment of cubs. Further, actual den sites/trees or candidate trees (bald cypress [*Taxodium distichum*] and tupelo gum [*Nyssa* sp.] with visible cavities, having a diameter at breast height of 0.9 m [3 ft] and occurring along rivers, lakes, streams, bayous, sloughs, or other water bodies) in occupied habitat should not be harvested (FWS 2004e). If these measures are undertaken, impacts to the subspecies from habitat loss and fragmentation would be considered negligible.

In addition to habitat destruction, vehicle collisions with bears would likely increase. The most recent daily traffic count on the segment of Grand Gulf Road nearest to the Grand Gulf site is 940 vehicles per day for the year 2000 (SERI 2003c). This number is projected to increase during construction of the Grand Gulf ESP facility by 1100 vehicles per day (SERI 2003c), which would be expected to increase the likelihood of vehicle collisions with bears. However, such encounters would likely be so rare that the overall impact to the local population of Louisiana black bears is be expected to be negligible.

Noise levels would increase from land-clearing equipment during construction at the Grand Gulf ESP site. Denning is the most critical period for bears, particularly pregnant females. Consequently, if bears are present, construction activities in the project area should be limited during the denning season (December through April) (FWS 2004e). Construction noise outside the denning season may cause bears, if present, to use more remote forested areas. However, this would not be likely to adversely affect bears to any great degree. In general, construction noise is considered relatively minor compared to habitat destruction or modification and this potential source of impact would remain only during the construction period.

In summary, the potential impact to the Louisiana black bear from construction at the Grand Gulf ESP site would be considered negligible.

Gulf Sturgeon - Threatened

The gulf sturgeon (*Acipenser oxyrinchus desotoi*) has not been collected in the region of the Grand Gulf site. The Mississippi River is considered part of the historical range for the gulf sturgeon, therefore the reach of the river at the Grand Gulf site is likely to be used by the sturgeon as it migrates up and down the river (68 FR 13370; NMFS 2004). Construction of the proposed intake and discharge structures would temporarily change the river bank environment (see Section 4.4.2). Widening the transmission corridor will bring the end of the Baxter-Wilson corridor in Warren County to within 0.6 km (0.4 mi) of the Mississippi River. Because of the width of the river (approximately 1 km [0.6 mi]), construction activities would not limit the migration of the gulf sturgeon through the area. Consequently, impacts to gulf sturgeon that could result from construction of the Grand Gulf ESP facility are unlikely.

Bayou Darter - Threatened

The bayou darter (*Etheostoma rubrum*) is endemic to the Bayou Pierre and tributaries, which flow as close as 3 km (1.9 mi) east of the Grand Gulf site (40 FR 44149; FWS 1990, 2000, and 2004a; Ross 2001). The construction of the proposed intake and discharge structures will not affect the regions where the bayou darter is found. Widening of the Franklin transmission corridor will cross the Bayou Pierre. NRC expects that SERI will work with the appropriate Federal and State agencies to develop and implement the plans for widening the transmission corridors that will have minimal impacts on the bayou darter.

Fat Pocketbook Mussel - Endangered

The fat pocketbook mussel (*Potamilus capax*) was historically found throughout the Mississippi River drainage from Minnesota to Louisiana. In 2003, the mussel was found near Vicksburg in the Mississippi River, as well as south of the Grand Gulf Site (41 FR 24062; FWS 1989, 2004c, and 2004d; MNHP 2004e). Widening of the transmission corridor in Warren County near the Mississippi River will not affect mussel habitat. Construction of the proposed intake and discharge structures would temporarily change the nearby river bank environment, and increase turbidity downstream of the in-river activities; however, this is likely to be localized and temporary and could be minimized by use of best management practices (see Section 4.4.2). Nevertheless, disrupted regions of river substrate could be habitat for the mussel. The shoreline where the intake and discharge structures are proposed have been disrupted in the past, yet the area may have been re-colonized by mussels. Impacts to the mussel from construction activities cannot be evaluated without conducting surveys to determine if the mussels are using the shoreline where the proposed intake and discharge structures will be located. Any specimens found could be relocated. However, the regions that would be disturbed are a small proportion of the total length of river bank along the Grand Gulf site, and the overall impact to the fat pocketbook mussel is likely to be minimal.

Pallid Sturgeon - Endangered

Pallid sturgeon (*Scaphirhynchus albus*) have been collected in the region of the Grand Gulf site. Adult pallid sturgeon have been caught in regions with moderate to strong currents, a sand or sand/gravel substrate, similar to the main channel of the Mississippi River as it passes by the Grand Gulf site. Spawning habitat may exist within 16 km (10 mi) upstream of the Grand Gulf site (MP&L 1973). Information on the spawning and juvenile use of the Mississippi River near the Grand Gulf site is sparse (55 FR 36641; FWS 1993, 2000, and 2004a; Ross 2001; Hartfield 2003; LDOTD 2003; SERI 2003c). Widening the transmission corridor will bring the end of the Baxter-Wilson corridor in Warren County to within 0.6 km (0.4 mi) of the Mississippi River. Construction of the proposed intake and discharge structures would temporarily change the river bank environment (see Section 4.4.2). During construction activities, sedimentation and turbidity would be controlled using standard construction practices. While these actions could limit the use of the region by adult pallid sturgeon in the immediate vicinity of the site, the impact would be minor and temporary, if at all. The timing for construction is also not likely to affect any spawning or use of the region by juvenile pallid sturgeon because of the size of the river, the location of shoreline activities, and the limited in-river activities associated with the construction of the intake and discharge structures. Consequently, any impacts to pallid sturgeon that could result from construction of the proposed Grand Gulf ESP facility would be unlikely.

4.4.3.2 Federally Listed Plant Species

No impacts to Federally listed or proposed threatened or endangered plant species–either terrestrial or aquatic–are anticipated because none of these species are known to occur on or within 16 km (10 mi) of the Grand Gulf site (MNHP 2004a and 2004b; FWS 2004a).

4.4.3.3 Threatened and Endangered Species Impact Summary

Based on the information provided by SERI, Entergy, and the staff's own independent review, the staff concludes the impacts of construction at the Grand Gulf ESP site on terrestrial and aquatic Federally listed species would be SMALL, and no additional mitigation would be warranted beyond that identified in this section.

4.5 Socioeconomic Impacts

Construction activities could affect individual communities, surrounding region, and minority and low-income populations. To assess the impacts of construction activities for the Grand Gulf ESP site, the staff evaluated the physical impacts, population, and community characteristics.

4.5.1 Physical Impacts

Construction activities at the Grand Gulf EPS site may cause temporary and localized physical impacts including, but not limited to, noise, odor, vehicle exhaust emissions, and dust. Impacts from vibration and shock are not expected because of the strict restriction and control of such activities onsite. This section addresses the potential impacts that may affect people, buildings, roads, and recreational facilities.

4.5.1.1 Workers and the Local Public

The Grand Gulf site is located in an area zoned for industrial use. The site is bounded by agricultural and recreational areas. The recreational area likely to be most affected by construction on the Grand Gulf site would be the Grand Gulf Military Park because of an increase in traffic, noise, and dust from construction activities. However, peak park use is on the weekend when construction activity would likely be reduced.

All construction activities would occur within the Grand Gulf site boundary. Offsite areas that would support construction activities (such as borrow pits, quarries, and disposal sites) would already be permitted and operational. Therefore, impacts on those facilities from constructing new units would be small incremental impacts associated with their normal operation.

Construction workers would have adequate training and personal protective equipment to minimize the risk of potentially harmful exposures. Services would be provided for emergency first-aid care, and regular health and safety monitoring would be conducted during construction. However, during construction activities the employees working the day shift at GGNS Unit 1 could be subjected to noise, dust, and gaseous pollutants associated with construction events. People living near the Grand Gulf ESP site would not experience any physical impacts greater than what would be considered an annoyance or nuisance. In the event that atypical or noisy construction activities would be necessary (for example, pile driving), the public would be notified. These activities would be performed in compliance with local, State, and Federal regulations, and site-specific permit conditions.

Reasonable efforts would be made to ensure that transient populations are aware of the potential impacts of construction activities. Signs would be posted at or near construction site entrances and exits to make the public aware of potentially high construction traffic areas.

During construction, noise would increase with the operation of vehicles, earthmoving equipment, materials-handling equipment, impact equipment, and other stationary equipment (such as pumps and compressors), and the increase of human activity. The surrounding counties are predominantly rural tracts. However, areas that are subject to farming are prone to seasonal noise-related events, such as planting and harvesting. Wooded areas provide natural noise abatement. Noise level also attenuates with distance.

At this time, it is not known if blasting would be necessary during the construction of a new facility. Because people are more sensitive to changes in noise levels at night, any blasting, along with other excessively loud construction activities, would be conducted during daytime hours.

During a series of five bimonthly noise surveys that were conducted at various phases of the existing GGNS Unit I construction, the impact of construction noise was considered to be small and of a temporary nature. Noise levels during construction at the site boundaries are expected to be below the regulatory guidance of 65 decibels stated in NUREG-1555 (NRC 2000). A construction noise abatement and protection program would provide required mitigative measures for noise. On a short-term basis, noise may exceed this guidance, however, it is expected that noise from construction equipment would have no discernible impacts on the local noise level. All equipment would be operated in accordance with local, State, and Federal noise requirements.

The Noise Control Act of 1972 gives authority to the EPA to determine the limits of noise and to set noise emission standards for major sources of noise in the environment, including construction equipment. Federal regulations exist for noise emitted from construction (40 CFR 204). In addition to the local ordinances and permitted noise restrictions, SERI states that the following controls could also be incorporated into activity planning (SERI 2003c):

- Regularly inspect and maintain equipment to help control noise.
- Restrict noise-related activities (for example, pile driving) to daylight hours.
- Restrict delivery times.

Physical impacts from air pollutants such as engine exhaust and fugitive dust would be limited. Therefore, no modeling was undertaken for this analysis. Temporary and minor effects on local ambient air quality occur as a result of normal construction activities. Emissions of fugitive dust and fine particulate matter, including those smaller than 10 micrometers (PM_{10}) in size, are generated during earth-moving and material-handling activities. Construction equipment and offsite vehicles used for hauling debris, equipment, and supplies also produce emissions during construction. The pollutants of primary concern include PM_{10} fugitive dust, reactive organic gases, oxides of nitrogen, carbon monoxide, and, to a lesser extent, sulfur dioxides. Because of the uncertainty of the variables affecting construction (for example, type of construction vehicles, timing and phasing of construction activities, and haul routes), precise estimates of emissions cannot be determined until the project is ready for construction, and no reasonable estimate of construction emissions can be undertaken. However, construction would be conducted in accordance with all Federal, State, and local regulations that govern construction activities and emissions from construction vehicles.

Specific mitigation measures to control fugitive dust would be identified in a dust control plan or similar document, prepared prior to project construction. SERI states that air pollution mitigation measures would include any or all of the following (SERI 2003c):

- stabilize construction roads and spoil piles
- limit speeds on unpaved construction roads
- perform housekeeping (for example, remove dirt spilled onto paved roads daily)
- cover haul trucks when loaded and unloaded
- minimize material handling (for example, minimize heights from which loads are dropped, avoid double handling)
- cease grading and excavation activities during high winds and extreme air pollution
- phase grading to minimize the area of disturbed soils
- phase construction to minimize daily emissions
- maintain construction vehicles properly to maximize efficiency and minimize emissions
- re-vegetate road medians and slopes in accordance with the site redress plan
- place emission controls on the onsite concrete batching plant
- use technology designed for open burning (if needed) to increase the efficiency of combustion while reducing smoke levels, and conduct burning in compliance with applicable air-permitting requirements established by MDEQ.

While emissions from construction activities and equipment would be unavoidable, a mitigation plan would minimize impact to local ambient air quality and the nuisance impact to the public in proximity to the project. Other mitigation measures would include temporary storm water management and erosion, and sediment control strategies.

4.5.1.2 Buildings

Construction activities would not affect any offsite buildings. Onsite buildings have been constructed to withstand safely any possible impact, including shock and vibration, from construction activities associated with the proposed activity. Except for GGNS Unit 1 structures, no other industrial, commercial, or residential structures would be directly affected by the construction of a new facility.

4.5.1.3 Roads

The use of public roadways and railways would be necessary to transport construction materials and equipment. The roadways could require some minor repairs or upgrading, such as patching and filling potholes, to allow safe equipment access. However, no extensive work is planned to the existing roads. The rail line, which extended from Vicksburg, Mississippi, to the site and beyond, and the spur constructed to the site to support GGNS Unit 1 construction have since been abandoned. No reconstruction of rail tracks along the former rights of way or construction of new rail lines is planned (SERI 2004d).

Material transportation routes (haul routes) would be selected based on equipment accessibility, existing traffic patterns, and noise restrictions, logistics, distance, costs, and safety. Methods to mitigate the potential impact of transporting construction materials include avoiding routes that could adversely affect sensitive areas (such as housing, hospitals, schools, retirement communities, and businesses) to the extent possible, and restricting activities during daylight hours. No new public roads would be required as a result of construction activities. No public roads would be altered (for example, widened) as a result of construction activities. Some minor road repairs and improvements (for example, patching cracks and potholes, adding turn lanes, reinforcing soft shoulders) would be necessary to enable equipment accessibility and reduce safety risks. Construction site exits onto public roads would be marked clearly with signs and maintained such that they are clear of debris and markings are visible. Any damage to public roads, markings, or signs caused by construction activities would be repaired to pre-existing conditions or better.

The transportation network at the Grand Gulf site in Claiborne County and in the surrounding counties of Copiah, Hinds, Jefferson, and Warren Counties in Mississippi and Tensas, Parish across the Mississippi River in Louisiana is a well-developed system and would not be significantly affected as a result of construction activities. Traffic on Grand Gulf Road will increase substantially during the peak construction period and will be at its peak during the morning and evening shift changes. Noise in the general area will increase from the larger volume of traffic, but the increases will be temporary and will only occur twice per day during the work week.

4.5.1.4 Aesthetics

An estimated 160 ha (400 acres) of the 850-ha (2100-acre) Grand Gulf site would be affected by construction of a new facility. Some areas of the site proposed for the new construction have been previously developed or altered for use by the existing GGNS Unit 1. New construction would have little impact in these areas. Of the roughly 160 ha (400 ac) estimated for the construction of a new facility, approximately 49 ha (120 ac) overlap currently developed or previously altered areas. It is estimated that approximately 50.6 ha (125 ac) would contain permanent structures (primarily a power block area, cooling tower area, and bottomland pipeline and intake areas). Some construction activities for the new facility may be visible from the Mississippi River (for example, the embayment and intake structure, and cooling towers) and from Grand Gulf Military Park. However, much of the construction activity at the site will 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 nuclear power plant with a 158-m (520-ft) natural draft cooling tower, and because construction impacts would be temporary, adverse impacts to visual aesthetics of the site and vicinity are not expected from the construction of a new facility.

Water turbidity could temporarily increase in the immediate construction area during construction and localized dredging. Measures to control turbidity include permit conditions, use of best management practices, and, if necessary, installing a barrier (for example, silt curtain) to prevent the migration of a turbid water plume into the Mississippi River.

Construction activities would include limited in-water activity to construct the intake structure and local dredging. The work would be executed in accordance with applicable regulations, such as the Clean Water Act, and with permit conditions, such as Section 404 of the Clean Water Act, administered by the ACE.

4.5.1.5 Summary of Impacts

Based on the information provided by SERI in the environmental report (SERI 2003c) and its own independent review, the staff concludes that the overall physical impacts of construction on workers and the local public, buildings, roads, and aesthetics would be SMALL as long as the mitigation actions, such as noise, dust, and traffic control and possible management measures identified by SERI are undertaken.

4.5.2 Demography

The evaluation of the economic and social impacts on the immediate vicinity and surrounding region during construction of new units addresses both the potential impact that could result from the construction-related activities at the Grand Gulf ESP site and the activities and demands of the workforce on the surrounding region.

Construction of each new unit is estimated to occur over a 5-year period. Construction of the second unit may lag the first by a year or more. Because a specific reactor design has not been selected, the peak workforce estimate does not include consideration of reactor-specific approaches, which could limit the types of activities and reduce the length of time onsite.

The peak workforce is estimated by SERI (2003c) to be 3150 people, a number that would be maintained for a large part of the construction period(s). SERI expects that the majority of construction workers and their families would settle into developed metropolitan areas or their associated suburbs, such as Vicksburg (Warren County), Natchez (Adams County), and Clinton/Jackson (Hinds County) (SERI 2003c). According to the 2000 U.S. Census, these three counties have a combined population of more than 300,000 people (USCB 2004). Assuming that 50 percent of the construction workforce with an average family size of four would move into the region, an estimated 6300 people would move into the area within 80 km (50 mi) of the proposed Grand Gulf ESP site. This represents approximately 2 percent of the year 2000 population for Adams, Hinds, and Warren counties. If such a large workforce were introduced into the region, it could affect traffic, taxes, housing, and public services. Most of the workforce would probably be selected from the population currently within 80 km (50 mi) of the Grand Gulf ESP site. The magnitude of the impact is dependent on two considerations:

- the percentage of the workforce that would be existing residents of the region

- where those who have to relocate to the region would reside. If substantial numbers of the workforce migrated into rural and small-town Claiborne and Jefferson counties, for example, the socioeconomic impacts generally would be larger than if they moved to the larger population centers.

Using information provided by SERI in its ER, the staff assumed 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 concludes that the impacts of construction on increases in population within the region would be SMALL, and mitigation is not warranted.

4.5.3 Social and Economic Impacts

This section evaluates the social and economic impacts to the surrounding region as a result of constructing additional nuclear units at the Grand Gulf ESP site. The evaluation assesses the impacts of construction and demands placed by the larger workforce on the surrounding region.

Construction activities are expected to last up to 5 years and employ up to 3150 workers. SERI expects this size workforce to be maintained for a large part of the construction period (SERI 2003c). This number is in addition to the 750 permanent and a variable number of contract personnel currently employed at the site (SERI 2003c).

4.5.3.1 Economy

The impacts of construction of the new units on the local and regional economy are based on the region's current and projected economy and population. In addition to the 3150 direct construction jobs, spending in the region by these workers and purchase of non-labor goods and services to support construction would result in a "multiplier effect" within the counties surrounding the Grand Gulf ESP site. The multiplier effect describes the situation in which each dollar spent regionally on goods and services by construction workers and contractors becomes income to a regional recipient who saves some but spends the rest. This creates income for someone else, who in turn saves part and spends the rest. The number of times the final increase in spending in the region exceeds the initial dollar spent is called the regional "multiplier."

Based on the positive aspects of station construction on the regional economies (mostly in Warren County) and the workforce availability, the staff concludes that the impacts on the economy are generally positive and could reach the MODERATE level in Warren County.

4.5.3.2 Taxes

The actual monetary value of the revenues generated from the construction of the new units cannot be estimated with precision because the type of reactor has not been selected. This decision would affect the size of the workforce and the percentage of the workforce that could come from outside the region. Therefore, at this time it is not possible to estimate the value of taxes that could be paid to the regional governments, nor expenditures that the regional governments would have to incur to accommodate the workforce.

Sales, Use, Income, and Franchise Taxes

The State of Mississippi and counties surrounding the Grand Gulf ESP site would experience an increase in the amount of taxes collected from labor, services, construction materials, and supplies purchased for the project. Mississippi would collect franchise taxes paid by contractors during construction of the additional units. State franchise taxes would be collected at the rate of $2.50 per $1000 on the capital value of equipment at the Grand Gulf ESP site (MSTC 2003a). The tax would be based on the value of property owned by the contractors that operate in Claiborne County during the construction period. Mississippi also collects a

3.5 percent contractors' tax on the total contract amount (including the tax itself) (MSTC 2003b). Additionally, sales, use, and income taxes would be generated by retail expenditures (restaurants, hotels, merchant sales) of construction workers. Although there is a small local sales and use tax, the State would collect most of these both from individual workers and from corporate entities in the general region of the site. No estimate is available of the day-to-day expenditures during construction that would occur in the region.

Property Taxes

Mississippi would benefit from additional property tax revenue for the incremental increase in value to the entire Grand Gulf site from the additional units. During the construction phase, this tax would be levied only on the value of the tangible personal property to become part of the additional units. Currently, it has not been decided whether the new facility would be treated for tax purposes as a "merchant plant" selling electric power to the eastern United States as a whole, whereupon it could be exempt from the special treatment in Mississippi tax law that taxes the GGNS property at the state level, allocates these funds by formula, and prevents the county from taxing the facility.

If the facility were treated as an ordinary industrial asset, the property tax would be a significant benefit to Claiborne County. If the final capital cost were in the range of $1000 per installed kilowatt, the maximum capacity 3000-MW(e) facility would (at completion) have an approximate capital value of $3 billion.

At Claiborne County's current average property tax rate of 65.01 mills and an assessment ratio of 15 percent of true market value for non-residential property (SERI 2004a), the tax yield would be about $29 million per year, a MODERATE to LARGE positive impact. During the assumed construction period of 5 years, about $6 million in tax yield would be added to the base each year. If the new facility were not exempt, this tax base would instead go to the State, and only a very small portion of the tax yield might be returned to the county, which would be a SMALL positive impact.

4.5.4 Infrastructure and Community Services

Infrastructure and community services include transportation, recreation, housing, public services, and education.

4.5.4.1 Transportation

Most of the larger pieces of equipment or structures and bulk materials would probably be brought to the site by barge. However, the transport of such large pieces of equipment would be an infrequent occurrence. No adverse impact to existing railway service in the area would occur from new facility construction activities at the Grand Gulf ESP site. The nearest active, regularly used railroad is operated by Kansas City Southern, which has freight train service that passes within 45 km (28 mi) northeast of the site. No new rail service is planned to support materials deliveries and new facility construction activities (SERI 2004d).

The number of traffic accidents on Grand Gulf Road increased during the construction of GGNS Unit 1. In the 4 years preceding construction (1971 to 1974), the average number of traffic accidents on Grand Gulf Road was five per year. During construction (1975 to 1978), an average of 30 accidents per year occurred on Grand Gulf Road. Traffic counts conducted during the construction of the GGNS Units 1 and 2 (GGNS Unit 2 was not completed) indicated the roadways were not overloaded. Temporary traffic overloads were reported during morning and evening shift changes (SERI 2003c). Combined with regular daily traffic to the existing GGNS Unit 1 facility, the large volume of construction workers could put stress on the existing road net.

Improvements were made to local roads and bridges leading to GGNS during construction of the existing facility. It should be noted that U.S. Highway 61, now a four-lane highway, was a two-lane highway from Vicksburg to Port Gibson and south to Natchez during the GGNS Units 1 and 2 construction peak. Although traffic was heavy during the mornings and evening commute, the highway was adequate with only two lanes.

A highway construction project to extend State Highway 18 is in the planning stages. This proposed extension would connect State Highway 18 from Port Gibson to Grand Gulf Road near the site, providing additional access to the Grand Gulf ESP site (SERI 2004a). The section of U.S. Highway 61 from Natchez Trace Parkway south through Claiborne and Jefferson Counties to the Jefferson/Adams County line is currently being widened from two to four lanes (SERI 2004a). The sections of U.S. Highway 61 to the north and south of the proposed construction are already four lanes. Therefore, U.S. Highway 61 is expected to accommodate the increased traffic created by construction workers headed to the Grand Gulf ESP site (SERI 2004a). New road construction beyond this should not be necessary.

Table 4-1 shows current daily traffic counts and estimated hourly capacity of the primary roads in Claiborne County. The information shows the primary access routes, including Grand Gulf Road, have sufficient capacity to handle the projected increase in traffic resulting from the construction workforce for a new facility, which would be about 1100 vehicles per shift. This value is based on 3150 workers, divided into two shifts, with 300 workers living close by, and 20 percent of the workers carpooling (SERI 2003c).

Table 4-1. Road Analysis in Claiborne County

Primary Route	Roadway Description and Improvements	Average Daily Traffic Count (vehicles/day)	Estimated Roadway Capacity (vehicles/hour)
Grand Gulf Nuclear Station to U.S. 61	2-lane Grand Gulf Road - no significant changes	940 to 1100	1100
U.S. 61 N to Vicksburg	U.S. 61 between Port Gibson and Vicksburg is a modern 4-lane, divided freeway	6800	1900 per lane (total 3800 for 2 northbound lanes)
U.S. 61 N and MS 462 E to Vicksburg	MS 462 re-paved and re-signed - added a span in the Kennison Creek bridge	600	1300
MS 18 W to Utica	MS 18 was re-paved in 2002 and brought up to MDOT standards with 12-foot wide lanes	2500	1300
MS 547 E to Hazlehurst	MS 547 re-surfaced in 2002	2900	1300
MS 552 S to U.S. 61 S to Natchez	MS 552 S is a 4-lane divided freeway from Alcorn State University to U.S. 61 S	360, then 2800 South of Alcorn	1900 per lane (total 3800 for 2 southbound lanes)
Westside to U.S. 61 S to Natchez	U.S. 61 S is two-lane improved roadway - will be 4- lane, divided freeway within 2 years like U.S. 61 N from Port Gibson	No MDOT data available for Westside Rd. - U.S. 61 S is 5500	>1400
MS 552 S to U.S. 61 S to Natchez	MS 552 S is a 4-lane divided freeway from Alcorn State University	2800	3800 for 4-lane freeway
	U.S. 61 S is a 2-lane road	5500	1900 for U.S. 61 S

MDOT = Mississippi Department of Transportation
MS =Mississippi State (Highway)
Source: SERI 2003c

A construction management traffic plan would be developed prior to the start of construction. This plan would include approaches to increase the number of workers per vehicle above the average of 1.8. The traffic management plan would include methods for enhancing the use of multi-person vans by the construction workforce. Typically, such a plan involves providing offsite parking areas from which workers can be bused to the site and incentives to encourage the use of vanpools and carpools.

Concurrently, SERI would implement measures that enhance the use of vanpools for use by the outage workforce. Additionally, schedules for shift changes for operating personnel, outage workers, and construction workforce would be coordinated to reduce the number of vehicles on the road at any one time (SERI 2003c). The need to hand off work from the outgoing to the incoming shift workers may complicate this scheduling effort for the construction workforce and, possibly, for the outage workforce.

Based on the information provided by Entergy Mississippi, Inc., SERI, interviews, and its own independent review, the staff concludes that the offsite impacts of construction of the new units on transportation could be managed so they would be SMALL. No additional mitigative actions beyond those identified above appear to be warranted.

4.5.4.2 Recreation

A description of local tourism and recreation is provided in Section 2.8.2.4. The only access to Grand Gulf Military Park to the north of the Grand Gulf site is via Grand Gulf Road; therefore, increased traffic resulting from the transportation of machinery and the construction workforce would affect the traffic flow to Grand Gulf Military Park. This impact would be expected to occur during periods of heavy traffic, primarily in the morning and in the evening when shift change takes place and generally only during the week. The majority of visitors frequent the Grand Gulf Military Park on the weekends. The effect on the recreation experience (access, aesthetics) at Grand Gulf Military Park would be temporary because construction activities are temporary. The overall impacts of construction on recreation would be SMALL.

4.5.4.3 Housing

If the entire construction workforce of 3150 originated within 80 km (50 mi) of the Grand Gulf ESP site, there would be no impact on housing demand. However, based on prior experience with projects of similar size, up to 50 percent of the workforce could come from beyond the 80-km (50-mi) region (SERI 2003c). Most, if not all, of these workers from outside the region would be expected to relocate to the region at least during the work week. If up to 1600 workers were to come from outside the region, there would be a demand for up to that many housing units, mainly apartments, although some single-family residences might be required if construction workers decide to relocate with their families. A review of the vacant housing available in the year 2000 (see Section 2.8.2.5) shows enough vacancies in the region to absorb the in-migrating construction workforce.

Some relocated construction workers might bring mobile homes for the duration of their employment. The environmental report assumed about 300 workers would live in nearby trailer parks (SERI 2003c). If this is the case, an influx of construction workers into the local area could compete with recreational users for spaces at existing trailer/RV parks. Alternatively, if the incoming construction force were to generate demand for additional private trailer parks, this demand could lead to an increase in spaces being made available. If, for example, the same percentage of in-migrating construction workers were to choose Port Gibson as a residence as has the current workforce (14.6 percent–see Table 4-2), the construction workers would need 230 local housing units, equal to about twice the vacant housing stock in the county at the 2000 U.S. Census (USCB 2004). SERI believes as many as 300 construction workers might live in trailer parks near the site (SERI 2003c). If construction workers concentrate in the county, the impact on the local Claiborne County rental housing market could be MODERATE. A similar situation might prevail in Fayette in Jefferson County, but the impact likely would be minimal in the surrounding counties, which have larger housing markets and most likely would experience a smaller influx of workers. If, as expected, many of the in-migrating construction workforce live in larger towns and cities of the region, then the impacts on housing would be SMALL.

Table 4-2. Potential Increase in Resident Population Resulting from Construction at the Grand Gulf Early Site Permit Site

Jurisdiction	Percent of Current Workforce by Location	Facility-Related Increase in Population	Year 2000 Census Population	Percentage Increase	Facility-Related Households	Year 2000 Vacant Housing Units
Vicksburg,	46.4%	2925	26,407	11.1%	731	1290
Port Gibson	14.6%	918	1840	49.9%	230	95
Other Locations:						
Clinton	7.3%	459	23,347	2.0%	115	571
Fayette	3.9%	243	2242	10.8%	61	68
Natchez	3.3%	207	18,464	1.1%	52	888
Brookhaven	2.7%	171	9861	1.7%	43	430
Jackson	2.7%	171	184,256	0.1%	43	7837
Wesson	2.3%	144	1693	8.5%	36	41
Hazelhurst	1.7%	108	4400	2.5%	27	158
All Other:	15.1%	954	NA	NA	239	NA
Total	**100.0%**	**6300**			**1575**	

Source of Resident Locations: SERI 2004a
Source of Year 2000 Census Population: USCB 2004

4.5.4.4 Public Services

This section describes the public services available and discusses the impacts of construction at the Grand Gulf ESP site on water supply and waste treatment, police, fire and medical services, and social services in the region.

Water Supply and Waste Treatment

A detailed description of construction-related water requirements and the impact is presented in Section 4.3.1 of this document. Construction activities for the existing GGNS Unit 1 required approximately 1,900,000 L/d (500,000 gal/d) of water for concrete batch plant operation, dust suppression, and sanitary needs (Entergy 2003). It is anticipated that construction of a new facility would require a similar quantity of water. The amount of water used for construction of a new facility may be reduced if portable toilet facilities are used for sanitary needs. The recommended planning number for potable water consumption for workers in hot climates is 11 L/d (3 gal/d) for each worker (EPA 1997). Based on the maximum construction worker population of 3150 workers, the potable water consumption is estimated at 35,770 L/d (9450 gal/d). Three wells completed within the Catahoula Formation are currently used to supply water for general site purposes. Two of these wells are in routine use, and the third well is a backup. During GGNS Unit 1 refueling outages, the two wells operate at near full capacity. Therefore, these existing wells would not have adequate production to supply the continuous construction water needs for a new facility, and the installation of an additional well or wells would likely be required for construction purposes. SERI did not expect that the new wells, with the capacity to supply the above construction needs, would have any significant impact on the local aquifer on on offsite water users (SERI 2003c). The staff determined that not enough information is available to support this conclusion (see Section 4.3.1). However, if later information shows that the Catahoula formation in the vicinity of the Grand Gulf ESP site is not able to support additional wells without adverse impact, the staff concluded that the facility could instead use treated Mississippi River water, which would minimize the impact on offsite users.

Because the new facility, like GGNS Unit 1, would use an independent onsite water supply and water and sewer treatment facilities, Port Gibson water and sewer services would not be burdened by construction of a new facility at the Grand Gulf ESP site. The short-term influx to the area of a construction-related population (workers and their families) of as many as 6300 persons (one-half the expected number of construction workers, times four persons per household) would not be expected to over-burden local sewer and water utilities in surrounding communities because the construction workforce would be spread over a large geographic area. The commuting construction workforce would commute from the surrounding Mississippi counties but would likely concentrate in larger population centers such as Vicksburg, Natchez, and Clinton/Jackson because of the services available in these developed, more populous areas.

Water and sewer availability and capacity information obtained from the Mississippi Development Authority was reviewed for the communities of Vicksburg and Jackson, Mississippi. The current water consumption in the community of Vicksburg is below the reported capacity. The water and sewer services in Vicksburg are currently at 70 percent of total capacity

(SERI 2004a). Municipal water and sewer services in Jackson are reported at 85 percent of total capacity (SERI 2004a). Based on utility capacity information for the communities of Vicksburg and Jackson, cities typical of the population centers that would be utilized by construction workers, the influx of construction workers would not overburden public utilities in surrounding communities. Costs incurred by local utilities for increased water use and sewer treatment supplies would be offset by revenues paid by the new users and by increased commercial retail demand and by property, sales, and income tax revenues generated by the in-migration of construction workers. Even in Port Gibson, where water use is 300 L (80 gal) per capita per day, the potential increase of 918 residents would increase demand by 277,800 L/d (73,400 gal/d), well within the excess capacity of the local water system. The impact on water and sewer systems would, therefore, not be significant.

Police, Fire, and Medical

The temporary increase in the construction workforce and the construction operations for a new nuclear facility can increase the burden on local fire and police departments. The impact to any one community would be minimized by the disbursement of the construction workforce in the more populous areas of surrounding communities. The impact to the local police and fire departments could result in the need for local communities to hire additional police or fire department staff, buy additional vehicles, build new facilities, and improve existing facilities. The additional tax revenues from the influx of construction staff would, in part, help offset the cost to expand local police and fire departments. The impact would further be offset by the benefits provided to local residents because of improvements in public safety departments and in increased employment in these departments. There are significant local concerns that the current tax structure, which provides a fixed dollar amount to Claiborne County from taxes on GGNS Unit 1, will not provide enough funds to offset the increased demand on local public resources, which would lead either to local tax increases, a deterioration in service, or both (Scott 2004).

Eleven hospitals with a total capacity of about 3000 hospital beds are located in Claiborne and the surrounding Mississippi counties. It is expected that minor injuries to construction workers can be treated or assessed by onsite medical personnel and supplies. Other injuries would be treated at one of eleven hospitals located in the contiguous Mississippi Counties, depending on capacity and ability to treat specific injuries. Detailed information concerning the capacity of the hospitals in Claiborne County and the adjacent Mississippi counties is provided in Section 2.8.2.6 of this document. Specific agreements were established with local medical care suppliers to support emergency planning (SERI 2003c). It is expected that these arrangements would be updated to support the new facility. A new medical center has recently been constructed in Vicksburg (56 km/35 mi from the site on Highway 61 North) with a full range of major medical capability. It is anticipated that Port Gibson Hospital would accept construction injuries. However, more serious injuries would be routed to medical centers more capable of handling severe injuries, including River Regional Medical Center and Parkview Hospital (SERI 2003c). Based on the size and availability of medical services in Claiborne and especially the immediate surrounding counties, the temporary construction workers would not overburden existing medical services.

Social Services

Under the assumption that the construction workforce would come from the region, the main social impact of the proposed construction would be most related to the transportation network in the vicinity of the Grand Gulf ESP site. If it is assumed that workers who relocate would settle in the more urban nearby communities of Vicksburg, Natchez, and Jackson, Mississippi, then the relative social impact of such an in-migration to these areas not be noticeable, given the population of the areas. Overall, the impact of construction on social services should be SMALL.

4.5.4.5 Education

Assuming that 3150 construction workers are required for a new nuclear power plant at Grand Gulf, and if the construction-related population increase of 6300 distributed itself in the same way as the current GGNS-related population, the impacts could be considerable in Port Gibson, which could experience an increase of 460 children (230 households times two students per household) in a district that has only 1195 total students (see Table 2-16). In that case, the impacts of building and staffing additional school facilities likely would be MODERATE, assuming some level of State impact assistance. However, if, as expected, most of the construction workforce lives outside of Claiborne County, the other school districts in the region likely to receive students are larger than Port Gibson or have sufficient capacity planned to absorb the potential increases in enrollment related to construction. The impacts on these districts likely would be SMALL to MODERATE (Scott 2004).

4.5.5 Summary of Socioeconomic Impacts

Based on information supplied by SERI and Entergy Mississippi, Inc.; staff interviews conducted with public officials in Claiborne, Jefferson, and Warren Counties; and the current availability of services, and additional taxes that would likely compensate the need for additional services, the staff concludes the construction impacts on the local economy would be positive and SMALL in most of the region and probably MODERATE in Warren County (Vicksburg). The effect on tax revenues would be beneficial and SMALL, except for property tax receipts in Claiborne County, which could be anywhere from SMALL to LARGE and beneficial, depending on how the State of Mississippi treats the facility for tax purposes. The impacts on transportation would be SMALL. The site is relatively isolated, industrial in nature, and well masked by forest in most directions so the impacts on aesthetics would be SMALL; and the impacts on recreation would be SMALL as well. The impacts on public services would be SMALL throughout the region, unless Claiborne County draws a substantial share of the in-migrating construction workforce, which is not expected. In that case, the impacts on housing and education in Claiborne County could be MODERATE.

4.6 Historic and Cultural Resource Impacts

The National Environmental Policy Act of 1969 (NEPA) requires Federal agencies to take into account the potential effects of their undertakings on the cultural environment, which includes archaeological sites, historic buildings, and traditional places important to local populations. The National Historic Preservation Act of 1966 (NHPA), as amended through 1992, also requires Federal agencies to consider the impact to those resources if they are eligible for listing on the National Register of Historic Places (such resources are referred to as "Historic Properties" in NHPA). As outlined in "Coordination with the National Environmental Policy Act," 36 CFR 800.8, the NRC is coordinating compliance with Section 106 of the NHPA in meeting the requirements of NEPA.

The NRC has determined that evaluating suitability of a potential Grand Gulf ESP site within the existing GGNS Unit 1 site for construction, operation, and decommissioning of new nuclear units is an undertaking that could possibly affect either known or potential historic properties that may be located at a proposed site. Therefore, in accordance with the provisions of NHPA and NEPA, the NRC is required to make a reasonable and good-faith effort to identify historic properties in the areas of potential effect and, if present, determine if any significant impact is likely to occur. Identification is to occur in consultation with the State Historic Preservation Officer, American Indian Tribes, interested parties, and the public. If significant impact is possible, efforts should be made to mitigate it.

To determine if significant archaeological and historic resources have been identified or may exist at the Grand Gulf ESP site, the NHPA Section 106 process is being integrated with the NEPA process, in accordance with 36 CFR 800.8. As part of this integration, an Area of Potential Effect, that is, the area within which cultural and historical sites could be affected by the proposed nuclear facility construction, was defined as

> ...the area at the power plant site and its immediate environs which may be impacted by land-disturbing activities associated with the construction and operation of the new unit(s) and construction of new transmission lines that may follow parallel with some of the existing transmission line systems now serving GGNS [NRC 2004q].

As part of the NEPA/NHPA integration, the NRC initiated consultation with the Advisory Council on Historic Preservation (NRC 2004q), the Mississippi Department of Archives and History (NRC 2004r), the Choctaw of Mississippi (NRC 2004s), the Choctaw Nation of Oklahoma (NRC 2004t), and the Tunika Biloxi Indian Tribe of Louisiana (NRC 2004u). A public meeting on the proposed project was held on January 21, 2004. See Section 2.9.3 of this document for additional information on these efforts. The consultation process continues with the issuance of this EIS.

Prior to defining the Area of Potential Effect, consideration was given to including the Grand Gulf Military Park, located adjacent to GGNS Unit 1 site, in the Area of Potential Effect because of possible visual effects from the proposed cooling tower. The park was not included because the cooling tower would not be visible from the main portions of the park. This was confirmed by an onsite visit on April 14, 2004, and discussions with monument personnel (Stapp 2004).

The Area of Potential Effect includes the areas where new facilities and associated infrastructure are planned, including all areas where construction laydown yards may be located. Because laydown yards and, in some cases, associated infrastructure have yet to be determined, the Area of Potential Effect is that area within the current Grand Gulf site boundary. Disturbed areas within the Area of Potential Effect are considered because the extent of disturbance in many areas is not known. Previous laydown yards, for example, are clearly disturbed at the surface, but that disturbance may be relatively shallow. Some areas, primarily the area around the weather station and adjacent to Grand Gulf Mound (22-Cb-522) were farmed previously, causing significant disturbance within the plow zone. Often, however, undisturbed deposits exist below the plow zone.

Within the Area of Potential Effect, previous cultural resource efforts have identified the presence of several archaeological sites and the potential for additional sites, as explained in Section 2.9 of this document. None of the known sites, however, are considered significant, and most are generally located away from the areas targeted for new construction. The Mississippi Department of Archives and History has identified two areas of the site where cultural resource surveys should be conducted if they are selected for construction "due to the possibility that unrecorded sites may exist" (see Figure 4-1) (SERI 2003c). If that area is selected, prior to construction these areas will be further investigated using appropriate methods such as tilling, survey, and shovel testing.

As indicated in Section 2.9.2 of this document, the Callendar House and the segment of the Grand Gulf and Port Gibson Railroad bed are not considered significant and are not located in areas planned for construction. Also, literature reviews and consultations with regional Native American tribes have not identified any traditional cultural properties in the vicinity of the proposed ESP construction area.

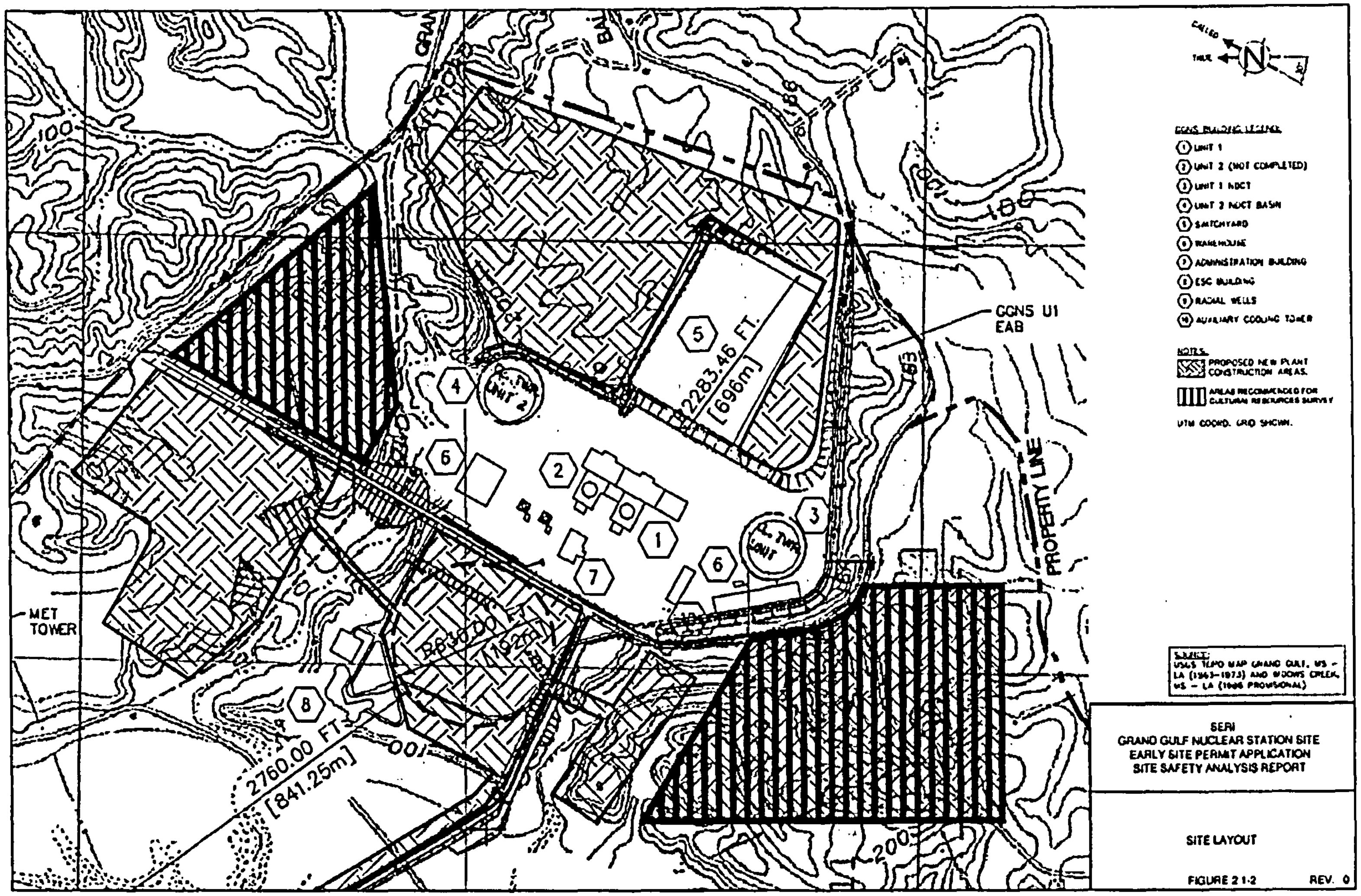

Figure 4-1. Map of Grand Gulf Site Showing Proposed Construction Areas and Locations Recommended by Mississippi Department of Archives and History for Cultural Resources Survey if Selected for Construction (adapted from SERI 2003c, Figure 2.1-2)

No analysis of cultural and historic resources was conducted for the power transmission corridors. The full extent of potential land-use impacts in the power transmission corridors can be estimated only after following the Federal Energy Regulatory Commission process for connecting new large generation to the grid. This process is detailed more specifically in Section 3.3. Once this process is completed, the appropriate cultural resources studies will be undertaken to ensure that resources are identified and addressed prior to construction.

In addition to assessing the known and potential occurrence for cultural resources, SERI would include cultural resource-specific written directions in their site-wide Excavation and Backfill Work Procedures, which will call for an immediate stop-work order should archaeological, historical, or other cultural resources be uncovered during excavation. The construction supervisor is responsible for ensuring the work stoppage and for notifying the Environmental Compliance Coordinator of an inadvertent discovery. In the event that an unanticipated discovery is made, site personnel would be instructed to notify the State Historic Preservation Officer and would consult with them in conducting an assessment of the discovery to determine if additional work is needed.

Based on the commitment to develop written procedures to provide immediate reaction and notification in the event of inadvertent discovery of cultural resources and the staff's cultural resource analysis and consultation, the staff concludes the potential impacts on historic and cultural resources would be SMALL. Mitigation may be warranted in the event of an inadvertent discovery.

4.7 Environmental Justice Impacts

Environmental justice refers to a Federal policy under which each Federal agency identifies and addresses, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority or low-income populations. On August 24, 2004, the Commission issued its policy statement on the treatment of environmental justice matters in licensing actions (69 FR 52040). Figures 2-12 and 2-13 in this document show the locations of minority and low-income populations around the Grand Gulf ESP site and within 80 km (50 mi) of the site.

The pathways through which the environmental impacts associated with the construction of new units at the Grand Gulf ESP site could affect human populations were ascertained. The staff then evaluated whether minority and low-income populations could be disproportionately affected. The staff found no unusual resource dependencies or practices, such as subsistence agriculture, hunting, or fishing through which the populations could be disproportionately affected. In addition, the staff did not identify any location-dependent disproportionate impacts affecting these minority and low-income populations.

4.7.1 Environmental Impacts

Based on information provided by SERI and its own independent review, the staff concludes that construction of new units at the Grand Gulf ESP site would not result in disproportionate and adverse offsite environmental impacts to minority and low-income populations and that mitigation is not warranted.

4.7.2 Socioeconomic Impacts

Potential adverse socioeconomic impacts during construction of a new facility include potential adverse impacts on aesthetics, schools, transportation, public safety, social services, public utilities, and recreational resources. However, impacts during the construction period would be temporary, and are judged not to be significant. Facility construction, including temporary construction areas, would be accomplished within the boundaries of the current GGNS Unit 1 site. No additional land must be procured beyond the current site, and no relocations or major alterations to local offsite roads as a result of construction of a new facility would be expected.

A positive socioeconomic impact, principally on larger Mississippi communities surrounding the site, could be realized by the construction of a new facility at the Grand Gulf ESP site. Construction would increase employment opportunities, both directly and indirectly for workers within the region of the proposed Grand Gulf ESP site, and increased tax revenues. See Section 2.8 of this document for additional discussion of special provisions for tax payments made directly to Claiborne County in recognition of its role as host county to the site. 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 staff concludes that the socioeconomic burden on local taxpayers (largely minority, and a majority of whom are low income) may be adverse, disproportionate, and MODERATE.

4.8 Nonradiological Health Impacts

SERI indicated that the physical impacts associated with construction at the ESP site may include dust, smoke, engine exhaust, and concrete operations as sources of air pollution during construction of the new nuclear unit(s). The area around the Grand Gulf ESP site is predominantly rural with a population of approximately 7250 people within a 16-km (10-mi) radius of the site. No significant industrial or commercial facilities are located or planned in this area. The following sections discuss the results of the staff's assessment of nonradiological health impacts for the Grand Gulf ESP site.

4.8.1 Public Health and Occupational Health

SERI stated in the environmental report (SERI 2003c) that the public will not be close to the construction site and, therefore, it is unlikely that physical impact would be considered more than an annoyance or nuisance. In addition, the impact will be temporary. It is not expected that fugitive dust emissions or noise from construction equipment would reach local residents.

The staff expects construction workers and personnel working onsite to be exposed to fugitive dust, gaseous effluents, and noise resulting from construction activities. Operational controls would be imposed to mitigate dust, such as wetting unpaved roads and construction areas. Cleared areas would be mulched or seeded to reduce wind-blown dust. The concrete facility would be equipped with dust-control systems to minimize releases of concrete dust (SERI 2003c). To prevent excessive exhaust emissions, construction equipment that use gasoline or diesel fuel would be inspected and repaired or replaced routinely.

In general, human health risks for construction workers and personnel working onsite are expected to be dominated by occupational injuries (e.g., falls, electrocution, asphyxiation) to workers engaged in activities such as construction, maintenance, and excavation. Historically, actual injury and fatality rates at nuclear reactor facilities have been lower than the average U.S. industrial rates. Occupational injury and fatality risks are reduced by adherence to NRC and Occupational Safety and Health Administration (OSHA) safety standards, practices, and procedures. Appropriate State and local statutes must also be considered when assessing the occupational hazards and health risks associated with construction. The staff assumes adherence to NRC, OSHA, and State safety standards, practices, and procedures during construction activities.

The staff reviewed the information in the SERI environmental report and concludes that nonradiological health impact to the site preparation workers and local population would be SMALL, and additional mitigation is not warranted.

4.8.2 Noise Impacts

Large construction projects involve many noise-generating activities. Regulations governing noise from construction activities are generally limited to worker health. Federal regulations governing construction noise are found in 29 CFR Part 1910 and 40 CFR Part 204. The regulations in 29 CFR Part 1910 deal with noise exposure in the construction environment, and the regulations in 40 CFR Part 204 generally govern the noise levels of compressors.

Activities associated with construction of a new nuclear power facility at the Grand Gulf ESP site would generate noise levels typical of larger construction projects. The plant parameter envelope indicates that maximum construction noise would be between 76 and 101 decibels at a distance of 15 m (50 ft) from the source (SERI 2003c). Noise levels for common construction activities are typically about 90 decibels at a distance of 3.5 m (10 ft). At 35 m (100 ft), the noise level would be about 70 decibels, and at a distance of 350 m (1000 ft), the noise level would be 50 decibels. A 10-decibel decrease in noise level is generally perceived as cutting the loudness in half. A few activities, such as jack hammers, have noise levels of about 110 decibels.

Many of the construction activities at the GGNS ESP site would take place near the existing GGNS Unit 1. Therefore, the potential for loud noises exists near the Unit 1 workforce. However, most of the workforce work indoors, which will reduce their exposure. For those Unit 1 workers who will be outside, training and noise protection will be provided. If it is necessary to do any blasting, the activity will be performed during the day to be less distracting to the local population.

The staff reviewed the information in the SERI environmental report (SERI 2003c) and concludes that nonradiological health impacts to construction workers, workers at the current GGNS Unit 1 facility, and the local population from fugitive dust, occupational injuries, and noise would be SMALL, and additional mitigation is not warranted.

4.9 Radiological Health Impacts

The sources of radiation exposure to site preparation workers (construction workers) include direct radiation and gaseous radioactive effluents from GGNS Unit 1 during the site preparation and construction phase. Exposure to liquid radioactive waste discharges are expected to be negligible. SERI (2003c) noted that 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).

4.9.1 Direct Radiation Exposures

In its environmental report, SERI (2003c) identified two principal sources of direct radiation exposure from the GGNS Unit 1 facility. These sources are skyshine from the nitrogen-16 source from the main turbine steam cycle and exposure from the condensate water storage tank. A minor contributor to direct radiation would also be from airborne emissions released from the facility. The staff did not identify any additional sources of direct radiation during the site visit or during documentation reviews.

In its environmental report, SERI (2003c) estimated direct radiation exposure to site preparation workers from measurements taken from thermoluminescent dosimeters (TLDs) used in the

Radiological Environmental Monitoring Program (REMP). These TLDs are located on an inner ring around the general area of the GGNS boundary, at the protected area boundary surrounding the facility, and on an outer ring located approximately 4.8 to 8 km (3 to 5 mi) from the site (SERI 2003c). SERI used the data from the 2001 *Annual Radiological Environmental Operating Report* (Entergy 2002b). The TLDs are read quarterly. SERI compared data for the years 1999 through 2002 and determined that the data for 2001 were representative for the site for the purposes of the ESP evaluation based on the average annual capacity factor of 93.6 percent for 2001 (SERI 2004d).

The location of the proposed power block and the normal heat sink cooling towers are west of the exiting unit. Other proposed construction areas are located south and east of the operating unit, all more than 76 m (250 ft) beyond the TLDs on the protected area fence. SERI used the average reading of the 16 TLDs around the protected area fence (approximately 0.375 mSv per quarter [37.5 mrem per quarter]) to determine the average dose rate for all areas proposed for new construction. This dose rate would result in a dose to a site preparation worker of 0.36 mSv per year (36 mrem per year). Most of the construction effort, however, would be west of the operating unit, which is a lower dose area. The readings from TLDs located on the west/northwest side of the protected area fence are essentially background levels (averaging approximately 0.1 mSv [10 mrem] per quarter). Proposed construction activities are planned east of the operating unit, where the protected-area-fence TLDs have higher readings. However, these activities would take place over 76 m (250 ft) beyond the protected-area fence, resulting in lower dose rates than indicated by the protected-area-fence TLDs.

SERI maintains that the direct-dose contribution from skyshine from nitrogen-16 and exposure from the condensate water storage tank would be accounted for in the protected-area-fence TLD readings. The occupational exposure period was assumed to be 2080 hours per year and a construction workforce of 3150 was assumed. The annual site preparation work force dose is therefore estimated to be 1.12 person-Sv (112 person-rem) (SERI 2004d). Adjustments for background dose were not made for the assessment of dose to the site preparation workers.

The staff's evaluation included a review of the proposed construction areas and recent records of dose rates, the locations of the TLDs, and the procedure used for estimating doses to members of the public in controlled areas. Based on this review, the staff concludes that the method used to estimate doses to site preparation workers from direct radiation from the existing GGNS Unit 1 would be acceptable.

4.9.2 Radiation Exposures from Gaseous Effluents

Gaseous effluents from GGNS Unit 1 are released from four points: the radwaste building vent, the turbine building vent, the containment building vent, and the auxiliary building vent. The maximum quarterly total body dose rates from airborne releases for 2001 was 0.0013 mSv/qtr (0.13 mrem/qtr) based on data from the 2001 *Annual Radiological Effluent Release Report* (Entergy 2002a). SERI considers that, on an annual basis, the dose to site preparation workers from gaseous effluents would be insignificant (approximately 0.001 person-sV/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.

The staff reviewed the data from the 2001 *Annual Radioactive Effluent Release Report* (Entergy 2002a) and from more recent years and found that 2001 data were typical of effluents in recent years. The staff also determined that the method for estimating dose from gaseous effluents was acceptable.

4.9.3 Radiation Exposures from Liquid Effluents

Liquid effluents from GGNS Unit 1 are combined with the cooling tower blowdown in the discharge basin and released to the Mississippi River at the existing barge slip. For 2001, the maximum individual whole body dose from liquid effluent was calculated to be 0.00018 mSv/yr (0.018 mrem/yr). SERI considers that, on an annual basis, the dose to site preparation workers from liquid effluents would be insignificant (approximately 0.0006 person-Sv/yr [0.06 person-rem/yr]) with respect to the dose from direct radiation.

The staff reviewed the data from the 2001 *Annual Radioactive Effluent Release Report* (Entergy 2002a) and from more recent years and found that 2001 data were typical of effluents in recent years. The staff also determined that the method for estimating dose from liquid effluents was acceptable.

4.9.4 Total Dose to the Site Preparation Workers

SERI (2003c) estimated an annual dose to a site preparation worker of 0.36 mSv (36 mrem) from the direct radiation pathway. Doses from liquid and gaseous releases are negligible compared to the dose from direct radiation. This estimate is well within both the dose limit to the public found in 10 CFR 20.1301 and occupational dose limits to workers found in 10 CFR 20.1201. The maximum estimated annual collective dose to site preparation workers, based on an annual individual dose of 0.36 mSv (36 mrem) and an estimated workforce of 3150 workers, is 1.12 person-Sv (112 person-rem). 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. The annual occupational dose limit is 0.05 Sv (5 rem) total effective dose equivalent.

4.9.5 Summary of Radiological Health Impacts

Having reviewed SERI's estimate of dose to site preparation workers during construction activities, the staff found the doses to be well within NRC exposure limits designed to protect the public health, even if workers exceed the 2080 hour per year occupancy factor. The staff concludes that the impact of radiological exposures to site preparation workers and the public would be SMALL, and mitigation is not warranted.

4.10 Measures and Controls to Limit Adverse Impacts

The staff relied, in their evaluation of environmental impact during construction activities for the proposed new units at the Grand Gulf ESP site, on SERI's compliance with the following regulatory requirements:

- compliance with applicable Federal, State, and local laws, ordinances, and regulations intended to prevent or minimize adverse environmental impacts (for example, solid waste management, erosion and sediment control, air emissions, noise control, storm water management, spill response and cleanup, and hazardous material management)

- compliance with applicable requirements of existing permits and licenses (for example, NPDES permit and operating license) for the existing units and other permits or licenses required for construction of the new units (for example, ACE Section 404 Permit)

- a permit from MDEQ and compliance with county ordinances if burning of construction materials is required

- a NPDES permit related to accidental spills and storm water runoff.

The following plant species were not addressed in SERI's environmental report (SERI 2003c), but were identified by the staff in Section 2.7.1.2 as plants to be avoided if they are documented in the area prior to construction: American bittersweet (*Celastrus scandens*), glade fern (*Diplazium pycnocarpon*), hairy waterclover (*Marsilea vestita*), and jug orchid (*Platythelys querceticola*).

SERI specifically identified the following general plans or specific mitigation measures in its environmental report (ER) (SERI 2003c, Table 4.6-1) upon which the staff relied in its evaluation:

- minimizing land cover impact by careful construction techniques and reclaim land disturbed by construction to the maximum extent possible (ER, Sections 4.1.1, 4.3.1, 4.4.1)

- using standard noise protection and abatement procedures during construction. Provide hearing protection to onsite personnel if needed (ER, Sections 4.1.4, 4.4.1)

- surveying areas prior to disturbance for archaeological resources, followed by data recovery, if necessary (ER, Section 4.1.3)

- stabilizing embayment banks with riprap or other appropriate means during and following construction, and following requirements of ACE (ER, Sections 4.2.1, 4.2.2, 4.3.2)

- implementing site-specific storm water pollution prevention plans; maintaining vegetative cover on land not in active construction; routing runoff to existing sedimentation basins, and monitoring discharges in accordance with NPDES and State water quality standards and requirements (ER, Sections 4.2.1, 4.2.2, 4.3.2)

- using tieback walls or similar control technology to limit effects of dewatering in accordance with applicable MDEQ regulations (ER, Sections 4.2.1, 4.2.2)

- preventing contaminants from entering the aquatic system through use of a Spill Prevention Control and Countermeasure Plan (ER, Section 4.3.2)

- segregating excavated topsoil for replacement in pipeline trench to allow wetland characteristics to be restored; confining construction to low-water periods to minimize disturbance of wetland soils; using low-weight construction equipment or operate from protective surfaces, and reseeding following construction (ER, Section 4.3.1)

- modifying construction activities as necessary to avoid nesting or similar critical life history periods (ER, Section 4.3.1)

- avoiding removal of isolated mixed hardwood-loblolly pine stand north of the switchyard (ER, Section 4.3.1)

- avoiding areas where square-stemmed monkeyflower (*Mimulus ringens*) occurs, if documented prior to construction (ER, Section 4.3.1)

- conducting surveys for species of special concern prior to construction activities (ER, Section 4.3.1)

- controlling air emissions, if necessary, to meet requirements of applicable air regulations and onsite permits. Open burning would be done in burn pits in compliance with MDEQ regulations (ER, Section 4.4.1).

- controlling dust by water spray, reseeding, and mulching, as necessary; equipping concrete batch plant with dust suppression equipment (ER, Section 4.4.1)

- implementing flexible construction shifts and Unit 1 operation shifts to minimize impact on local traffic (ER, Section 4.4.2).

In the event that a new nuclear power plant were constructed at the Grand Gulf ESP site, it is likely the local governments will need additional resources to provide public services—especially safety, medical, and schools.

4.11 Summary of Construction Impacts

Table 4-3 shows impact level categories as SMALL, MODERATE, or LARGE as a measure of their expected adverse environmental impacts, if any. A brief statement in the "Comments" column explains the basis for the impact level. Some impacts, such as the addition of tax revenue for the local economies, are beneficial. The beneficial aspect is also reflected in the "Comments" column.

Table 4-3. Characterization of Impacts from Construction of One or More Units at the Grand Gulf Early Site Permit Site

Category	Comments	Impact Level
Land-use impacts		--
Site and vicinity	Construction activities would take place within existing site boundaries.	SMALL
Transmission corridors	Additional capacity needed for full plant parameter envelope to be accommodated through upgrades of existing lines.	SMALL
Air quality impacts	Construction activities would be conducted in accordance with applicable Mississippi Department of Environmental Quality (MDEQ) requirements, and dust and emissions would be minimized through a dust control plan.	SMALL

Table 4.3. (contd)

Category	Comments	Impact Level
Water-related impacts		–
Water use	Construction would require minimal water use.	SMALL
Water quality	Construction would be conducted using best management practices to control spills and storm water runoff.	SMALL
Hydrological alterations	Impacts would be localized and temporary. MDEQ and U.S. Army Corps of Engineers (ACE) permit processes would minimize impact.	SMALL
Ecological impacts		--
Terrestrial ecosystems	No important terrestrial species would be affected by construction at the Grand Gulf ESP site. Alterations to existing hardwood forest would be noticeable but not destabilizing.	MODERATE
Aquatic ecosystems	Construction impacts on aquatic resources would be temporary and spatially limited.	SMALL
Threatened and endangered species	Construction impacts on Federally listed and State-listed species and their habitat in the area would be minor.	SMALL
Socioeconomic impacts		--
Physical impacts		SMALL
Workers/local public	Construction would take place within existing site boundaries, so impact to the public would be minimal. Impact to workers would be mitigated with training and protective equipment.	–
Buildings	Construction would not affect any offsite buildings, and onsite buildings were constructed to withstand vibration from construction activities.	–
Roads	Growth would put pressure on local road systems, but traffic control and management measures would protect any local roads during construction.	–
Aesthetics	Construction activities would be temporary and would occur on a site already occupied by a	–

Table 4.3. (contd)

	Category	Comments	Impact Level
		nuclear power facility.	
21	Demography	Percentage of construction workers relocating to the region would be small relative to the existing population base.	SMALL
22	Social and economic		LARGE Beneficial to SMALL Beneficial
23	Economy	Economic impact of construction overall would be beneficial to local economies.	–
24	Taxes	Dependent on handling of tax revenues under State law: if the facility is taxed as ordinary industrial asset, the benefit would be large to Claiborne County. If the taxes go instead to the State, the beneficial effect on Claiborne County would be small.	–
25 26	Infrastructure and community services		SMALL to MODERATE
27	Transportation	Planned upgrades and traffic management plans would reduce temporary construction transportation impact.	–
28	Recreation	Visual impact of construction would be limited at the Grand Gulf Military Park.	–
29	Housing	Adequate housing is available in the greater Vicksburg area to handle construction workers. If workers concentrate in Claiborne County, the impact could be moderate.	–
30	Public services	Public services are adequate for any temporary influx of workers resulting from construction at the Grand Gulf ESP site.	–
31	Education	Adequate infrastructure exists to support the temporary influx of workers if they settle primarily outside of Claiborne County. If they settle in Port Gibson, however, impacts could be moderate.	–
32 33	**Historic and cultural resources impacts**	Proposed construction area is previously disturbed, and Entergy Mississippi, Inc. will incorporate cultural resource protection	SMALL

Table 4.3. (contd)

Category	Comments	Impact Level
	directions in their site-wide excavation and backfill work procedures.	
Environmental justice impacts	If tax revenues are not shared with the State, adequate resources exist to accommodate changes required in Claiborne County. If the tax revenues are shared with the State, the impact on Claiborne County taxpayers (largely minority and low income) would be moderate.	LARGE Beneficial to MODERATE Adverse
Nonradiological health impacts	Emission controls and remote location of the proposed Grand Gulf ESP site would keep nonradiological health impacts small. Occupational health impacts related to construction would be within the bounds of other similarly sized construction projects.	SMALL
Radiological health impacts	Exposures would be below annual occupational and public dose limits.	SMALL

4.12 References

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10 CFR Part 51. Code of Federal Regulations. Title 10, *Energy*, Part 51, Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 52. Code of Federal Regulations. Title 10, *Energy*, Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

29 CFR Part 1910. Code of Federal Regulations. Title 29, *Labor*, Part 1910, "Occupational Safety and Health Standards."

36 CFR Part 800.8. Code of Federal Regulations. Title 36, *Parks, Forests, and Public Property*, Part 800, "Protection of Historic Properties," Subpart 8, "Coordination with the National Environmental Policy Act."

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5.0 Station Operation Impacts at the Proposed Site

This chapter examines the environmental issues associated with operation of one or two additional nuclear units at the proposed Grand Gulf early site permit (ESP) site for an initial 40-year period as described in the application for an ESP submitted by System Energy Resources, Inc. (SERI). As part of this application, SERI submitted an environmental report (SERI 2003c) that provides the plant parameter envelope (PPE) (see Appendix I) as the basis for the environmental review.

Sections 5.1 through 5.10 of this chapter discuss the potential impacts on land use, air quality, water, ecosystems, socioeconomics, historic and cultural resources, and environmental justice, as well as nonradiological and radiological health effects and impacts of postulated accidents. In accordance with Title 10 of the Code of Federal Regulations (CFR), Part 51, the impacts have been analyzed, and a significance level of potential adverse impact (SMALL, MODERATE, or LARGE) has been assigned to each analysis. Measures and controls to limit adverse impacts of station operation during the initial 40 years are presented in Section 5.11. The staff's determination of significance levels is based on the assumption that the mitigation measures identified in the environmental report and in Section 5.11 of this environmental impact statement (EIS), or activities planned by various State and county governments as discussed throughout this chapter, such as infrastructure upgrades, are implemented. A summary of the operational impacts is presented in Section 5.12. The references cited in this chapter are listed in Section 5.13.

5.1 Land-Use Impacts

The land-use areas considered include those (such as the site, vicinity, area along transmission lines, and offsite areas) with the potential to be affected by operational activities. Operations of the ESP facility are not anticipated to require temporary or permanent changes of any current or planned land use.

5.1.1 Site and Vicinity

Operation of the proposed unit or units at the Grand Gulf ESP site would result in social and economic impacts that may translate into impacts on land use in the vicinity. These impacts are discussed in Section 5.5.2. A conservative estimate of the expected increase in population related to new personnel being employed at the ESP site would be 2380 people. This conservatively assumes that all facility-related employment associated with the ESP would relocate to the impact region (within 80 km/50 mi.) of the ESP site. Section 5.5.2 presents potential population impacts to individual jurisdictions, assuming relocations occur in proportion to the current distribution of worker residences.

The staff analyzed recent mortgage finance data for Claiborne County (FFIEC 2001; 2002; 2003; 2004) to evaluate the potential need for new housing in the vicinity. The Federal Financial Institutions Examination Council (FFIEC) annually collects data on each mortgage finance transaction in the country from institutions required to report, including banks, mortgage companies, credit unions, and other finance companies. The detailed transaction data and borrower characteristics are provided to the census tract level. Table 5-1 provides a summary of such transactions reported in Claiborne County over the last four years. The data indicate that the 196 financed home purchases over the four years ending in 2003 have been evenly distributed across the county's three census tracts: the northern portion of the county, the Port Gibson area, and the southern portion of the county. Section 5.5.2 indicates that plant workers moving to the region would most likely locate in the Vicksburg area where housing and services are most available. The home purchase data summarized in Table 5-1 suggest that Claiborne County conservatively averages just 49 home sales annually, distributed somewhat evenly across the county.

Table 5-1. Mortgage Transactions in Claiborne County, Mississippi, 2000-2003

	2000	2001	2002	2003
Home Purchase Mortgages	71	54	31	40
Average Loan Amount ($K)	43.2	52.3	47.5	55.3
Median Loan Amount ($K)	32.0	35.5	47.0	48.5
Average Borrower Income ($K)	36.8	43.5	40.3	41.1
Median Borrower Income ($K)	36	36	36	32

Source: FFEIC Home Mortgage Disclosure Act data (FFIEC 2001; 2002; 2003; 2004). These data include only mortgage transactions financed through Federally regulated institutions. Cash purchases are not included.

Based on this analysis and information presented in Section 5.5.2, the staff finds that relocating workers would tend to seek housing where it is currently most available and where the choice of homes is greatest, such as Vicksburg, Natchez, or Clinton. Relocation in proportion to the current distribution of worker residences is unlikely, given current housing availability in Claiborne County. It is not possible to know what real estate or land development might occur in Claiborne County as a result of siting and operating the ESP facility. Therefore, the staff concludes that land-use impacts from development of new housing would occur, but such impacts would be widely disbursed and would not be concentrated in any one community. Such impacts might include land-cover alteration on private lands, new property access roads, or conversion from private agricultural to residential use.

Another potential impact to land use includes the effects of salt drift on crops, timber, and other vegetation from operation of wet cooling towers (either natural or mechanical draft) that have been proposed for the Grand Gulf ESP facility. Forests both on the Grand Gulf site and offsite to the northwest of the ESP facility could be in the path of vapor plumes carried on southeasterly prevailing winds (SERI 2003c) and could thus be affected by salt drift. However, agricultural land occurs only offsite and largely to the southeast and east of the Grand Gulf ESP facility, and thus would be less likely to be affected by salt drift, based on the direction of prevailing winds.

It is assumed that new cooling towers would produce salt concentrations similar to cooling towers at existing nuclear power plants. New cooling towers would be located near the existing natural draft cooling tower at the Grand Gulf site and would be subject to the same meteorological conditions and hence produce a similar plume footprint, potentially tripling the current salt deposition. The impact of salt drift on crops, ornamental vegetation, and native plants was evaluated for existing nuclear power plants in the Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS) (NRC 1996) and was found to be of minor significance. This determination also included existing nuclear power plants with more than one cooling tower. Consequently, damage to timber or crops from the operation of cooling towers for the Grand Gulf ESP facility would be negligible. Impacts to land use that would occur include minor land cover alterations because of the geographically disbursed construction of new housing for ESP facility workers. Therefore, the staff concludes that land-use impacts in the vicinity of the ESP facility due to operations would be SMALL, and additional mitigation would not be warranted.

5.1.2 Transmission Corridors and Offsite Areas

Section 4.1.2 indicates that although the current transmission system serving the GGNS site is likely to be inadequate under the bounding assumptions of the PPE, the full extent of changes to the transmission system cannot be known until SERI initiates the Federal Energy Regulatory Commission (FERC) process for connecting new large generation to the grid. This process is discussed more specifically in Section 3.3. Whether that process results in findings that the existing rights-of-way can be upgraded, or that new rights-of-way must be acquired, maintenance of the lines is expected to be accomplished using standard industry practices and following applicable laws and regulations. Impacts to land use would occur as a result of normal maintenance activities, such as right-of-way vegetation clearing, line maintenance, and other normal access needs. Impacts on land use during the construction phase are discussed in Section 4.1.2, and the subsequent impacts of line and corridor maintenance would be minimal. These may include access easements, building restrictions, temporary closures, and other activities as part of routine maintenance.

Based on information provided by SERI (2003c) and its own independent review, the staff concludes that land-use impacts in the power transmission corridors and offsite areas from ESP facility operations would be SMALL, and additional mitigation is not warranted.

5.2 Meteorological and Air Quality Impacts

Sections 2.3.1 and 2.3.2 describe the meteorological characteristics and air quality of the Grand Gulf ESP site. The primary impacts of operation of the Grand Gulf ESP facility on local meteorology and air quality would be from releases to the environment of heat and moisture from the primary cooling system (cooling towers), operation of auxiliary equipment (generators and boilers), and emissions from workers' vehicles. This section provides information on these factors and discusses the potential impacts of transmission corridors on air quality.

5.2.1 Cooling System

The proposed cooling system for the new nuclear unit or units at the Grand Gulf ESP site is wet cooling towers. Both natural draft and mechanical draft cooling towers are being considered. The most apparent impacts of wet cooling towers are the land use and aesthetic impacts associated with visible plumes. The air-quality impacts of wet cooling towers are associated with the drift from the cooling towers and possible interactions between the moist plumes and other pollutants. Existing wet cooling towers at nuclear power plants have drift eliminators to reduce drift.

Drift is composed of small water droplets that are carried out of the cooling tower. These droplets evaporate, leaving particles that contain residual salts and chemicals from the cooling water. Drift from mechanical draft cooling towers is deposited near the cooling tower, and drift from natural draft towers is deposited farther downwind. Based on a review of the measurements of deposition of drift from nuclear power plants, the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS)* (NUREG-1437) (NRC 1996) states the "...measurements indicate that, beyond about 1.5 km (1 mile) from nuclear plant cooling tower, salt deposition is not significantly above background levels."

Based on the above considerations and 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 concludes that the impacts of the cooling towers on air quality would be SMALL and that additional mitigation of the air quality impacts is not warranted.

5.2.2 Routine Releases Other than Cooling System

Operation of auxiliary equipment, such as generators and boilers associated with a postulated facility at the Grand Gulf ESP site, would be intermittent. SERI provided bounding values for particulate sulfur and nitrogen oxides, carbon monoxide, and hydrocarbon emissions from auxiliary boilers, standby diesel generators, and standby power system gas turbines in the PPE. Auxiliary boilers are assumed to operate 30 days per year, and standby diesel generators and standby power system gas turbines are assumed to operate 4 hours per month. SERI (2003a) states that gaseous releases associated with the postulated units would comply with Federal, State, and local emission standards.

No major air pollution sources exist near the Grand Gulf ESP site. Diesel generators and boilers at the GGNS operate for limited periods. Generators and boilers associated with the new nuclear unit or units would also be operated for limited periods. Emissions from the generators and boilers would be minor compared to emissions from boilers and generators that run continuously. Interactions between pollutants emitted from these sources and the plumes from the new nuclear unit cooling towers would be intermittent and would not have a significant impact on air quality.

Because these systems are used on an infrequent basis and no significant industrial source exists within 16 km (10 mi) of the proposed site, the staff concludes the impacts of these releases would be SMALL.

5.2.3 Transmission Line Impacts

The impacts of existing transmission lines on air quality are reviewed in the GEIS (NRC 1996). Small amounts of ozone and smaller amounts of oxides of nitrogen are produced by transmission lines. The small amounts of these gases were found to be insignificant for 745-kV lines (the largest lines in operation) and for a prototype 1200-kV line. In addition, it was determined that potential mitigation measures would be very costly and would not be warranted. The largest existing line in the transmission and distribution system serving the proposed Grand Gulf ESP site is a 500-kV line, well within the range of lines considered in NUREG-1437.

Based on the information provided by SERI, the staff's independent review, and the analyses discussed above, the staff concludes the potential impacts of operation of the Grand Gulf ESP facility would be SMALL, and mitigation measures would not be warranted.

5.3 Water-Related Impacts

Water-use and water-quality impacts involved in the operation of a nuclear power plant are similar to the impacts that would be associated with any large thermoelectric power generation facility. Accordingly, a construction permit (CP) or combined license (COL) SERI must obtain the same water-related permits and certifications as any other large industrial facility. These would include:

- Clean Water Act Section 401 certification. This certification would be issued by the Mississippi Department of Environmental Quality (MDEQ) and would ensure that projects do not conflict with State water quality management programs.

- Clean Water Act Section 402(p) National Pollutant Discharge Elimination System (NPDES) discharge permit. This permit would be issued by MDEQ and would regulate point source storm water discharges. The U.S. Environmental Protection Agency (EPA) has delegated the responsibility for administering the NPDES program in Mississippi to MDEQ.

- Clean Water Act Section 316(a). This section regulates heated and chlorinated cooling water discharges to protect the health of the aquatic habitat.

- Clean Water Act Section 316(b). This section regulates cooling water intake structures to minimize environmental impacts associated with location, design, construction, and capacity of those structures.

- Section 10 of the Rivers and Harbors Act of 1899. This section prohibits the obstruction or alteration of navigable waters of the United States without a permit. Appropriate U.S. Army Corps of Engineers (ACE) permits would be obtained for maintenance of the proposed intake and discharge structures on the shore of the Mississippi River.

- Section 1424(e) of the Safe Drinking Water Act of 1974. This section prohibits any commitment for Federal financial assistance (through a grant, contract, loan guarantee, or otherwise) for any project which the EPA Administrator determines may contaminate an aquifer designated by the Administrator to be a sole-source aquifer. EPA has identified the Southern Hills Aquifer, which includes the Catahoula formation beneath the Grand Gulf ESP site, to be a sole-source aquifer (EPA 1998).

Managing water resources requires understanding and balancing the tradeoffs between various, often conflicting objectives. At the Grand Gulf ESP site, these include navigation, recreation, visual aesthetics, fishery, and a variety of beneficial consumptive domestic and industrial uses of water. The responsibility for regulating water use and water quality is delegated to ACE and MDEQ through Federal laws and laws of the State of Mississippi. This section discusses the estimated impacts on water use and water quality resulting from operation of a facility at the Grand Gulf ESP site bounded by the PPE.

5.3.1 Water-Use Impacts

The ESP facility would use surface water from the Mississippi River for cooling purposes and groundwater from the Catahoula formation for other facility water needs. By far, the largest single use of water for the proposed Grand Gulf ESP facility would be makeup for the normal heat sink. SERI stated that operation of the makeup water system for a new facility would have a negligible impact on the use and water supply of the Mississippi River (SERI 2003c). Normal makeup flow rate to a new ESP facility would be approximately 3175 L/s (50,320 gpm), and the maximum expected makeup flow would be 5400 L/s (85,000 gpm). About 25 percent of this water would be returned to the Mississippi River as blowdown. The staff concludes that a new facility would require only a small amount of water withdrawal relative to the total river flow (about 0.2 percent) at even the lowest minimum river discharge conditions recorded for the area. Also, because of the proposed location and the small area of the river that would be affected by the proposed new facility, the staff concludes that the intake structure would not affect recreational or commercial fishing operations or otherwise restrict navigation on the Mississippi River. Because the withdrawal would be small relative to river flow (conservatively considering withdrawals for both the proposed ESP unit(s) and the existing GGNS Unit 1), the staff concludes that impacts would be small.

SERI stated that no water from Stream A or Stream B would be used by the proposed ESP facility (SERI 2003c). However, the alteration of the existing landscape would likely increase the impervious surfaces at the site, thereby increasing storm water flow. While this could possibly alter the timing and magnitude of runoff without significantly altering the overall water budget, the staff concludes that, by employing standard best management practices for storm water management, the impact of the ESP facility on water uses associated with Stream A and Stream B would be insignificant.

No new consumptive wells in the Holocene alluvial aquifer are proposed for operation of the new facility; therefore, the staff concludes no impacts would be anticipated on the alluvial aquifer.

SERI (2003c) stated that the use of the additional wells installed in the Catahoula formation for water needs other than for cooling makeup water would not significantly affect the groundwater water surface elevation in the vicinity. However, the staff concludes that the characterization of the Catahoula aquifer was inadequate to support such a conclusion, particularly given the significance of the aquifer to local domestic water supplies and its designation by EPA as a sole-source aquifer (EPA 1998). Because of the limited number of borings, hydraulic conductivity measurements, and long-term pump tests in this portion of the aquifer that are currently available, the staff was unable to assess reliably the impact of a significant increase in the groundwater withdrawal at the Grand Gulf ESP site. However, the staff's analysis does not depend on more precise characterization of withdrawal volume, given that such groundwater withdrawal would be regulated by the State. The staff assumes that if such a withdrawal were environmentally unacceptable, an applicant wishing to construct new nuclear unit(s) at the ESP site could rely on treated water from the Mississippi River, should the Catahoula formation prove inadequate.

Based on the above, the staff concludes that the water use impacts associated with the Grand Gulf ESP facility would be SMALL. However, at the CP or COL stage, SERI would need to demonstrate that the Catahoula could support the additional withdrawals.

5.3.2 Water-Quality Impacts

In Section 5.3.2 of its environmental report (SERI 2003c), SERI described the impact of effluent discharges from both the existing GGNS Unit 1 and the proposed ESP facility. While the specific design of the outfall, including the diffuser, has not yet been specified, parameters from the PPE were used to bound the impact of the outfall on the river environment. Environmental parameters, such as river discharge and receiving water temperature, were also varied in this analysis, using the historical record.

5.3.2.1 Mississippi River

SERI's evaluation (2003c) assumed the discharge outfall would enter the Mississippi River several hundred feet downstream of the intake screens and on the left bank (the same side as the Grand Gulf ESP site) of the river. The proposed discharge would enter perpendicular to the river via a shoreline-located discharge canal that would be rectangular in cross-section. Water depth in the canal at the terminus was assumed to be 10 m (33 ft) wide by 0.5 m (1.6 ft) deep. Regardless of river environment, local river depth at the shoreline- located discharge exit would be 0.5 m (1.6 ft) deep, and the bank would slope 19.3 degrees. Based upon PPE values for the Grand Gulf ESP facility and the *Updated Final Safety Analysis Report* (UFSAR) (MP&L 1994) for GGNS Unit 1, the bounding discharge flow rate was assumed to be 3.34 m^3/s (52,900 gpm) at a temperature of 37.7°C (100°F).

For purposes of determining bounding conditions, the variable flow conditions of the river were examined. Mississippi River flows examined by SERI (SERI 2003c) were assumed to be either 15,860 m^3/s (560,000 cfs) for average river flow or 3653 m^3/s (129,000 cfs) for low river flow. The river was assumed to be rectangular in cross-section, with a constant width of 884 m (2900 ft) and a depth of either 9.44 m (31.0 ft) for the average river flow or 2.44 m (8.00 ft) for low river flow. These combinations of discharges and cross-sectional areas results in a mean ambient river velocity of 1.9 m/s (6.2 ft/s) for average flow or 1.69 m/s (5.54 ft/s) for low flow. Ambient winter river water temperatures examined were both 1°C (34°F) and 4°C (39°F) and ambient summer river water temperatures were both 27.8°C (82.0°F) or 30.6°C (87.1°F).

SERI estimated the length and width of the discharge plume using the Cornell Mixing Zone Expert System (CORMIX) version 3.2 (Jirka et al. 1996). Simulation parameters and summary of results are shown in the environmental report (SERI 2003c). The plume width and length were defined in the analysis as the location of the 2.8°C (5°F) isotherm. CORMIX version 3.2 results indicate the maximum width and length of the plume to have occurred with the higher discharge and colder river case. Under these conditions, the worst case (i.e., largest) surface extent of the plume was reported to be 187 m (614 ft) long and 16.3 m (53.5 ft) wide.

The U.S. Nuclear Regulatory Commission (NRC) staff performed an independent analysis of the outfall plume using CORMIX version 4.3 (Jirka et al. 2004). This is the most recent version of the model available and includes several revisions to the buoyant plume algorithms that are germane to the SERI application. The staff's evaluation assumed that the discharge plume would enter perpendicular to the river, several hundred feet downstream of the intake screens, and on the left bank. Water depth at the canal terminus was 10 m (33 ft) wide by 0.5 m (1.6 ft), and the local river depth at the outfall location was also 0.5 m (1.6 ft). Based on the UFSAR (MP&L 1994), the slope of the protected river bank was assumed to be 14 degrees (approximately 4 ft horizontal for every vertical foot). Based upon PPE bounding values (SERI 2003c) and the UFSAR (MP&L 1994), the outfall discharge was assumed to be 3.34 m^3/s (52,900 gpm) at a temperature of 37.7°C (100°F).

The staff evaluated two assumed river discharges during its analysis. These discharges were based on monthly average Mississippi River streamflow data collected between 1931 and 1998 near Vicksburg by the U.S. Geological Survey (USGS 2004). From this dataset, the mean flow was approximately 17,040 m^3/s (601,800 cfs) and the low flow was 3115 m^3/s (110,000 cfs). Water temperature data maxima and minima were examined between 1962 and 1979 to determine bounding values. Based upon the UFSAR (MP&L 1994), the average winter water temperature is 5°C (41°F) with a minimum of approximately 1°C (34°F). The average summer river temperature is 27.8°C (82.0°F), with a maximum of 30.6°C (87.1°F).

The cross-sectional areas of the river at both the mean and the low flow were determined using ACE (2001), SERI's environmental report (SERI 2003c), and the UFSAR (MP&L 1994). For the mean flow scenarios, the river width was 1000 m (3281 ft) and the average water depth was 13 m (43 ft), resulting in an ambient river water velocity of 1.31 m/s (4.30 ft/s). For the low flow scenarios, the river width was 730 m (2400 ft) and the average water depth of 5.7 m (19 ft), resulting in an ambient river water velocity of 0.75 m/s (2.5 m/s). Ambient water velocities match typical observed values at similar river discharges.

Plume dimensions computed using CORMIX version 4.3 are presented in Table 5-2 for the eight different scenarios. The plume is larger in winter because of the much larger difference between ambient and outfall temperatures. The winter low-flow scenario with the minimum ambient river temperature produced the largest plume, with a length of 387 m (1270 ft) and a width of 58 m (190 ft). The winter low-flow scenario results in a mixing zone of 2.2 ha (5.5 ac).

Table 5-2. Dimensions of 2.8°C (5.0°F) Isotherm Plume in the Mississippi River Based on the Staff's CORMIX Simulations

			Low River Flow 3115 m³/s		Average River Flow 17,040 m³/s	
Case Studied	**Ambient River Temperature(a)**	**Isotherm Above Ambient Considered(a)**	**Mixing Zone Length (b)**	**Mixing Zone Width(b)**	**Mixing Zone Length(b)**	**Mixing Zone Width(b)**
Summer high temperature	30.6 (87)	2.8 (5.0)	72 (236)	36 (118)	8 (26)	10 (33)
Summer average temperature	27.8 (82)	2.8 (5.0)	75 (246)	34 (112)	8 (26)	9 (30)
Winter mean temperature	5 (41)	2.8 (5.0)	352 (1150)	53 (174)	254 (833)	21 (69)
Winter low temperature	1 (34)	2.8 (5.0)	387 (1270)	58 (190)	265 (869)	26 (85)

(a) °C (°F).
(b) meters (feet).

In addition to these scenarios, several submerged single-port diffuser outfalls were tested to determine if the size of the plume could be increased beyond those shown in the table above. As expected, by using a port diffuser located beneath the water surface, the buoyant jet entrained ambient water as it rose to the surface. It was therefore concluded that the shoreline diffuser discussed above is indeed the bounding case.

The maximum predicted size of the 2.8°C (5°F) above-ambient isotherm predicted by CORMIX version 4.3 is an approximately 400-m by 60-m (1300-ft by 200-ft) wedge-shaped region downstream of the outfall diffuser. By comparison, the Mississippi River is approximately 1000 m (3281 ft) wide at this location. An approximate sketch of this plume in relation to the site is shown in Figure 5-1. The NRC staff, concludes therefore, that the impact of the thermal plume on the Mississippi River would be small and localized. The thermal discharge to the Mississippi River would be regulated by the MDEQ.

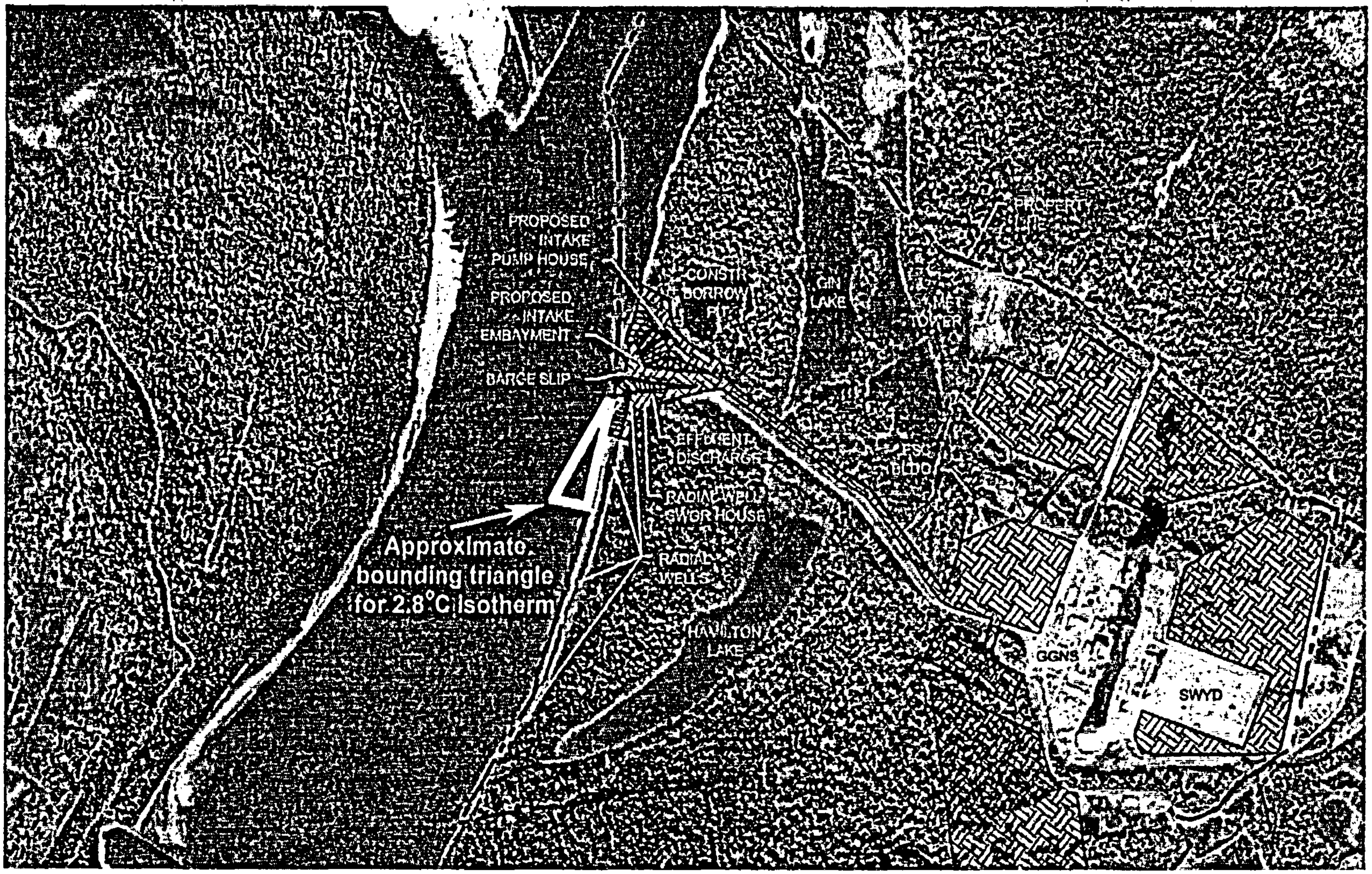

Figure 5-1. Bounding Triangle for the Location of the 2.8°C Above-Ambient Isotherm Based upon the Winter Extreme Temperature Difference, Low-Discharge Scenario

The staff extended its thermal impact assessment using the CORMIX model to consider the potential impacts of chemical pollutants in the discharge to the Mississippi River. The results presented in Table 5-2 can be used to derive mixing zone dilution factors for the cases considered in the thermal analysis. The dilution factor is the fractional concentration of a unit concentration in the discharge at the edge of the mixing zone. For instance, if the dilution factor were 10 percent and the discharge concentration were 20 ppm, then the concentration at the edge of the mixing zone would be 2 ppm. Table 5-3 presents dilution factors and the mixing zone (plume) dimensions for the four scenarios considered in the staff's thermal analysis.

Table 5-3. Dilution Factors for Chemical Discharge to the Mississippi River Based on the Staff's CORMIX Simulations

Case Studied	Dilution Factor
Summer high temperature	28%
Summer average temperature	39%
Winter mean temperature	9%
Winter low temperature	8%

For an 8-percent dilution factor, based on the low-flow condition, the mixing zone for the combined discharge from GGNS Unit 1 and the proposed ESP facility would be approximately 400 m long by 60 m wide (1300 ft by 200 ft). Again, this 60-m (200-ft) width is in comparison to the 1000-m (3281-ft) width of the Mississippi River at this location. The chemical discharge to the Mississippi River will be regulated by the MDEQ. SERI did not provide information in the PPE or environmental report defining the bounds of concentrations of chemical effluents to be discharged to the Mississippi River. Prior to a construction permit or combined license, SERI would need to provide such information to the NRC and the MDEQ.

5.3.2.2 Streams A and B

SERI stated that discharges to Streams A and B from the Grand Gulf ESP facility would include sanitary waste water, storm water, and sump drains. SERI did not provide information in the environmental report defining the bounds of concentrations of effluents to be discharged to Streams A and B. Prior to a CP or COL, SERI would need to provide such information to the NRC and the MDEQ. The allowable concentrations and volumes of such effluents to Stream A and B would be regulated by the MDEQ.

5.3.2.3 Groundwater

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. However, deep groundwater drawdowns are extremely unlikely because groundwater withdrawals from the Catahoula formation would be in accordance with applicable standards published in the MDEQ regulations (MDEQ 1994) and necessary permits would be obtained from the MDEQ.

5.3.2.4 Summary

Based on information provided by SERI in the ER (SERI 2003c) and its own independent review, the staff concludes that the overall impacts of operation of a new nuclear facility on water quality at the Grand Gulf ESP site would be SMALL, provided that the applicable permits required by the MDEQ are secured.

5.4 Ecological Impacts

This section describes the potential impacts from operation of the Grand Gulf ESP facility, including transmission lines, to terrestrial ecosystems, aquatic ecosystems, and threatened and endangered species.

5.4.1 Terrestrial Ecosystems

The proposed cooling system for the Grand Gulf ESP facility is closed-cycle that would employ either natural or mechanical draft cooling towers. The rejected heat would be manifest in the form of water vapor plumes. Impacts associated with vapor plumes includes those resulting from salt drift, fogging, and icing. Vapor plumes may affect crops, ornamental vegetation, and native plants, and water losses could affect shoreline habitat. In addition, bird collisions and disturbance because of noise are possible with wet cooling towers. Each of these topics is discussed in the following paragraphs.

Electric transmission systems have the potential to affect terrestrial ecological resources through right-of-way maintenance, bird collisions with power lines, and electromagnetic fields. The transmission and distribution system existing at the time of startup and operation of the proposed Grand Gulf ESP facility would be relied upon to distribute the power generated. A study conducted by SERI concluded that the existing system is adequate for an additional 1311-MW(e) generating capacity, assuming that modifications and upgrades are made to equipment in the switchyard of GGNS Unit 1. However, the maximum generating capacity is approximately 3000 MW(e) (SERI 2003c). If 3000-MW(e) generating capacity were installed, the existing transmission lines would have to be upgraded or additional transmission lines would be required.

Should the Grand Gulf ESP facility be constructed, the actual need for and nature of any transmission system improvements would be determined definitively prior to or during the CP or COL phase by the transmission and distribution system owner and operator (currently Entergy Mississippi, Inc.) under FERC Order No. 2003 (18 CFR Part 35) *Standardization of Generator Interconnection Agreements and Procedures.* The magnitude of the environmental impacts associated with any transmission system improvements would also be established by the transmission and distribution system owner and operator at that time.

5.4.1.1 Impacts on Crops, Ornamental Vegetation, and Native Plants

Impacts on crops, ornamental vegetation, and native plants may result from cooling tower salt drift, icing, fogging, or increased humidity. No agricultural land exists on the Grand Gulf site. Offsite and in the immediate vicinity of the location of the Grand Gulf ESP facility, there is agricultural land only to the southeast and east, and winds originate most frequently in the southeast (SERI 2003c). Based solely on the direction of prevailing winds, it appears unlikely that cooling tower impacts on crops and ornamental vegetation would result. However, forests and forested wetlands both onsite and offsite to the northwest of the Grand Gulf ESP facility could be in the path of vapor plumes carried on southeasterly prevailing winds and could thus be affected.

It is assumed that new cooling towers would produce salt concentrations similar to cooling towers at existing nuclear power plants. New cooling towers would be located near the existing natural draft cooling tower at the Grand Gulf site and be subject to the same meteorological conditions and hence produce a similar plume footprint, potentially tripling the current salt deposition. A salt drift deposition study was conducted for GGNS Unit 1 from 1983 to 1988. The salt drift deposition rate was not significantly different between onsite and offsite locations. Consequently, a supplemental study was not undertaken to determine the biological effects of salt drift at the Grand Gulf site (Entergy 1992). The impact of salt drift on crops, ornamental vegetation, and native plants was evaluated for existing nuclear power plants in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) (NRC 1996) and was found to be of minor significance. This determination also included existing nuclear power plants with more than one cooling tower. Information from the GEIS for license renewal is useful for this analysis. Therefore, the potential impact on crops, ornamental vegetation, and native plants from the operation of cooling towers for the Grand Gulf ESP facility would be minimal and mitigation is not warranted.

5.4.1.2 Bird Collisions with Cooling Towers

Although the Grand Gulf ESP site is located adjacent to the Mississippi River and thus along the Mississippi flyway (Bird Nature 2004), no bird collisions have been reported for the existing 159-m (522-ft) GGNS Unit 1 natural draft cooling tower (SERI 2003c). However, there is no plan in place to monitor and report avian fatalities. The conclusion presented in the GEIS (NRC 1996) is that bird collisions with natural draft cooling towers are of small significance at all operating nuclear power plants, including those with multiple cooling towers. Mechanical draft cooling towers are known to cause only negligible avian mortality and were thus not addressed in the GEIS (NRC 1996). Consequently, the incremental number of bird collisions, if any, associated with the operation of wet cooling towers for the proposed Grand Gulf ESP facility, regardless of the type of cooling tower (natural or mechanical draft) employed, would be minimal and mitigation is not warranted.

5.4.1.3 Noise

For both natural and mechanical draft cooling towers, the noise levels from cooling tower operation is anticipated to be 55 decibels at 300 m (1000 ft) (SERI 2003c). This noise level is well below the 80- to 85-decibel threshold at which birds and small mammals are startled or frightened (Golden et al. 1980). Thus, noise from operating natural or mechanical draft cooling towers would not be likely to disturb wildlife beyond the Grand Gulf site perimeter fence, which is over 300 m (1000 ft) from the source. Consequently, the potential impact to wildlife posed by the incremental noise resulting from the operation of one or more wet cooling towers for the Grand Gulf ESP facility would be minimal and mitigation is not warranted.

5.4.1.4 Shoreline Habitat

Because of the small quantity of water withdrawn and discharged during operation relative to the flow in the Mississippi River, adverse impacts to the river shoreline are unlikely. SERI has estimated the water use for the Grand Gulf ESP facility and the areal extent of the thermal plume (SERI 2003c). The staff's independent assessment is presented in Section 5.3.2. The amount of water to be withdrawn from the Mississippi River represents about 0.2 percent of the total lowest minimum flow. The discharge plume, based on the 2.8°C (5°F) above-background isotherm, would range from 8 to 400 m (26 to 1300 ft) in length and 9 to 60 m (30 to 200 ft) in width, depending on season and flow (see Section 5.3.2). No additional shoreline habitat would be exposed from the water removal, and evaporative loss for the proposed facility would be undetectable and not likely to affect use of the shoreline plants or wildlife. Consequently, the potential effects on terrestrial ecology from the drawdown of the Mississippi River resulting from operation of cooling towers for the Grand Gulf ESP facility would be negligible and mitigation is not warranted.

5.4.1.5 Transmission Corridor Management (Cutting and Herbicide Application)

It is currently anticipated that if the maximum generating capacity for the Grand Gulf ESP facility (approximately 3,000 MW(e) (SERI 2003c) were installed, the existing transmission lines would have to be upgraded or additional transmission lines would be required. It is assumed that any transmission line improvements, such as the addition of new lines and pole support structures, for example, would be sited within the existing utility corridors to the greatest extent possible and that no new corridors would be required (see Section 4.4.1.2). However, it is likely that doubling the size of the existing corridors would be required (see Section 4.4.1.2). Existing roads providing access to the current transmission corridors likely would be sufficient for use in any expanded corridor and no new roads would be required.

The staff assumes that the same vegetation management practices currently in effect for the existing GGNS Unit 1 plant power line rights-of-way (such as, bush hogging on an as-needed basis as discussed in Section 2.7.1.1) would be applied to any expanded corridors associated with the Grand Gulf ESP facility. Thus, for the Grand Gulf ESP facility, vegetation management would simply occur along the same corridors but over twice the area. Transmission line right-of-way maintenance was evaluated previously in the GEIS (NRC 1996), and the impact was found to be of small significance at operating nuclear power plants, and these include transmission corridors of variable widths. Consequently, the incremental effects of transmission corridor maintenance posed by doubling the size of the existing corridors for the Grand Gulf ESP facility would be minimal and mitigation other than following best management practices is not warranted.

5.4.1.6 *Bird Collisions with Transmission Lines*

Transmission-line and right-of-way maintenance personnel have not reported dead birds from collisions with the GGNS Unit 1 plant transmission lines. However, there is no plan in place to monitor and report avian fatalities under transmission lines. The conclusion presented in the GEIS (NRC 1996) is that bird collisions with power lines are of small significance at operating nuclear power plants, including transmission corridors with variable numbers of power lines.

Thus, although additional transmission lines could be required for the Grand Gulf ESP facility (see Section 4.4.1.2), these would likely present few new opportunities for bird collisions. The additional number of bird collisions, if any, would not be expected to cause a measurable reduction in local bird populations. Consequently, the incremental number of bird collisions posed by possible addition of new transmission lines for the Grand Gulf ESP facility would be negligible and mitigation is not warranted.

5.4.1.7 Impact of Electromagnetic Fields on Flora and Fauna (Plants, Agricultural Crops, Honeybees, Wildlife, Livestock)

As discussed in the GEIS (NRC 1996), a careful review of the biological and physical studies of electromagnetic fields (EMF) has not revealed consistent evidence linking harmful effects with field exposures. Electromagnetic fields are unlike other agents that have an adverse effect (such as toxic chemicals and ionizing radiation) in that dramatic acute effects have not been observed and long-term effects, if real, are subtle. Therefore, the staff concludes that the impact of EMFs on terrestrial flora and fauna is of small significance at operating nuclear power plants, including those with rights-of-way with variable numbers of transmission lines (NRC 1996). Consequently, the incremental EMF impact posed by possible addition of new power lines for a new nuclear unit or units at the Grand Gulf ESP site would be minimal and mitigation is not warranted.

5.4.1.8 Floodplains and Wetlands on Transmission Corridors

As noted earlier, the existing transmission lines would have to be upgraded or additional transmission lines would be required to support the full PPE. These upgrades likely would be sited within the existing utility corridors to the greatest extent possible. However, these upgrades may double the size of the existing corridors. It is assumed existing roads providing access to the current transmission corridors would be sufficient for use in any expanded corridor and that no new roads would be required.

The effects of transmission line right-of-way maintenance on floodplains and wetlands was evaluated previously in the GEIS (NRC 1996). The impacts were found to be of small significance at operating nuclear power plants, and that included transmission corridors of variable widths. The incremental effects of transmission corridor maintenance on floodplains and wetlands posed by doubling the size of the existing corridors for the Grand Gulf ESP facility would be negligible and mitigation is not warranted.

5.4.1.9 State-Listed Species

<u>Animal Species</u>

The endangered wood stork *(Mycteria americana)* was observed in the summertime on Gin and/or Hamilton lakes 18 years prior to construction of GGNS Unit 1 (AEC 1973). The wood stork should be considered a possible non-breeding transient to the Grand Gulf site and vicinity (SERI 2003c; MNHP 2004a and 2004b). Consequently, the potential impacts from collisions with cooling towers and/or any additional transmission lines associated with the Grand Gulf ESP facility are considered minimal.

Plant Species

The critically imperiled hairy water clover (*Marsilea vestita*) and jug orchid (*Platythelys querceticola*), and the imperiled glade fern (*Diplazium pycnocarpon*) and American bittersweet (*Celastrus scandens*), are known to occur beyond 3.2 km (2 mi) but within 16 km (10 mi) of the Grand Gulf site (MNHP 2004b). The critically imperiled/imperiled Allegheny monkeyflower (*Mimulus ringens*) is known to occur about 17.6 km (11 mi) from the Grand Gulf site (SERI 2003c). Although the known locations of these five species occur at some distance from the Grand Gulf site, they could yet occur onsite. However, potential impacts to these five species from the effects of cooling tower operation (salt drift), transmission line operation, and right-of-way maintenance, as described above, would be considered negligible.

5.4.1.10 Summary of Terrestrial Ecosystem Impacts

The potential impacts of operating wet cooling towers for the Grand Gulf ESP facility on crops, ornamental vegetation, native plants, birds, shoreline, habitat, and any related impacts to State-listed species were considered negligible. The potential impacts of transmission line-right-of-way maintenance (cutting and herbicide application) and similar impacts to floodplains and wetlands, birds, and biota because of EMFs and any related impacts to State-listed species are considered negligible.

The staff reviewed the potential terrestrial ecological impacts of a new generation facility at the Grand Gulf ESP site including the associated heat dissipation system, transmission lines, and associated corridor maintenance. The staff concludes the impacts from operation of the Grand Gulf ESP facility would be SMALL, and further mitigation is not warranted.

5.4.2 Aquatic Ecosystems

The potential impacts to the aquatic ecosystem from operation of the Grand Gulf ESP facility, including water intake, discharge of heated effluents, physical changes to aquatic systems from storm water collection, and transmission corridor maintenance activities were evaluated.

5.4.2.1 Intake System

For aquatic resources, the primary concerns of water intake are the location of the cooling water intake structure and the potential for organisms to be impinged on the intake screens or entrained into the cooling-water system. Impingement occurs when organisms are trapped against intake screens by the force of the water passing through the cooling-water intake structure (66 FR 65255). Impingement can result in starvation and exhaustion, asphyxiation (water velocity forces may prevent proper gill movement or organisms may be removed from the water for prolonged periods of time), and descaling (66 FR 65255). Entrainment occurs when organisms are drawn through the cooling water intake structure into the cooling system. Organisms that become entrained are relatively small benthic, planktonic, and nektonic (organisms in the water column) forms, including early life stages of fish and shellfish, and which often serve as prey for larger organisms (66 FR 65255). As entrained organisms pass through a plant's cooling system, they are subject to mechanical, thermal, and toxic stress.

The U.S. Environmental Protection Agency (EPA) has promulgated regulations that implement Section 316 (b) of the Federal Water Pollution Control Act of 1972 for new and existing electric power producing facilities (66 FR 65255; 69 FR 41576). The regulations apply to facilities that employ a cooling water intake structure and withdraw 50 million gallons per day or more of water from waters of the United States for cooling purposes. The new nuclear unit would be subject to these regulations. The new regulations state that if the facility employs a closed-cycle cooling system, then the facility is deemed to have met the performance standards to reduce impingement mortality and entrainment. SERI has not yet finalized a detailed design of the cooling water system; however, the PPE proposes cooling system designs that employ the use of mechanical draft, natural draft, or a wet-dry hybrid cooling design, all of which are considered a closed-cycle cooling system. Therefore, the staff believes that the ESP facilities will meet the performance standards specified in the new EPA regulations implementing Section 316(b).

The Grand Gulf ESP facility would, as the existing GGNS Unit 1 does, use cooling towers. Losses of fish from impingement and entrainment are significantly less with systems that have cooling towers because relatively small volumes of makeup water are needed for the evaporative loss of water in comparison to systems with once-through cooling. GGNS Unit 1 uses radial wells located along the shoreline of the Mississippi River to collect makeup water through the influx of river and groundwater into the well system. The ESP facility would require more water than can be generated through the radial well network. An intake structure designed to collect water from the river itself is proposed to supply the makeup water for the proposed plant (SERI 2003c).

The proposed intake structure for the Grand Gulf ESP facility and the designs of the other portions of the cooling water system have not been finalized. The flow for makeup water from the Mississippi River is estimated to average 3175 L/s (50,320 gpm), with a maximum peak flow of 5400 L/s (85,000 gpm). The maximum peak flow would equal about 0.2 percent of the river flow at the Grand Gulf site under extreme low-flow conditions in the river (3650 m^3/s [129,000 cfs]). The intake structure for the proposed Grand Gulf ESP facility would be of a different design than the existing radial well system currently used at the GGNS. The intake structure would be located along the upstream shoreline of the existing barge slip. The intake would consist of screened suction pipes supplying the makeup water pumps. The intake screens would be sized so that the average intake velocity through the screen would be less than or equal to 0.15 m/s (0.5 fps). The depth of the intake screens would be such that the removal of water would minimize the uptake of aquatic biota and river debris. The plans for the intake screen are based on a design that is currently being employed at the River Bend Station intake (SERI 2003c). Located on the Mississippi River at River Mile 262, the River Bend Station is a 2894 MW(t) nuclear power plant that uses closed-cycle cooling dissipating heat using mechanical draft cooling towers.

In correspondence with resource agencies associated with the Grand Gulf ESP facility, eight aquatic species that could be affected by operation of the new facility (SERI 2003c) were identified as being of special interest. Four of these species are Federal or State-listed threatened or endangered species, and are discussed in Section 5.4.3: gulf sturgeon (*Acipenser oxyrinchus desotoi*), pallid sturgeon (*Scaphirhynchus albus*), bayou darter (*Etheostoma rubrum*) and crystal darter (*Crystallaria asprella*). Of the remaining fish species, chestnut lamprey (*Ichthyomyzon castaneus*), paddlefish (*Polyodon spathula*), and blue sucker (*Cycleptus elongatus*) were found in the Mississippi River and lakes on the Grand Gulf site in the pre-construction surveys (MP&L 1973). The black buffalo (*Ictiobus niger*) has been reported from the Mississippi River in the vicinity of the Grand Gulf site (Ross 2001) The black buffalo is a species of "special concern" to the State of Mississippi (MNHP 2004a; 2004b). No biologically important areas (e.g., critical habitats) were identified by the resource agencies as being in the immediate vicinity of the Grand Gulf ESP facility (SERI 2003c).

As adults, the fish of special interest described above would be able to avoid the proposed intake structure and not be impinged. Also, the design for the proposed intake structure would create a low-intake velocity that would not be likely to affect fish. Larval stages of fish and eggs of fish that are released into the water column travel at the speed of the current of the river. These organisms are susceptible to entrainment if they are trapped in the flow of an intake structure. A study conducted as part of the pre-construction surveys in 1972-73 found that the numbers of fish larvae in the Mississippi River at Grand Gulf were low (MP&L 1973). No fish of special interest were collected. The amount of water that would be removed by the intake structure is about 0.2 percent of the overall flow in the river.

A comparison of the proposed intake structure for the new facility to the performance of the similarly designed structure at the once-through River Bend Nuclear Station is the only means to evaluate impingement and entrainment. The intake structure at the River Bend Nuclear Station has an intake water velocity of 0.15 m/s (0.5 fps) or lower through the screens. The structure was located within an embayment so as not to block the passage of fish, similar to that proposed for the Grand Gulf ESP facility. The Final Environmental Statement for the River Bend Nuclear Station (NRC 1985) concluded that impingement of organisms on the intake screens was not likely to be a problem because of low-intake velocities. Also, entrained plankton and other non-swimming species would be limited because the highest density of organisms was located on the far side of the river, away from the intake structure (NRC 1985). The staff is not aware of any recent studies of impingement or entrainment conducted at the

River Bend Nuclear Station that indicate the impact to aquatic organisms has changed. Thus, 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 (SERI 2003c).

5.4.2.2 Aquatic Thermal Impacts

The effluent discharge from the Grand Gulf ESP facility would be directly into the Mississippi River, and would be located downstream of the intake embayment to avoid recirculation of effluents into the river water intake. While the design of the structure has not been finalized, it was assumed that the effluent outfall (diffuser) would be located approximately 152 to 183 m (500 to 600 ft) downstream of the intake screens. The proposed diffuser would be a concrete structure extending above the river water line, at approximately 9.1 m (30 ft) above the low water reference plane for the river. The location is thought to be outside the influence of the intake structure and any currents created by the intake embayment and barge slip, based on the configuration at the River Bend Nuclear Station. The effluent from the GGNS Unit 1 would combine with the effluent from new facility into a common discharge (SERI 2003c).

To model the thermal plume created by the proposed effluent discharge into the river, SERI and staff have used the mathematical modeling tool, CORMIX (See Section 5.3.2). The size and temperature of the thermal plume and the river flow was modeled using the parameters that SERI stated for the proposed discharge structure. The staff estimated plumes varying from 8 to 387 m (26 to 1270 ft) in length and 10 to 58 m (33 to 190 ft) in width (Figure 5-1). The size of the plume varied with the summer and winter conditions. The model defines the plume as a 2.8°C (5°F) degree difference in temperature from the ambient water temperature, thus the smaller size of the plume occurred during the summer.

Impacts to the aquatic organisms in the Mississippi River would be minimized by the proposed design of a closed loop cooling system with cooling towers for the Grand Gulf ESP facility. With this design, the majority of the waste heat would be discharged to the atmosphere and not the Mississippi River (SERI 2003c).

Impacts to aquatic organisms from thermal discharge effects were evaluated as part of the design for the existing GGNS. The size of the plume (defined as 2.8°C [5°F] or more higher than the ambient temperature of the river) is small in comparison to the width of the Mississippi River at the Grand Gulf ESP site. Fish and other organisms in the river would move through the plume unencumbered by any structures or physical features that would retain them in the plume. Furthermore, fish will avoid elevated temperatures that are potentially harmful, if possible. The increase in temperature expected at the discharge could be disorienting to organisms moving through the plume, but the temperature is unlikely to be lethal (NRC 1981a; Fry 1971; Dean 1973; Beitinger et al. 2000).

Cold shock occurs when aquatic organisms that have been acclimated to warm water, such as fish in a power plant's discharge canal, are exposed to a sudden temperature decrease. This sometimes occurs when single-unit power plants shut down suddenly in winter. It is less likely to occur at a multiple-unit plant, because a sudden temperature decrease is moderated by the heated discharge from the unit or units that continue to operate. Cold shock mortalities at U.S. nuclear power plants are "relatively rare" and typically involve small numbers of fish (NRC 1996). Cold shock is unlikely to happen at Grand Gulf since the increase in temperature is not relatively large in comparison to the ambient temperature and the volume of the discharge in comparison to the flow of the river is very small. Furthermore, there is no confined area like a discharge canal that will attract the fish to the thermal plume and concentrate the organisms (SERI 2003c).

The thermal plume could affect the movement and distribution of the aquatic biota. The warmer water could attract some organisms during the colder months. Fish could avoid the plume if the temperature were too high. The location and design of the discharge diffuser would not impede fish passage. During normal and minimal flows of the river, the thermal discharge would be along the river bank. During the flood season, the discharge structure would be below the river level. The amount of water and swift current would minimize the time for mixing the effluent with the river water, thus minimizing any potential impact (SERI 2003c).

The location of the discharge diffuser along the bank of the Mississippi River, the flow of the river, and the stabilization of the river shoreline by concrete mats and riprap will minimize other potential impacts to aquatic organisms from the thermal discharge of the proposed facility. Aquatic insects and benthic macrofauna are not in great abundance along the shore of the Mississippi River, based on pre-construction surveys in 1972-73, and the conditions are not thought to have changed over time. Nuisance organisms are not likely to be encouraged since the discharge is into the river flow and the substrate is not suitable for colonization by most of these organisms. The plume in the river is not in a confined area for aquatic organisms and the flow of the river is not encumbered by the proposed design such that predation, parasitism and disease, changes in dissolved gases, or accumulation of contaminants would become an issue (MP&L 1973; NRC 1981a; SERI 2003c).

5.4.2.3 Shoreline Erosion and Other Physical Impacts

As mentioned above, the shoreline of the Mississippi River at the GGNS has been stabilized by concrete mats and riprap. SERI has stated that any disruption of the stabilized banks would be addressed during operation of the Grand Gulf ESP facility. Periodic dredging of the intake embayment to remove sediment deposits and littoral debris carried into the embayment would be necessary. Dredging may lead to temporary increase in turbidity in river. However, these activities would require a permit from the ACE and would have a minimal impact on the existing aquatic resources in the vicinity (MP&L 1973; NRC 1981a; SERI 2003c).

5.4.2.4 Transmission Corridor Maintenance Activities

Maintenance activities along the proposed widened Baxter-Wilson and Franklin transmission corridors could lead to temporary impacts in the waterways being crossed. Plans for maintenance procedures of the widened corridors have not been developed. The impacts to aquatic resources would vary depending on whether physical or chemical means for controlling vegetation in the right-of-ways are used. The maintenance procedures currently being used (primarily bushhogging performed on an as-needed basis) would likely continue for the widened corridors (Energy Services 2004b). NRC expects that SERI will work with the appropriate Federal and State agencies to develop and implement the plans for widening the transmission corridors that will have minimal impacts on the aquatic ecosystems.

5.4.2.5 State-Listed Species

Animal Species

The endangered crystal darter (*Crystallaria asprella*) is found in Bayou Pierre and its tributaries, which flow as close as 3 km (1.9 mi) east of the Grand Gulf site (Ross 2001; MNHP 2004b; Katula 2004). The operation of the Grand Gulf ESP site will not affect the regions where the crystal darter is found. The Franklin transmission corridor crosses Bayou Pierre approximately 5.5 km (3.4 mi) to the south of the Grand Gulf site. NRC expects that SERI will work with the appropriate State agencies to develop and implement the plans for maintenance of the transmission corridors that will have minimal impacts on Bayou Pierre and the crystal darter.

Plant Species

No State-listed aquatic plant species are known to occur within 16 km (10 mi) of the Grand Gulf site (MNHP 2004a; 2004b).

5.4.2.6 Summary of Aquatic Ecosystem Impacts

The final design of the proposed intake and discharge systems for the Grand Gulf ESP facility will consider potential impact to aquatic organisms. The use of cooling towers is a mitigative measure for reducing impacts from impingement and entrainment. The characteristics of the thermal discharge into the river would be reduced through the use of a cooling tower system. The staff therefore concludes that the impact from operations would be SMALL and further mitigation is not warranted.

5.4.3 Threatened and Endangered Species

The potential impacts of operation at the ESP facility, including the transmission corridors, on terrestrial and aquatic Federally listed species were evaluated. These species were identified through correspondence with the U.S. Fish and Wildlife Service (FWS) (FWS 2004a; 2004b) and the National Oceanic and Atmospheric Administration Fisheries (NMFS 2004).

5.4.3.1 Federally Listed Animal Species

Florida Panther - Endangered

Currently no viable populations of the Florida panther *(Puma concolor coryi)* occur outside of Florida (SERI 2003c). Therefore, potential impacts to Florida panthers from cooling tower and transmission line operation and right-of-way maintenance, as discussed in Section 5.4.1, would be minimal.

Bald Eagle - Threatened

Bald eagle (*Haliaeetus leucocephalus*) occurrences have not been reported within 16 km (10 mi) of the Grand Gulf ESP site (MNHP 2004b). Therefore, potential impacts to bald eagles from cooling tower and transmission line operation and right-of-way maintenance, as discussed in Section 5.4.1, would be minimal.

Interior Least Tern - Endangered

The nearest areas occupied by least terns (*Sterna antillarum*) upstream and downstream from the Grand Gulf ESP site (River Mile [RM] 405 [SERI 2003c]) were at Yucatan Dikes (RM 409.8) and Below Bondurant Towhead Dikes (RM 393.0) (ACE 2004a). Therefore, potential impacts to interior least terns from cooling tower and transmission line operation and right-of-way maintenance, as discussed in Section 5.4.1, would be considered minimal.

American Alligator - Threatened

The only Federally listed animal species known to inhabit the Grand Gulf site is the threatened American alligator (*Alligator mississippiensis*). However, the alligator is listed only because of its similarity of appearance to the American crocodile (*Crocodylus acutus*). American alligator populations are considered disjunct, limited to available habitat but stable (52 FR 21059). Although the alligator is present in wetland habitats onsite, potential impacts to the species from the effect of cooling tower and transmission line operation and right-of-way maintenance, as discussed in Section 5.4.1, would be minimal.

Louisiana Black Bear - Threatened

It is likely that the Louisiana black bear *(Ursus americanus luteolus)* also occurs in the vicinity of the Grand Gulf site and could potentially be affected by noise from cooling tower operation. However, if present, the bear likely has become accustomed to noise produced by the existing GGNS Unit 1 cooling tower. Thus, the potential effect from operation of one or more cooling towers for the Grand Gulf ESP facility would be expected to be negligible. The Louisiana black bear would not be expected to be affected by transmission line operation and right-of-way maintenance. Consequently, the potential impacts to the species from cooling towers and transmission line operation and right-of-way maintenance would be negligible.

Gulf Sturgeon - Threatened

The gulf sturgeon *(Acipenser oxyrinchus desotoi)* has not been collected in the region of the Grand Gulf site; however, the Mississippi River is considered part of the historical range for the gulf sturgeon. Therefore, the reach of the river at the Grand Gulf site is likely to be used by the sturgeon as it migrates up and down the river. No known spawning areas for the gulf sturgeon exist near the Grand Gulf site, and thus it is unlikely that this area of the river is used by larval stages of the gulf sturgeon (69 FR 13370; FWS & GSMFC 1995; Ross 2001; NMFS 2004).

The end of the Baxter-Wilson transmission corridor will be within 0.6 km (0.4 mi) of the Mississippi River. The NRC expects that SERI will work with the appropriate Federal and State agencies to develop and implement the plans for maintenance of the transmission corridors that will have minimal impacts on the Mississippi River and gulf sturgeon.

The operational activities of the Grand Gulf ESP facility that could influence the juvenile and adult gulf sturgeon as they migrate through the area would include water removal from the Mississippi River via a water intake structure and discharge of water downstream. The proposed intake structure is estimated to have a through-screen velocity of less than 0.2 m/s (0.5 fps) (SERI 2003c). Juvenile and adult sturgeon could easily escape the planned through-screen velocity at the plant's intake structure and would not become impinged on the screens. The thermal plume created from the discharge of blowdown water from the proposed plant would not likely influence the migration of the sturgeon. The plume is estimated to have a width of 8 to 387 m (26 to 1270 ft), which varies based on the season. The impacts to sturgeon from such elevated temperatures are not known (Beitinger et al. 2000). However, the juvenile and adult stages of the sturgeon could easily avoid the thermal plume if the temperature were too high. Consequently, impacts to gulf sturgeon that could result from operation of the Grand Gulf ESP facility would be unlikely.

Bayou Darter - Threatened

The bayou darter (*Etheostoma rubrum*) is endemic to Bayou Pierre and its tributaries, which flow as close as 3 km (1.9 mi) east of the Grand Gulf site (40 FR 44149; FWS 1990, 2000, and 2004a; Ross 2001). The operation of the Grand Gulf facility will not affect the regions where the bayou darter is found. The Franklin transmission corridor crosses Bayou Pierre. The NRC expects that SERI will work with the appropriate Federal and State agencies to develop and implement the plans for maintenance of the transmission corridors that will have minimal impacts on the Mississippi River and bayou darter.

Fat Pocketbook Mussel - Endangered

The fat pocketbook mussel *(Potamilus capax)* was historically found throughout the Mississippi River drainage from Minnesota to Louisiana. In 2003, the mussel was found near Vicksburg in the Mississippi River, as well as south of the Grand Gulf Site (41 FR 24062; FWS 1989, 2000, 2004a, 2004b, and 2004c; MNHP 2004c). The adult mussels are found in sand and mud as well as in stable substrates of fast flowing rivers. Little information is available on the reproduction of the fat pocketbook mussel; however, they are thought to be similar to other freshwater mussels. When the mussels reproduce, the sperm are released into the water column and the sperm are taken in by the female through siphoning. Fertilized embryos then develop inside the female mussel into a parasitic stage (glochidia). Upon release from the female, the glochidia attach to a fish host and, after a period of time, metamorphose into a free-living juvenile. As the mussel matures, it settles into the sand and mud or onto a stable substrate to grow into an adult. The fat pocketbook mussel population is thought to be a long-period breeder, spawning in summer, retaining golchidia through fall and winter, and releasing them in late spring and early summer. Gravid females have been found from June through October (CMI 1996).

The end of the Baxter-Wilson transmission corridor will be within 0.6 km (0.4 mi) of the Mississippi River. The NRC expects that SERI will work with the appropriate Federal and State agencies to develop and implement the plans for maintenance of the transmission corridors that will have minimal impacts on the fat pocketbook mussel.

Operation of the Grand Gulf ESP facility will include water removal from the Mississippi River via a water intake structure and discharge of water downstream. While the intake screens would be sized so that the through-screen velocity is less than 0.2 m/s (0.5 fps) (SERI 2003c), the sperm and free-living juvenile stage of the mussel could be entrained by the water intake system of the proposed plant. The area influenced by the flow into the intake structure is not great in comparison to the entire region of the Mississippi River where the mussel might occur. Not enough is known about the mussel's life history to determine if the increased temperature within the discharge plume of the proposed plant would have any impact; however, it would be highly unlikely. The area that would be affected by the increased temperature from the discharge plume is small and the warmer water is buoyant and would not normally impinge on the river bottom. Increased water temperature might affect the abundance of food for the mussels and might change the period for reproduction. It is likely that the impact of a thermal discharge from a new nuclear facility would be minimal because the region of the shoreline habitat in the Mississippi River that would change with operation is small compared to the entire shoreline habitat available for this species.

Pallid Sturgeon - Endangered

Pallid sturgeon *(Scaphirhynchus albus)* have been collected in the region of the Grand Gulf ESP site. Adult pallid sturgeon have been caught in regions with moderate to strong currents, a sand or sand/gravel substrate, similar to the main channel of the Mississippi River as it passes by the Grand Gulf site. Little is known about the use of the Mississippi River in the area of the Grand Gulf ESP site for spawning by the pallid sturgeon. Spawning habitat may exist within 16 km (10 mi) of the Grand Gulf ESP site. There also is little information about the use of the reach by larvae or juvenile pallid sturgeon (55 FR 36641; FWS 1993, 2000, and 2004a; Ross 2001; Hartfield 2003; LDOTD 2003; SERI 2003c).

The end of the Baxter-Wilson transmission corridor will be within 0.6 km (0.4 mi) of the Mississippi River. The NRC expects that SERI will work with the appropriate Federal and State agencies to develop and implement the plans for maintenance of the transmission corridors that will have minimal impacts on the Mississippi River and pallid sturgeon.

The operation of the Grand Gulf ESP facility in the vicinity of the pallid sturgeon's habitat would include water removal from the Mississippi River with a water intake structure and discharge of water downstream. The adult and juvenile sturgeon would likely not be impinged on the screens of the intake structure because they would easily be able to avoid impingement from the anticipated through-screen velocity of water (less than 0.2 m/s [0.5 fps]). Larval sturgeon (less than 3 cm [1.2 in.] in size) are thought to drift along the bottom of the river (less than 0.5 m [1.6 ft]) from the bottom) at the velocity of the river (Braaten and Fuller 2005). If the intake screens are designed to be in the upper portion of the water column in the Mississippi River, the impact on pallid sturgeon would likely be minimal.

Discharge at the downstream structure would create a thermal plume that might influence the passage of pallid sturgeon on the eastern shore of the Mississippi River. If the sturgeon, at any life stage, were to drift through the thermal plume at the average velocity of the river, then the individual would spend from 13 seconds to 15 minutes at temperatures 2.8°C (5°F) or more above ambient temperature. The estimate of residence time in the plume is based on a river velocity of 0.4 to 0.6 m/s (1.3 to 2 fps) (SERI 2003c) and a thermal plume estimated by staff to have a length of 8 to 387 m (26 to 1270 ft), which varies based on the season. The impact to sturgeon from such elevated temperatures is not known (Beitinger et al. 2000). However, the juvenile and adult stages of the sturgeon could easily swim and avoid the thermal plume if the temperature were too high. There are no known spawning areas in the reach of the Mississippi River that would be influenced by the thermal plume, and thus the number of larval pallid sturgeon using this area of the Mississippi is likely to be low. If the higher temperatures are detrimental, the larval stages of the pallid sturgeon that are drifting with the river current could become disoriented, but the temperature increase would not likely be lethal (Beitinger et al. 2000). Therefore, the impacts on pallid sturgeon from the discharges at the Grand Gulf ESP plant would likely be minimal.

5.4.3.2 Federally Listed Plant Species

No impacts to Federally listed or proposed threatened or endangered plant species–either terrestrial or aquatic–are anticipated from operation of the Grand Gulf ESP facility because no such plant species are known to occur on or within 16 km (10 mi) of the Grand Gulf ESP site (MNHP 2004b; FWS 2004a).

5.4.3.3 Summary of Threatened and Endangered Species Impacts

The staff concludes the impacts to terrestrial and aquatic Federally listed species from operation of the Grand Gulf ESP facility would be SMALL, and no additional mitigation would be warranted.

5.5 Socioeconomic Impacts

The socioeconomic impacts from operating the Grand Gulf ESP facility and from the activities and demands of the operating workforce on the surrounding region include the potential impacts on individual communities, the surrounding region, and minority and low-income populations. To assess the potential impacts of operations, the staff evaluated the physical impacts, population impacts, and impacts on community characteristics.

5.5.1 Physical Impacts

The potential physical impacts on the nearby communities resulting from operation of the new units includes noise, odors, exhaust, thermal emissions, and visual intrusions.

5.5.1.1 Workers and Local Public

The town of Port Gibson, located about 10 km (6 mi) southeast of the Grand Gulf site, is a small rural community that includes small businesses, houses, and farm buildings and has a population of 1840, according to the 2000 U.S. Census (USCB 2004c). Because of Port Gibson's distance from the Grand Gulf ESP site, its residents would not experience any physical impact from operation of the new units.

The new units would produce noise from the operation of pumps, transformers, turbines, generators, and switchyard equipment. The noise levels would be controlled in accordance with applicable local regulations. Most equipment would be located inside structures, reducing the outdoor noise level.

Two types of cooling systems will be considered for a new facility at the Grand Gulf ESP site: natural draft cooling towers and mechanical draft cooling towers (SERI 2003c). Natural and mechanical draft cooling towers emit broadband noise. Therefore, the noise associated with the cooling towers would be largely indistinguishable and nonobtrusive. The anticipated noise levels from either of the cooling tower options are not expected to be significantly greater than background levels. Noise levels below 60 to 65 decibels are not considered to be significant because these levels are not sufficient to cause hearing loss (NRC 1996).

Based on the PPE (see Appendix I), both natural and mechanical draft cooling towers have anticipated noise levels of 55 decibels at 300 m (1000 ft). The proposed location of the cooling towers would place them approximately 300 m (1000 ft) from the nearest site boundary on the north side of the property. The resulting operational noise level from the addition of a new unit or units would not significantly increase the noise level at the property line. Therefore, the noise level at the property line is expected to remain below the limit of 65 decibels recommended in NUREG-1555 (NRC 2000a). In general, power plant sites do not result in offsite noise level increases of more than 10 decibels above background levels. Therefore, background noise levels are expected to range from 45 to 55 decibels at the nearest site boundary.

Noise levels below 60 to 65 decibels are considered to be of SMALL significance (NRC 1996). Therefore, the noise impact at the nearest residence would be SMALL and no mitigation would be warranted. Although noise would not cause adverse offsite impacts, a noise study would be performed as part of the final selection of the cooling system, and the results described in the COL application.

Ambient noise heard by recreational users of Grand Gulf Military Park under normal conditions includes some noise from GGNS Unit 1 plant. The noise level generated by the operation of the new unit or units would not affect the recreational use of Grand Gulf Military Park.

In Section 2.7 of NRC Regulatory Guide 4.2 (NRC 1976), the staff states that an assessment should be made of the ambient noise level within 8 km (5 mi) of any proposed nuclear facility. Particular attention is directed toward obtaining acoustic levels associated with high voltage transmission lines. An assessment of the impact from the transmission system would be studied at a suitable time within future planning work and after a decision has been made to proceed with the new capacity.

The new unit or units would have standby diesel generators and auxiliary power systems. Air permits acquired for these generators would ensure that air emissions comply with regulations. In addition, standby diesel generators would be operated on a limited short-term basis.

5.5.1.2 Buildings

Operations activities would not affect any offsite buildings. Onsite buildings have been constructed to safely withstand any possible impact, including shock and vibration, from operations activities associated with the proposed activity. Except for GGNS Unit 1 structures, no other industrial, commercial, or residential structures would be directly affected by the construction of a new facility.

5.5.1.3 Roads

Commuter traffic would be controlled by speed limits. The access roads to the Grand Gulf ESP site would be paved. Good road conditions and appropriate speed limits would minimize the noise level generated by the workforce commuting to the GGNS Unit 1 site.

5.5.1.4 Aesthetics

The nearest residential area is about 500 m (1650 ft) from the Grand Gulf ESP site and is shielded by woods. Given this distance, residents near the site would not have a clear view of the new unit or units. Some structures of the new facility may be visible from the Mississippi River (for example, intake structure, cooling towers) and from Grand Gulf Military Park. Bluffs on the site east of the Mississippi River are about 20 m (65 ft) above the average river level (Entergy 2003c), and dense forest throughout the vicinity would help conceal the new structures.

The natural draft cooling towers, if used, would be about 170 m (550 ft) tall, so some visual impact would result. The mechanical draft cooling towers would be plume-abated. Therefore, no visible plumes would occur under most meteorological conditions. If natural draft cooling towers are used, a visible plume would be inevitable. The reactor design and ancillary facilities (cooling water system) have not yet been selected. Depending on the design selected, a visual impact study would be performed and described in the combined license application. Because the Grand Gulf ESP site is already aesthetically altered by the presence of an existing nuclear power plant (GGNS Unit 1) with a natural draft cooling tower along with its visual plume, only slight adverse impacts to visual aesthetics of the site and vicinity are expected from the operation of a new facility.

During normal plant operation, the new unit or units would not use a large amount of chemicals that would generate odors exceeding the odor threshold value.

5.5.1.5 Summary of Physical Impacts

Based on the information provided by SERI, staff interviews with local public officials, and its own independent review, the staff concludes that the physical impacts of operation of the new units at the Grand Gulf ESP site would be SMALL, and that additional mitigative actions beyond those identified by SERI are not warranted.

5.5.2 Demography

The demographic impacts from the operation of new unit or units at the Grand Gulf ESP site would be associated with employment related to the daily operation of the new unit(s) and with resulting effects on the surrounding region.

Approximately 1160 workers would be required for the operation of the new units, about 50 percent more than are currently required for the existing GGNS Unit 1. A conservative estimate of 50 percent of these would be expected to in-migrate to the region, accompanied by their families. Assuming an average family size of four, 2380 people could be expected to move to the region from other areas and would represent both a source of income to the community and a potential demand on community services, such as schools and police protection.

The expected number of permanent workers needed to operate the new units and their families generally would be a small fraction of the total projected population growth in the region. Assuming that the geographic distribution of new employees would be the same as for the existing units, Table 5-4 shows the potential geographic distribution of new employees and the potential percentage increase for each jurisdiction's population represented by facility-related population if facility operations started today. Proportionally more new migrants, however, are expected to reside in the Vicksburg area rather than in Port Gibson because of the wider availability of housing and services in Vicksburg (SERI 2003c).

Based on the information provided by SERI, staff interviews with local public officials, and its own independent review, the staff concludes that the demographic impacts of operation of the new units at the Grand Gulf ESP site on most of the region would be SMALL. 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, which would be a MODERATE to LARGE demographic impact.

Table 5-4. Potential Increase in Resident Population Resulting from Operations at the Grand Gulf Early Site Permit Site

Jurisdiction	Percent of Current Workforce by Location	Facility-Related Increase in Population	Year 2000 Census Population	Percentage Increase	Facility-Related Households	Year 2000 Vacant Housing Units
Vicksburg	46.4%	1105	26,407	4.2%	269	1290
Port Gibson	14.6%	347	1840	18.8%	85	95
Other locations						
Clinton	7.3%	173	23,347	0.7%	42	571
Fayette	3.9%	92	2242	4.1%	22	68
Natchez	3.3%	78	18,464	0.4%	19	888
Brookhaven	2.7%	65	9861	0.7%	16	430
Jackson	2.7%	65	184,256	0.0%	16	7837
Wesson	2.3%	54	1693	3.2%	13	41
Hazelhurst	1.7%	41	4400	0.9%	10	158
All Other	15.1%	360	NA	NA	88	NA
Total	**100.0%**	**2380**			**580**	

Source of resident locations: SERI 2004a
Source of Year 2000 Census Population: USCB 2004c.

5.5.3 Social and Economic Impacts

The social and economic impacts to the surrounding region as a result of operating the Grand Gulf ESP facility were evaluated, assessing the impacts during a 40-year operating license period.

5.5.3.1 Economy

The main economic impacts of the new workers and their families on the area would be related to taxes, housing, and requirements for goods and services. Economic impacts related to the operation of the new units would be associated mainly with payment of the plant property taxes.

A detailed description of local and regional employment trends is provided in Section 2.8. December 2002 area labor force data indicate that Claiborne County has an unemployment rate of 12.4 percent (SERI 2004a). General trends for Claiborne and the contiguous counties indicate the total number of jobs across many of the surveyed industries have decreased from 1990 to 2000 (USCB 2004a, 2004b). Operation of the new facility could generate jobs for the residents of the area. The addition of 1160 permanent workers traveling into the area would also increase demand for commercial retail establishments, which would provide some additional employment. The overall impact on the economy of the region (including Claiborne County and surrounding counties – especially Vicksburg and Warren County) would be positive.

5.5.3.2 Taxes

The assessed value of the new unit or units would exceed that of the existing unit, which has depreciated with time. It is not possible at this time to estimate the actual taxes that would be paid to the regional governments or the expenditures regional governments would incur to accommodate the workforce. The expenditures by the regional governments would, in part, be related to the size and age distribution of the families of the new employees. Based on the assumption that the new employees would come from outside the region, the regional governments would experience both outflows and inflows of monies as a result of the operation of the new unit or units. Expenditures would be related to the impact on the local and regional infrastructure because of the increased use of the school, recreational, medical, fire and police, and transportation systems. The types of non-income taxes and their bases can be addressed and are presented below.

Sales, Use, and Income Taxes

Sales, use, and income taxes would be generated by retail expenditures (restaurants, hotels, and merchant sales) of operations workers. Although there is a small local sales and use tax, the State would collect most of these, both from individual workers and from corporate entities in the general region of the site. No estimate is available of the day-to-day expenditures during operations that would occur in the region.

Property Taxes

The jurisdictions shown in Table 5-4 would benefit from additional property tax revenues from two sources associated with the Grand Gulf ESP facility: property tax on the new unit or units and property tax on land owned by the new employees. Because of the manner in which Mississippi treats the tax base of nuclear power facilities, local property taxes might or might not be levied for the increase in value of the Grand Gulf site because of the new unit or units. The property tax payments to Claiborne County are discussed in Section 2.8 and Section 4.5, and are identified as a potential beneficial impact for the State of Mississippi or for Claiborne County, depending on tax treatment of the new plant. The addition of the new unit or units to the Grand Gulf site would substantially increase the property tax payments in the State.

The existing units have contributed 83 percent of the property taxes paid to Claiborne County over the past decade but have not necessarily reduced assessment rates relative to those of neighboring counties. The construction and operation of the new unit or units may or may not serve to maintain the very high percent of the property taxes in Claiborne County paid by Entergy.

The potential effect of future electric utility deregulation within Mississippi is not known. However, if Mississippi were not to regulate the Grand Gulf ESP facility as a public utility, it is reasonable to conclude the facility could be treated as ordinary corporate assets subject to normal local property taxation. If so, the new unit or units would result in a substantial increase in property tax payments to Claiborne County.

If the final capital cost were in the range of $1000 per installed kilowatt, the maximum capacity 3000 MW(e) facility would (at completion) have an approximate capital value of $3 billion. At Claiborne County's current property tax rate of 65.01 mills and 15 percent assessment ratio for nonresidential property (SERI 2004a), the tax yield would be about $29 million per year, a very significant positive impact.

5.5.4 Infrastructure and Community Services

Infrastructure and community services include transportation, recreation, housing, public services, and education.

5.5.4.1 Transportation

Roads within the vicinity of the Grand Gulf ESP site would experience a temporary increase in traffic at the beginning and the end of the workday period. However, the current road network has sufficient capacity to accommodate the increase, as discussed in Section 4.5.1.3. Section 4.5.1.3 shows a number of permanent changes to the regional and local transportation network that would reduce any potential adverse impacts generated by the influx of 3150 construction workers during construction of one or two new units. These permanent changes would also reduce or eliminate any potential adverse impacts that could be generated by the operating workforce of 1160 for the new units, 50 percent of whom are expected to have relocated with their families into the region.

5.5.4.2 Recreation

The facility-related population increase in the potentially affected counties is expected to be about 2380 people (SERI 2003b). To accommodate normal increases in population, which are expected to be much larger, the surrounding counties would need to address and fund new recreational areas as they update their comprehensive plans. The GEIS (NRC 1996) concludes the impacts of existing employees and their families on parks and other recreational areas within a typical region are small. This likely would also apply to the employees of the new units and their families who would relocate to the area because they represent a small fraction of the projected population growth for the area.

A detailed description of local tourism and recreation is provided in Section 2.8. Because of the proximity of the Grand Gulf Military Park to the north of the Grand Gulf ESP site, it is possible that increased traffic resulting from the influx of site workers would indirectly affect the traffic flow to Grand Gulf Military Park, and that there would be minor effects on noise and visual aesthetics in the park. However, the majority of tourists visit the park on the weekends when fewer people report for work at the Grand Gulf ESP site (SERI 2004a, Attachment 14). In addition, the traffic associated with the Grand Gulf site is limited to specific times of the day, during shift changes, which would minimize the impact of potential Grand Gulf ESP site traffic on the Grand Gulf Military Park. Case studies conducted during operation of several nuclear power facilities indicated no adverse impact to local tourism and recreation as a result of the operation of existing nuclear power plants (NRC 1996).

5.5.4.3 Housing

The number of housing units required to support the expected permanent workforce migrating into the area would be 580, half of the 1160 new employees (see Table 5-4). In Port Gibson, plant-related migration would absorb a substantial portion of the vacant housing stock, if today's residence pattern of GGNS workers were the same for new workers and if the population increase were to happen today. There is no accurate way to estimate the number of housing units that would be available in the region in the year 2030, the year a new ESP facility would be expected to begin operations (SERI 2003c). However, the counties in the vicinity of the Grand Gulf ESP site and within the region are addressing the needs of the projected increases in population and an adequate number of units likely would be available, especially in the larger towns. Because the new workforce incomes would be high relative to other incomes in the region, it can be expected that the housing purchases would be on the high end of the price range. The new workers and their families would be about 9.4 percent of the population growth SERI (2003c) has projected for the area within 80 km (50 mi) over the next 30 years (see Table H-2 in Appendix H). Therefore, the impact of the property taxes paid for housing by these families overall would be a small benefit to the region, but possibly locally more important in Port Gibson and Vicksburg, Mississippi, if they concentrate in those cities.

Currently, 100-200 additional planned outage workers conducting refueling of the reactor(s) would be onsite for a period of 30 to 40 days per outage (SERI 2003c). It is expected the planned outages for the new unit or units would be scheduled so that multiple units would not be worked on simultaneously. This would also reduce the potential for exceeding the availability of short-term housing in the immediate vicinity of the Grand Gulf ESP site. The temporary outage staff for the existing GGNS typically stays in area hotels or trailer courts dispersed throughout the region. Therefore, no single community would be overburdened by the influx of temporary workers. It is expected the increased frequency of the temporary outage staff would not significantly affect the region.

5.5.4.4 Public Services

Water Supply and Waste Treatment

Detailed information regarding the current sewer and water services available at Grand Gulf site is provided in Section 2.8.2.6. GGNS Unit 1 currently operates an onsite water and sewer system for treatment of sanitary waste. Additional water and sewage treatment facilities would be constructed as part of a new facility to support future operations. However, the designs for water and sewer treatment facilities for the ESP facility have not been selected. Because a new facility would use onsite water and sewer services, the operation of a new facility at the Grand Gulf site would not burden public utilities in surrounding communities. In general, case studies indicate minimal impact to public utilities resulting from plant operation (NRC 1996).

The in-migration of additional employees and their families would increase the demand for public utilities in the communities where these employees reside. As was the case with the construction of GGNS Unit 1, it is expected these workers would reside in or around the more populous areas such as Vicksburg, Mississippi, because of the public utilities and other services available. The water and sewer services in Vicksburg are currently at 70 percent of total capacity (SERI 2004a). Therefore, the addition of plant personnel to this or other comparable communities would not be expected to overburden public utilities. The possible exception would be Port Gibson where, if population increased by 18.8 percent (Table 5-4), water use could increase to close to the maximum capacity of the system. Because operational staff in-migrating to the region for a new facility would likely settle in numerous surrounding communities, the potential impacts to public utilities of any one community would be expected to be minimal. Increases in sales, property, and income taxes generated by the population in-migrating to specific communities would at least partially offset costs associated with any upgrades a community may find necessary. The impacts of relocated families on these water and sewer systems would not be significant.

Police, Fire, and Medical

The police and fire departments within 16 km (10 mi) of the Grand Gulf ESP site are part of the existing emergency response plan for the existing units. The Claiborne County Sheriff and other local police departments are responsible for the proper evacuation of the area in the event of an emergency at the Grand Gulf site. This would continue to be the case should the new units become operational. Despite the transfer of funds from the State government to

Claiborne County, there is substantial local concern about the adequacy of emergency resources to implement the current evacuation plan and the ability of local officials to carry it out (Scott 2004).

The nearest medical facilities generally consist of local physicians' offices and the 32-bed hospital in Port Gibson, Mississippi. However, major medical facilities are available in Vicksburg, Natchez, and Jackson, Mississippi. These facilities are readily accessible to county residents and have held successful emergency drills with the GGNS. The surrounding counties assess the need for additional medical, fire, and police facilities and add new facilities or expand existing facilities as needed. For example, the Warren County hospitals and medical facilities recently have accommodated economic and population growth from 1800 new jobs at two Japanese-owned companies (Scott 2004). The increase of 580 (half of the total 1160) new resident employees and their families would represent a small fraction of the expected population growth in the multi-county region around the Grand Gulf ESP site. However if new residents were to concentrate in Claiborne County, the increase in Claiborne County population might be quite significant relative to the current population. Therefore, while in general no unforeseen demands on medical facilities would result from the operation of the new units, there may be increased demands for beds in Port Gibson's hospital as well as increased hours of operation. Financing the potential hospital upgrades, would require additional revenue (Scott 2004)..

Detailed information concerning the capacity of the hospitals in Claiborne County and the adjacent Mississippi counties is provided in Section 2.8.2.6. It is expected that a majority of the future employees will reside in more populous areas located in neighboring counties (for example, Vicksburg, Warren County). Therefore, the influx of plant workers is not expected to overburden Claiborne County health or social services. Case studies of several nuclear power plants show only a small impact on local social services associated with the influx of plant workers (NRC 1996).

5.5.4.5 Education

Table 2-16 shows the number of schools within the Mississippi counties surrounding Claiborne in the Grand Gulf ESP site area. As was the case with GGNS Unit 1, new workers would likely move to the more populous areas in the surrounding communities where they would have access to more developed public services. Workers with school-aged children would be interested in communities with good school districts. The largest school district near the Grand Gulf ESP site is in Vicksburg, Mississippi. The current student population at Vicksburg is 9180 (NCES 2002). Given sufficient lead times, school officials in Warren County are not concerned about absorbing the potential increase in students (Scott 2004). The impact on Vicksburg schools would likely be small.

Port Gibson has only 1195 students. If 14.5 percent of new workers moving to the area located in Port Gibson and their family size is assumed to be four (two of whom are students), the impact in Port Gibson would be 168 students, a 14 percent increase. This would be a MODERATE impact (assuming some impact assistance from the State) on Port Gibson schools were it to happen. Part of this increase could be absorbed by private schools located in the area. It is also likely that facility workers would choose to live in the more populous communities rather than in Port Gibson. Any adverse impact to local school districts because of the influx of plant workers into a community would likely be at least partially offset by increased sales, personal property, and income tax revenues paid by facility personnel.

5.5.5 Summary of Socioeconomic Impacts

Based on information supplied by SERI staff interviews conducted with public officials in Claiborne, Jefferson, and Warren counties, concerning the current availability of services, and additional taxes that would likely compensate the need for additional services, the staff concludes that the operations impacts on the local economy would be positive and SMALL in most of the region and probably MODERATE and positive in Warren County (Vicksburg). The estimated workforce of 1160 would have a SMALL effect on the transportation network in the vicinity and region because permanent transportation mitigation measures proposed for the construction of the new units would also result in much reduced transportation-related impacts during operation of the new units. The effect on tax revenues would be positive and SMALL except for property tax receipts in Claiborne County, which could be positive and anywhere from SMALL to LARGE, depending on how the State of Mississippi treats the plant for tax purposes. The site is relatively isolated, industrial in nature, and well masked by forest in most directions so the impacts on aesthetics would be SMALL, as would the impacts on recreation. The impacts on public services and infrastructure would be SMALL throughout the region, unless Claiborne County draws a substantial share of the in-migrating construction workforce, which is not expected. In that case, the impacts on housing and education in Claiborne County could be MODERATE and negative.

5.6 Historic and Cultural Resources Impacts

The National Environmental Policy Act of 1969 (NEPA) requires Federal agencies to take into account the potential effects of their undertakings on the cultural environment, which includes archaeological sites, historic buildings, and traditional places important to local populations. The National Historic Preservation Act of 1966 (NHPA), as amended through 1992, also requires Federal agencies to consider impacts to those resources if they are eligible for listing on the National Register of Historic Places (such resources are referred to as "Historic

Properties" in NHPA). As outlined in "Coordination with the National Environmental Policy Act," 36 CFR 800.8, the NRC is coordinating compliance with Section 106 of the NHPA in meeting the requirements of NEPA.

Because all ground-disturbing activities that could have an impact on historic or archaeological resources would probably occur during the construction phase, there would be limited potential for impacts during operation of one or more additional units at the Grand Gulf ESP site. Any new excavations that might occur would be covered by cultural resource-specific written directions in site-wide Excavation and Backfill Work Procedures, which will involve an immediate stop work order should archaeological, historical, or other cultural resources be uncovered during excavation. The construction supervisor would be responsible for ensuring the work stoppage and for notifying the Environmental Compliance Coordinator of an inadvertent discovery. In the event that an unanticipated discovery is made, site personnel would be instructed to notify the State Historic Preservation Officer and would consult with him or her in conducting an assessment of the discovery to determine if additional work is needed. Therefore, the staff concludes that the impacts from operations would be SMALL, and no additional mitigation considerations would be warranted.

5.7 Environmental Justice Impacts

Environmental justice refers to a Federal policy under which each Federal agency identifies and addresses, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority or low-income populations. On August 24, 2004, the Commission issued its policy statement on the treatment of environmental justice matters in licensing actions (69 FR 52040). Section 2.10 discusses the locations of minority and low-income populations around the Grand Gulf ESP site and within the 80-km (50-mi) radius.

As discussed in Section 4.7, the staff examined the geographic distribution of minority and low-income populations recorded during the 2000 U.S. Census (USCB 2004c) within 80 km (50 mi) of the Grand Gulf ESP site, encompassing 25 counties and parishes. The analysis was also supplemented by field inquiries to the planning department and social service agencies in Claiborne, Warren, and Jefferson counties.

Minority and low-income areas identified from the census block group data are shown graphically in Figures 2-12 and 2-13, respectively. However, it is also clear from examining census block group data that most of the counties and parishes within 32 km (20 mi) of the Grand Gulf ESP site have large African-American populations, whether or not they meet the usual plus-20 or -50 percent criteria.

The scope of the review as defined in NRC Guidance (NRC 2001 and 2004b; 69 FR 52040) should include an analysis of the impacts on minority and low-income populations, the location and significance of any environmental impacts during operations on populations that are particularly sensitive, and any additional information pertaining to mitigation. The descriptions to be provided by this review should state whether the impacts are likely to be disproportionately high and adverse and to evaluate the significance of such impacts.

With the locations of minority and low-income populations identified, the staff proceeded to evaluate whether the environmental impacts of the proposed action could affect these populations in a disproportionate manner. Based on staff guidance (NRC 2001 and 2004b; 69 FR 52040), air, land, and water resources within about 80 km (50 mi) of the Grand Gulf ESP site were examined. Within that area, potential environmental impacts could affect human populations. All physical environmental impacts would be SMALL for the general population, and the socioeconomic impacts varied from LARGE beneficial to MODERATE adverse, depending on how the new facility would be treated for tax purposes and where the plant-related population actually would decide to reside.

5.7.1 Environmental Impacts

The pathways through which the environmental impacts associated with the new units could affect human populations are discussed in each associated section. The staff then evaluated whether minority and low-income populations could be disproportionately affected by these impacts. The staff found no unusual resource dependencies or practices, such as subsistence agriculture, hunting, or fishing, through which the populations could be disproportionately affected. In addition, the staff did not identify any location-dependent disproportionate impacts affecting these minority and low-income populations. The staff concludes that offsite impacts to minority and low-income populations from operating new units at the Grand Gulf ESP site would be minor, and no additional mitigation actions are warranted.

5.7.2 Human Health Impacts

Operation of the new facility would result in slight contributions to radiation dose to members of the public living in the vicinity of the site, far below that associated with natural radiation background levels.

As presented in Section 5.9, the critical pathways to humans for routine radiation releases from facilities at the Grand Gulf ESP site are exposure from air, inhalation of contaminated air, drinking milk from a cow that feeds on open pasture near the site, eating vegetables from a garden near the site, and eating fish caught in the Mississippi River. The results of the normal operation dose assessments indicate that the maximum individual dose for these pathways was found to be insignificant, well below the regulatory guidelines in Appendix I of 10 CFR Part 50 and the regulatory standards of 10 CFR Part 20.

The evaluation of postulated accidents is provided in Section 5.10 and demonstrates that radiological consequences of these accidents would meet the site acceptance criteria of 10 CFR 50.34 and 10 CFR Part 100 for the exclusion area boundary and low population zone boundary. In demonstrating compliance with these criteria, an adequate level of protection would be provided. There would be no significant adverse health impacts to members of the public, and, therefore, minimal negative and disproportionate health impacts on minority and low-income members of the public.

5.7.3 Socioeconomic Impacts

Potential adverse socioeconomic impacts during operations include potential adverse impacts on air quality, aesthetics, schools, transportation, public safety, social services, public utilities, and recreational resources. None of the potential physical impacts attributable to operation of a new facility were judged to be significant to most of the region. However, depending on where new in-migrating employees decide to live, Claiborne County might have to upgrade several components of its social services and public utilities infrastructure. It is not clear how the new nuclear facility would be treated for property tax purposes, so it is not clear whether Claiborne County would receive property taxes, sales, and use taxes, or other taxes and public monies commensurate with the costs of its additional emergency management and public services obligations. The net financial burden may fall on local residents and taxpayers, most of whom are minority and low-income persons.

5.8 Nonradiological Health Impacts

This section discusses the nonradiological health impacts of operating the proposed new unit(s) at the Grand Gulf ESP site. Health impacts to the public from the cooling system, noise generated by unit operations, and EMFs are discussed. Health impacts from the same sources are also evaluated for workers at the new units. The health impacts from radiological sources during operations are discussed in Section 5.9.

5.8.1 Thermophilic Microorganisms

The SERI environmental report (SERI 2003c) noted thermal discharges to the Mississippi River would result from the use of cooling towers. Such discharges have the potential to increase the growth of thermophilic microorganisms both in the cooling tower and river. The types of thermophilic microorganisms sometimes found where elevated moist temperatures exist are

Salmonella sp., *Psudomonas aeruginosa*, *Legionella* sp., and free-living amoebae of the genera *Naegleria, Acanthamoeba*, and *N. fowleri.* Serious illness and even death can occur when there is high exposure to these microorganisms.

As described in the GEIS (NRC 1996), nuclear power plants that use cooling ponds, lakes, or canals and those that discharge to "small rivers" have the greatest chance of affecting the public from increased in thermophilic microbial populations. A small river is defined as one with an average flow rate of less than 2830 m^3/s (100,000 ft^3/s). The average flow of the Mississippi River between the years 1973 and 1999 was about 20,700 m^3/s (730,000 ft^3/s) and, therefore, does not meet the criterion of a small river (SERI 2003c). GGNS Unit 1 and up to two new units would be discharging thermal effluent into the river. SERI reviewed data from the Center of Disease Control for the years 1991 through 2000 and found no incidences of waterborne diseases in Mississippi that were associated with the Mississippi River (SERI 2004).

5.8.2 Noise

In the GEIS (NRC 1996), the staff discusses the environmental impacts of noise at existing nuclear power plants. Common sources of noise from plant operation include cooling towers, transformers, and loud speakers with intermittent contributions from auxiliary equipment. These noise sources are generally sufficiently distant from the plant boundaries that the noise generated by the plant is attenuated to near ambient levels before reaching critical receptors outside the plant boundary.

GGNS Unit 1 has a closed-cycle cooling system that uses a natural draft cooling tower. This system does not contribute significantly to noise at the plant site or at the plant boundary. SERI's environmental report (SERI 2003c) specifies that additional units at the proposed Grand Gulf ESP site would be cooled by wet cooling towers. If the ESP is approved and cooling towers are used at the site, the towers would be the primary noise source on the site in addition to the existing cooling tower for GGNS Unit 1.

Sound surveys made prior to startup of the GGNS Unit 1 plant showed that ambient noise levels at the site generally varied from about 40 to 60 decibels during the course of a day (SERI 2003c). SERI (2003c) does not indicate any more recent sound surveys. Assuming the PPE cooling tower noise level of 55 decibels at 300 m (1000 ft) for the existing cooling tower, the staff estimates that the background noise level at the exclusion area boundary closest to the postulated location for new cooling towers has increased by less than 1 decibel, an increase in the background noise level that would not be perceptible.

At its closest point of approach, the site fence line is approximately 300 m (1000 ft) from the postulated location of the cooling towers at the Grand Gulf ESP site. Using this distance and the PPE cooling tower noise specification, the noise level at the closest point on the fence line is expected to increase to about 62 decibels. The noise level at 500 m (1650 ft), the closest residence, would be less than 60 decibels, and the noise level at 800 m (0.5 mi) from the cooling towers is expected to be about 55 decibels. For context, Tipler (1982) lists the sound intensity of a quiet office as 50 decibels, normal conversation as 60 decibels, busy traffic as 70 decibels, and a noisy office with machines or an average factory as 80 decibels. Construction noise (at 3 m [10 ft]) is listed as 110 decibels, and the pain threshold is 120 decibels.

According to the GEIS (NRC 1996), noise levels below 60 to 65 decibels are considered to be of small significance. More recently, the impact of noise was considered in the *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities, Supplement 1 Regarding the Decommissioning of Nuclear Power Reactors* (NRC 2002a). In that document, the criterion for assessing the level of significance was not expressed in terms of sound levels. Rather, the level of significance was based on the effect of noise on human activities and threatened or endangered species. The criterion in NUREG-0586 Supplement 1 (NRC 1988) is stated as follows:

> The noise impacts of... are considered detectable if sound levels are sufficiently high to disrupt normal human activities on a regular basis. The noise impacts ... are considered destabilizing if sound levels are sufficiently high that the affected area is essentially unsuitable for normal human activities, or if the behavior or breeding of a threatened or endangered species is affected.

In addition, the U.S. Department of Housing and Urban Development (24 CFR 51.101(a)(8)) considers day-night average exterior noise levels 65 decibels and below to be acceptable for residential areas.

On these bases, the staff concludes that the potential impacts of noise resulting from operation of additional nuclear power plants with cooling systems meeting the noise criteria of the PPE (see Appendix I) would be minor at the Grand Gulf ESP site.

5.8.3 Acute Effects of Electromagnetic Fields

EMFs are produced by electrical devices including transmission lines. Two issues related to the health effects of EMFs are addressed in some detail in the GEIS (NRC 1996). Those issues are acute effects (shock hazard) and chronic effects (effects of long-term exposures to EMF).

Acute effects can result from direct contact with transmission lines. Transmission line construction practices minimize public access to the lines. Acute effects can also be caused by induced currents. The 1981 revision of National Electric Safety Code (NESC) added criteria related to construction of transmission lines to minimize potential impacts associated with induced currents. Section 3.7 of SERI's environmental report (SERI 2003c) states that the existing transmission and distribution system serving the GGNS Unit 1 plant is adequate for at least an additional 1311 MW(e) generating capacity. Should a new plant with capacity greater than 1311 MW(e) be proposed, a study would be undertaken to determine the adequacy of the transmission and distribution system existing at that time.

SERI (2003c) has not asserted that the existing transmission and distribution system meets NESC criteria for induced currents or that modifications to the existing system would comply with the relevant local, state, and industry standards including NESC and various American National Standards Institute/Institute of Electrical and Electronics Engineers standards. As a result, the staff cannot come to a conclusion on potential acute impacts of electric fields.

5.8.4 Chronic Effects of Electromagnetic Fields

There is considerable scientific debate regarding the potential impacts from exposure to 60-Hz electromagnetic fields resulting from energized transmission lines. The potential for chronic effects from these fields continues to be studied and consensus results are still outstanding. The National Institute of Environmental Health Sciences (NIEHS) directs related research through the DOE. A recent report (NIEHS 1999) contains the following conclusion:

> The NIEHS concludes that ELF-EMF (extremely low frequency-electromagnetic field) exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In our opinion, this finding is insufficient to warrant aggressive regulatory concern. However, because virtually everyone in the United States uses electricity and is exposed to ELF-EMF, passive regulatory action is warranted such as a continued emphasis on educating both the public and the regulated community on means aimed at reducing exposure. The NIEHS does not believe that other cancers or non-cancer health outcomes provide sufficient evidence of a risk to currently warranted concern.

This statement is not sufficient to cause the staff to consider the potential impact as significant to the public, but the staff will continue to follow developments on this issue.

5.8.5 Occupational Health

In general, human health risks for the operation of new nuclear units are expected to be dominated by occupational injuries (for example, falls, electric shock, asphyxiation) to workers engaged in activities such as maintenance, testing, and facilities modifications. Historically, actual injury and fatality rates at nuclear reactor facilities have been lower than the average U.S. industrial rates. Occupational injury and fatality risks are reduced by adherence to NRC and Occupational Safety and Health Administration (OSHA) safety standards, practices, and procedures. Appropriate State and local statutes must also be considered when assessing the occupational hazards and health risks for operation of new nuclear units. The staff assumes adherence to NRC, OSHA, and State safety standards, practices, and procedures for operation of new nuclear units.

Occupational health impacts from thermophilic microorganisms would be the same as those discussed in Section 5.8.1. Health impacts to workers from noise and electromagnetic fields would be monitored and controlled in accordance with the applicable OSHA regulations.

5.8.6 Summary of Nonradiological Health Impacts

The staff evaluated health impacts to the public and the workers. Health risks to workers are expected to be dominated by occupational injuries at rates below the average U.S. industrial rates. Health impacts to the public and workers from thermophilic microorganisms and noise generated by operations would be minimal. Based on information provided by SERI and the staff's own independent review, the staff concludes that the potential impacts of nonradiological effects resulting from the operation of one or two new nuclear units as defined in the environmental report (SERI 2003c) would be SMALL, and additional mitigation is not warranted. The staff does not come to a conclusion on acute and chronic impacts of EMFs.

5.9 Radiological Impacts of Normal Operations

This section addresses the radiological impacts of normal operations of the new unit(s), including a discussion of the estimated radiation dose to a member of the public and to the biota inhabiting the area around the new unit(s). Estimated doses to workers at the new unit(s) are also discussed. Radiological impacts were determined using the PPE approach where the bounding direct radiation and liquid and gaseous effluent were used in the evaluation (see discussion in Section 3.2.3).

5.9.1 Exposure Pathways

Using the PPE, SERI's environmental report (SERI 2003c) provided a list of fission and activation products that may be released in gaseous emissions and liquid effluents from the new unit(s) (see SERI 2003c, Tables 3.0-7 and 3.0-8). The impacts from releases and direct radiation were evaluated by considering the probable pathways to individuals, populations, and biota near the additional unit(s). The highest dose from the major exposure pathways were evaluated for a given receptor. The exposure pathways, described in Regulatory Guides 1.109 and 1.111 (NRC 1977a; 1977b) are illustrated in Figures 5-2 and 5-3.

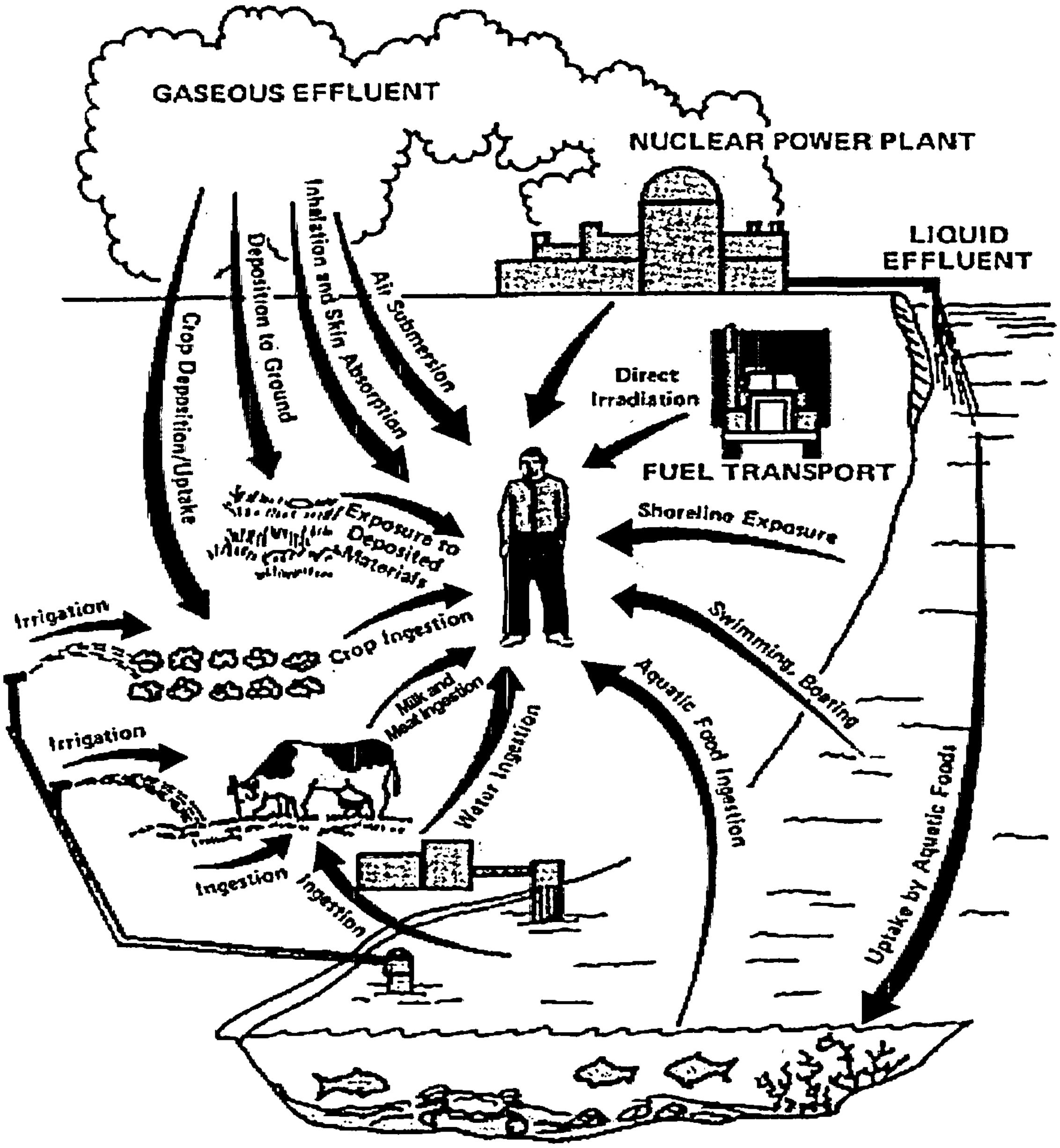

Figure 5-2. Exposure Pathways to Humans

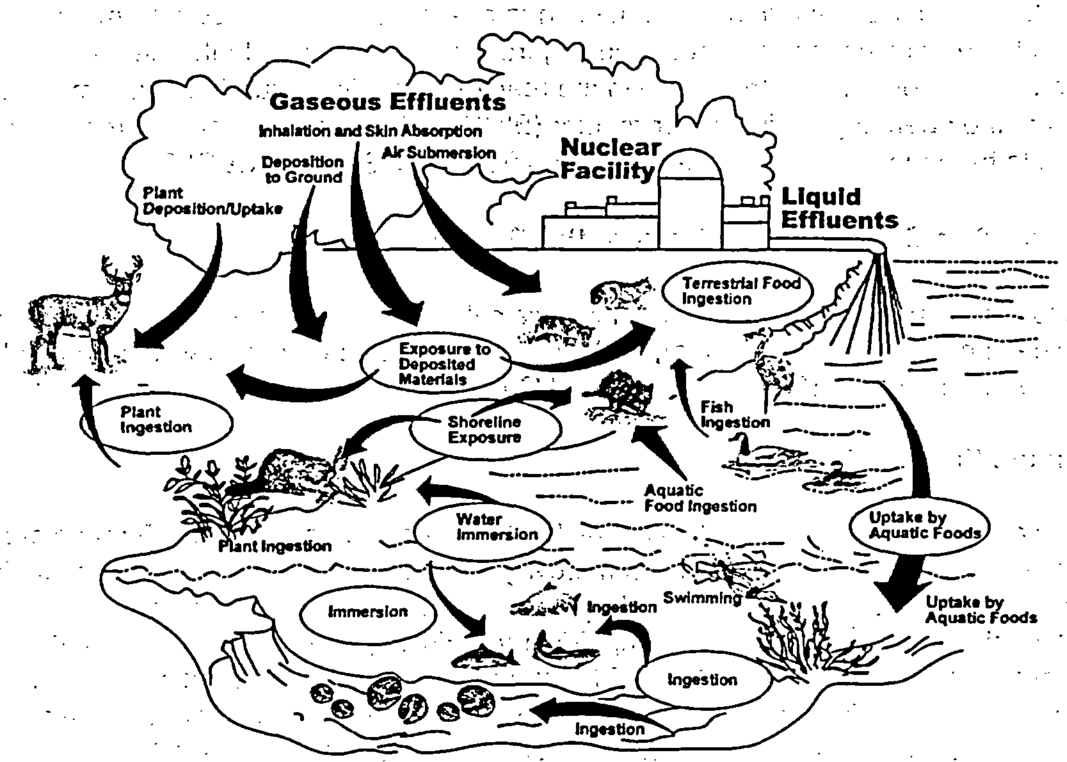

Figure 5-3. Exposure Pathways to Biota Other than Humans

The staff reviewed the SERI environmental report and data used for the analysis of the maximally exposed members of the public. Inconsistencies were noted in the data presented in the environmental report and data used in running the models. In its letter to the NRC staff dated February 14, 2005, SERI adequately clarified the inconsistencies. In the following discussions, data from the environmental report and the February 14, 2005, letter are used, as appropriate.

The new unit(s) at the Grand Gulf ESP site would release liquid effluents mixed with the GGNS Unit 1 radiological effluents and cooling tower blowdown to a discharge basin that is then released into the Mississippi River. The liquid pathways considered are ingestion of aquatic food, ingestion of drinking water, exposure to shoreline sediment, and external exposure from the surface of contaminated water or from shoreline sediment and from immersion in contaminated water (SERI 2003c).

The gaseous pathways discussed in the SERI environmental report (SERI 2003c) were external exposure to the airborne radioactivity, external exposure to contaminated ground, inhalation of airborne activity, and ingestion of contaminated agricultural products.

SERI (2003c) stated that the primary contribution to direct radiation exposure from new reactor designs would be from sky-shine doses resulting from air scattering of high-energy gamma radiation emitted by decaying nitrogen-16 in the reactor steam lines, turbines, and moisture separators of the operating boiling water reactor (BWR). These doses were estimated and determined to be bounded by the doses produced from GGNS Unit 1 (SERI 2003c).

5.9.2 Radiation Doses to Members of the Public

The dose to a maximally exposed individual was calculated from both the liquid and gaseous effluent release pathways (SERI 2003c), and a collective whole body dose was calculated for the population within 80 km (50 mi) of the Grand Gulf ESP site.

5.9.2.1 Liquid Effluent Pathway

Liquid pathway doses were calculated using the LADTAP II computer program (Strenge et al. 1986) for the following activities: eating commercially caught fish and invertebrates caught in the river and using the shoreline for recreational purposes. SERI's environmental report (SERI 2003c) shows no use of the Mississippi River for drinking water within 160 km (100 mi) downstream from the Grand Gulf ESP site. Therefore, drinking water was not considered in the assessment. The liquid effluent releases for one ESP unit used in the estimate of dose to a maximally exposed individual are shown in the SERI environmental report (SERI 2003c). These releases were based on the advanced boiling water reactor (ABWR) design with an output level of 4300 MW(t) rather than the certified level of 3926 MW(t). This resulted in a slight increase in release rate for those isotopes where the ABWR design was the bounding condition. Other parameters used as input to the LADTAP II program including effluent discharge rate, amount of commercial fish catch, invertebrate harvest, and usage consumption factors are found in Tables 5.4-1 and 5.4-2 of the SERI environmental report (SERI 2003c).

Liquid pathway doses to the maximally exposed individuals calculated by SERI are presented in Table 5-5. The maximum annual dose to the total body of an adult was 0.022 mSv (2.2 mrem) for one unit. The maximum annual dose to the bone of a child was 0.041 mSv (4.1 mrem) (SERI 2005). The staff performed an independent evaluation of liquid pathway doses and found similar results.

5.9.2.2 Gaseous Effluent Pathway

Gaseous pathway doses to the maximally exposed individual were calculated by SERI using the GASPAR II computer program (Strenge et al. 1987) at the following locations: the nearest site boundary, nearest vegetable garden, nearest residence, nearest milk cow, and nearest meat cow. The gaseous effluents used in the estimate of dose to the maximally exposed individual are shown in the SERI environmental report (SERI 2003c). These releases, which were

Table 5-5. Liquid Pathway Doses for Maximally Exposed Individual at the Grand Gulf Early Site Permit Site from Operation of One New Nuclear Unit

Pathway	Total Body Dose (adult) (mSv/yr)[a]	Maximum Organ (bone, child) (mSv/yr)[a]
Aquatic Foods	0.022	0.041
Shoreline Use	3.06×10^{-5}	3.56×10^{-5}
Total	**0.022**	**0.041**

(a) Multiply mSv/yr by 100 to obtain mrem/yr.
Source: SERI 2005. Doses were estimated for one unit.

estimated for one ESP unit, were based on the ABWR design with an output level of 4300 MW(t) rather than the certified level of 3926 MW(t). This resulted in a slight increase in release rate for those isotopes where the ABWR design was the bounding condition. Other parameters used as input to the GASPAR II program (including milk, meat, and vegetable production rates, meteorological data, population data, and consumption factors) are found in Tables 5.4-3 through 5.4-5 of the SERI environmental report (SERI 2003c).

Gaseous pathway doses to the maximally exposed individuals calculated by SERI are presented in Table 5-6. The dose calculations in Table 5-6 are based on dispersion factors from meteorological data from 1996-2000. SERI also calculated dispersion factors derived from meteorological data from 2002-2003. The bounding locations changed with the 2002-2003 data, and the increase in dose at the site boundary was not significant (14 percent). The doses at the residence, garden, milk cow, and meat cow locations decreased. The staff performed an independent evaluation of gaseous pathway doses and found similar results.

Table 5-6. Gaseous Pathway Doses for Maximally Exposed Individual from Operation of One New Nuclear Unit [a]

Location	Pathway	Dose Rate (mSv/yr)[b] Total Body	Skin[e]	Thyroid
Nearest Residence[c]	Plume Exposure	0.0015	0.011	0.0015
(NNE, 1.02 km [0.64 mi])	Inhalation			
	Adult	0.0029		0.009
	Teen	0.0029		0.011
	Child	0.0026		0.013
	Infant	0.0015		0.011
Nearest Garden[c]	Vegetable Consumption			
(ENE, 1.07 km [0.67 mi])	Adult	0.008		0.04
	Teen	0.01		0.05
	Child	0.019		0.09
Nearest Site Boundary[d]	Inhalation			
(NE, 0.8 km [0.52 mi])	Adult	0.004		0.014
	Teen	0.004		0.017
	Child	0.004		0.019

Table 5-6. (contd)

Location	Pathway	Dose Rate (mSv/yr)[(b)] Total Body	Skin [(e)]	Thyroid
Nearest Milk Cow[(c)] (SSW, 16 km [10 mi])	Cow Milk			
	Adult	0.0001		0.0006
	Teen	0.0001		0.0009
	Child	0.0003		0.0015
	Infant	0.0005		0.0045
Nearest Meat Cow[(c)] (S, 6.4 km [4.0 miles])	Meat Consumption			
	Adult	0.00015		0.00025
	Teen	0.0001		0.00015
	Child	0.00015		0.00025

Notes:
(a) Data provided in SERI 2003c was for two units.
(b) Multiply mSv/yr by 100 to obtain mrem/yr.
(c) "Nearest" refers to the location at which the highest radiation dose to an individual from the applicable pathways has been estimated.
(d) "Nearest" refers to that site boundary location at which the highest radiation doses from gaseous emissions have been estimated to occur.
(e) Skin dose is only applicable to plume exposure.
Source: SERI 2005

5.9.3 Impacts to Members of the Public

The staff evaluated the impacts to members of the public from the operation of the proposed Grand Gulf ESP facility by identifying the maximally exposed individual and population dose.

5.9.3.1 Maximally Exposed Individual

SERI (2003c) stated that whole body and organ dose estimates to the maximally exposed individual from liquid effluent and gaseous emissions for one unit were within the design objectives of 10 CFR Part 50, Appendix I. Doses to whole body and maximum organ (bone) from liquid effluent were well within the 0.03 mSv/yr (3 mrem/yr) and 0.1 mSv/yr (10 mrem/yr) 10 CFR Part 50 Appendix I design objectives, respectively. Doses at the exclusion area boundary from gaseous effluents were well within the 10 CFR Part 50 Appendix I design objectives of 0.1 mGy/yr (10 mrad/yr) gamma in air, 0.2 mGy/yr (20 mrad/yr) beta in air, 0.05 mSv/yr (5 mrem/yr) close to the whole body, and 0.15 mSv/yr (15 mrem/yr) dose to the skin. In addition, dose to the thyroid was within the 0.15 mSv/yr (15 mrem/yr) 10 CFR Part 50 Appendix I design objectives (SERI 2003c). A comparison of dose estimates for one ESP unit to the 10 CFR Part 50 Appendix I design objectives is presented in Table 5-7.

SERI (2003b) stated that doses from liquid and gaseous effluents to the maximally exposed individual at the site boundary from the existing GGNS Unit 1 and the proposed two units combined were within the regulatory standards of 40 CFR Part 190. The dose standards from

Table 5-7. Comparison of Maximum Individual Dose to 10 CFR Part 50, Appendix I Design Objective

Type of Dose	Design Objective (a, b, c)	Point of Evaluation	Calculated Dose (a, b, c)
		Gaseous Effluents (noble gases only)	
Gamma air dose	0.1 mGy/yr (10 mrad/yr)	Exclusion Area Boundary	4.2×10^{-3} mGy/yr (4.2×10^{-1} mrad/yr)
Beta air dose	0.2 mGy/yr (20 mrad/yr)	Exclusion Area Boundary	0.025 mGy/yr (2.5 mrad/yr)
Total body dose	0.05 mSv/yr (5 mrem/yr)	Exclusion Area Boundary	2.5×10^{-3} mSv/yr (2.5×10^{-1} mrem/yr)
Skin dose	0.15 mSv/yr (15 mrem/yr)	Exclusion Area Boundary	0.017 mSv/yr (1.7 mrem/yr)
		Radioiodines and Particulates	
Vegetable Consumption	0.15 mSv/yr (15 mrem/yr)	Nearest Garden	0.094 mSv/yr (9.4 mrem/yr) (thyroid, child)

(a) mrad = millirad.
(b) Multiply mGy/yr by 100 to obtain mrad/yr.
(c) Multiply mSv/yr by 100 to obtain mrem/yr.
Sources: 10 CFR Part 50, Appendix I; SERI 2005.

40 CFR Part 190 are 0.25 mSv/yr (25 mrem/yr) to the whole body, 0.75 mSv/yr (75 mrem/yr) to the thyroid, and 0.25 mSv/yr (25 mrem/yr) to any other organ. The combined doses from the existing units and the ESP units were 0.07 mSv/yr (7.0 mrem/yr) to the whole body, 0.15 mSv/yr (15 mrem/yr) to the thyroid, and 0.18 mSv/yr (18 mrem/yr) to the bone for the maximally exposed member of the public (SERI 2003c, Table 5.4-18). These data are summarized in Table 5-8. Therefore, the combined dose to the maximally exposed individual from GGNS and the new units would be within the 40 CFR Part 190 standards, 10 CFR Part 20 standards, and 10 CFR Part 50 Appendix I design objectives.

5.9.3.2 Population Dose

SERI (2003c) estimated a collective whole body dose within 80 km (50 mi) of each Grand Gulf ESP unit to be 0.0543 person-Sv/yr (5.43 person-rem/yr). Collective dose was estimated using the GASPAR II computer code (SERI 2003c, Tables 5.4-10 and 5.4-13). Collective dose from the liquid effluent pathways was not calculated since the Mississippi River is not used for drinking water within 160 km (100 mi). The staff independently evaluated the population doses and found similar results. In response to a query from the staff, SERI evaluated the impact on

Table 5-8. Comparison of Maximally Exposed Individual Dose Estimates from Liquid and Gaseous Effluents from Operation of GGNS Unit 1 and Two New Nuclear Units to 40 CFR Part 190 Standards

Dose	SERI Estimate[(a)(b)]	40 CFR 190 Standards[(b)]
Whole body dose equivalent	0.07 mSv/yr	0.25 mSv/yr
Thyroid dose	0.15 mSv/yr	0.75 mSv/yr
Dose to organ (bone)	0.18 mSv/yr	0.25 mSv/yr

(a) Doses were estimated for GGNS Unit 1 and two ESP units (SERI 2003c, Table 5.4-18).
(b) Multiply mSv/yr by 100 to obtain mrem/yr.

the population dose of using the population distribution from the environmental report (SERI 2003c) and the meteorological data from 2002-2003. SERI concluded that these changes would result in a slightly lower population dose. The staff did not adjust its population dose estimate using either of these two potential parameter changes, therefore, its population dose estimates are bounding. For comparative purposes, the estimated collective dose from natural background radiation to the population within 80 km (50 mi) of the proposed Grand Gulf ESP site is 1020 person-Sv/yr (102,000 person-rem/yr).

Although radiation may cause cancers at high doses and high dose rates, currently there are no data that unequivocally establish the occurrence of cancer following exposure to low doses and dose rates, below about 100 mSv (10,000 mrem). However, radiation protection experts conservatively assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. Simply stated, any increase in dose, no matter how small, results in an incremental increase in health risk. This theory is accepted by the NRC as a conservative model for estimating health risks from radiation exposure, recognizing that the model probably overestimates those risks.

Based on this model, the staff estimated the risk to the public from radiation exposure using the nominal probability coefficient for total detriment (730 fatal cancers, nonfatal cancers, and severe hereditary effects per 10,000 person-Sv [1,000,000 person-rem]) from International Commission on Radiation Protection (ICRP) Publication 60 (ICRP 1990). This coefficient was multiplied by the estimated collective whole body population dose of 0.0543 person-Sv/yr (5.43 person-rem/yr) to calculate that the population living within 80 km (50 mi) of the Grand Gulf ESP site would incur a total of approximately 0.004 fatal cancers, nonfatal cancers, and severe hereditary effects annually. The risks from the cumulative radiation exposure from GGNS and the proposed ESP units would be only slightly higher. This risk is very small compared to the estimated 75 fatal cancers, nonfatal cancers, and severe hereditary effects that the same population would incur annually from exposure to natural sources of radiation.

In addition, at the request of the U.S. Congress, the National Cancer Institute (NCI) conducted a study and published, "Cancer in Populations Living Near Nuclear Facilities," in 1990 (NCI 1990). This report included an evaluation of health statistics around all nuclear power plants, as well as several other nuclear fuel cycle facilities, in operation in the United States in 1981 and found "no evidence that an excess occurrence of cancer has resulted from living near nuclear facilities" (NCI 1990).

5.9.3.3 Summary of Radiological Impacts to Members of the Public

The staff evaluated the health impacts from routine gaseous and liquid radiological effluent releases from new nuclear units at the Grand Gulf ESP site. Based on the information provided by SERI and on its own independent evaluation, the staff concludes there would be no observable health impacts to the public from normal operation of new nuclear units, and the health impacts would be SMALL.

5.9.4 Occupational Doses to Workers

In NUREG-0713 (NRC 2002b), NRC reported the average annual collective dose per operating reactor to be 1.72 person-Sv/yr (172 person-rem yr) for the time period from 1992 to 2001. Limited information is available on occupational dose estimates from the advanced reactor designs, and SERI did not provide such information. However, Dominion Energy, Inc., in a study regarding potential sites for new nuclear power plants, reported annual occupational dose estimates of 1.5 person-Sv (150 person-rem) for the AP1000 reactor, International Reactor Innovative and Secure (IRIS), and Gas Turbine Modular Helium Reactor (GT-MHR) designs (Dominion 2002). The estimated occupational doses for the advanced reactor designs were slightly less than annual occupational doses for current light water reactors (LWRs). The staff reviewed this information and concluded: (1) that the information was generically applicable to SERI's application; and (2) that the annual dose estimates are reasonable. Moreover, the environmental impact from this occupational dose is considered small because the dose to any individual worker is maintained within the limits of 10 CFR Part 20 (0.05 Sv/yr [5 rem/yr]).

5.9.5 Impacts to Biota Other than Members of the Public

SERI (2003c) estimated doses to surrogate species (fish, invertebrates, algae, muskrat, raccoon, heron, and duck). Fish, invertebrates, and algae are referred to as aquatic species. Muskrats, racoons, herons, and ducks are referred to as terrestrial species. Important biota species for the Grand Gulf ESP site and the corresponding surrogate species are bald eagle and woodstork (heron), pallid sturgeon (fish), and fat pocketbook mussel (invertebrate). Surrogate species are well defined and provide an acceptable method for judging doses to the biota (SERI 2003c). Exposure pathways considered in evaluating dose to the biota were discussed in Section 5.9.1 and shown in Figure 5-3.

5.9.5.1 Liquid Effluent Pathways

SERI (2003c) used the LADTAP II computer code to calculate doses to the biota from liquid effluent pathways. The following exposure pathways were evaluated for the different surrogate biota:

- Fish and invertebrates – internal exposure from bioaccumulation of radionuclides and external exposure from swimming and shoreline activities

- Algae – internal exposure from bioaccumulation of radionuclides and external exposure from immersion in water

- Muskrat and duck – internal exposure from ingestion of aquatic plants and external exposure from swimming and shoreline activities

- Raccoon – internal exposure from ingestion of invertebrates and external exposure from shoreline activities

- Heron – internal exposure from ingestion of fish and external exposure from swimming and shoreline activities.

Input parameters used in the dose calculation included food consumption rates, body masses, and effective body radii. These parameters were taken from NUREG/CR-4013 (Strenge et al. 1986) and Regulatory Guide 1.109 (NRC 1977a). These parameters are shown in Tables 5.4-14 and 5.4-15 of the SERI environmental report (SERI 2003c). The LADTAP II Program has an adjustment factor because the biota would be closer to any potential shoreline contamination than humans.

5.9.5.2 Gaseous Effluent Pathways

SERI used the doses calculated for the maximally exposed individual from the gaseous effluent pathways (described earlier in this section) as a basis for the doses to the biota. External doses from ground deposition were increased to account for the terrestrial organisms being closer to the ground (SERI 2003c).

5.9.5.3 Impacts of Estimated Biota Doses

Table 5-9 shows the estimated whole body dose to the biota from the liquid and gaseous effluent pathways calculated by SERI from one proposed new unit at the Grand Gulf ESP site. The biota doses for all surrogate species except fish and raccoon exceed the regulatory standard in 40 CFR Part 190 for humans of 0.25 mSv/yr (25 mrem/yr) to the total body (SERI 2003c). The staff performed an independent evaluation of biota doses and found similar results.

Table 5-9. Comparison of Biota Dose Estimates from Liquid and Gaseous Effluents from Operation of New Nuclear Units to 40 CFR 190 Standards and Relevant Guidelines for Biota Protection

Biota	Dose from Liquid Effluents/Unit (mGy/yr)[a]	Dose from Gaseous Effluents/Unit (mGy/yr)[a]	Total Dose/Unit (mGy/yr)[a]	Total Dose for Two Units (mGy/yr)[a]	40 CFR 190 Total Body Dose Limit (mSv/yr)[b]	IAEA/NCRP Guideline for Protection of Biota Populations (mGy/yr)[a]
Fish	0.25	0	0.25	0.51	0.25	3650
Invertebrate	1.65	0	1.65	3.31	0.25	3650
Algae	1.48	0	1.48	2.96	0.25	3650
Muskrat	0.81	0.0289	0.84	1.68	0.25	365
Raccoon	0.19	0.024	0.21	0.43	0.25	365
Heron	1.93	0.0211	1.96	3.91	0.25	365
Duck	0.81	0.0313	0.84	1.68	0.25	365

(a) Multiply mGy/yr by 100 to obtain mrad.
(b) Multiply mSv/yr by 100 to obtain mrem.
IAEA = International Atomic Energy Agency
NCRP = National Council on Radiation Protection
Source: SERI 2003c, Table 5.4-17

Although the 40 CFR Part 190 standards apply to members of the public in unrestricted areas and not to biota, they are provided here for comparative purposes. Radiation doses to the biota are expressed in units of absorbed dose (mGy [mrad]) because dose equivalent (mSv [mrem]) only applies to human radiation doses. SERI (2003c) assumed that mSv (mrem) and mGy (mrad) are approximately equivalent for comparison of biota doses to the 40 CFR Part 190 standards. Annual dose to invertebrate, muskrat, duck, algae, and heron-surrogate species exceeded the dose standard in 40 CFR Part 190. The biota dose estimates for a new nuclear unit are conservative because they do not consider dilution or decay of liquid effluents during transit. Actual doses to the biota are likely to be much less.

The International Council on Radiation Protection (ICRP 1977; 1990) states that if humans are adequately protected, other living things are also likely to be sufficiently protected. The International Atomic Energy Agency (IAEA) (ORNL 1995) and the National Council on Radiation Protection and Measurements (NCRP 1991) found that appreciable effects in aquatic populations would not be expected at doses lower than 10 mGy/d (1000 mrad/d). IAEA (ORNL 1995) also concluded that chronic dose rates of 1 mGy/d (100 mrad/d) or less do not appear to cause observable changes in terrestrial animal populations. Table 5-9 compares the estimated total body dose to the biota from a new nuclear unit to the IAEA chronic dose rate values for aquatic organisms and terrestrial animals. The cumulative effects of GGNS and up to two new nuclear units result in dose rates less than the NCRP and IAEA studies.

The staff performed an independent evaluation of doses to biota and found similar results.

In conclusion, the staff has reviewed the available information related to the radiological impact on biota from the routine operation of the proposed Grand Gulf ESP unit(s) and has concluded that the impact would be SMALL, and mitigation would not be warranted.

5.9.6 Radiological Monitoring

A radiological environmental monitoring program (REMP) has been performed around the Grand Gulf site since 1978. The REMP includes monitoring of the airborne exposure pathway, direct exposure pathway, water exposure pathway, aquatic exposure pathway with control and indicator locations within a 29 km (18 mi) radius of the site. Milk is sampled when there is commercial milk production within 8 km (5 mi) of the site. The pre-operational REMP sampled various media in the environment to determine a baseline from which to observe the magnitude and fluctuation of radioactivity in the environment once the unit began operation (Entergy 2003b). The pre-operational program included collection and analysis of samples of air particulates, precipitation, milk, crops, soil, well water, surface water, fish, and silt as well as measurement of ambient gamma radiation. After operation of GGNS Unit 1 plant began in 1985, the monitoring program continued to assess the radiological impacts to workers, the public, and the environment. Radiological releases are summarized in the two annual reports: the *Annual Radiological Environmental Operating Report* (Entergy 2003b) and *Annual Radioactive Effluent Release Report* (Entergy 2003a). The limits for all radiological releases are specified in the *Grand Gulf Offsite Dose Calculation Manual* (ODCM) (Entergy 2003a; 2003b; 2004). No additional monitoring program has been established for the new unit(s). The staff reviewed the documentation for the REMP, the ODCM, 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 to the environment related to the construction and operation of proposed new unit(s) at the Grand Gulf ESP site.

5.10 Environmental Impacts of Postulated Accidents

The staff considered the radiological consequences on the human environment of potential accidents at new nuclear units at the Grand Gulf ESP site. Consequence estimates are based on the General Electric ABWR standard reactor design, which has been certified by the NRC, and the surrogate Westinghouse AP1000. The term "accident," as used in this section, refers to any off-normal event not addressed in Section 5.9 that results in the release of radioactive materials into the environment. The focus of this review is on events that could lead to releases substantially in excess of permissible limits for normal operations. Normal release limits are specified in 10 CFR Part 20, Appendix B, Table 2.

Numerous features combine to reduce the risk associated with accidents at nuclear power plants. Safety features in the design, construction, and operation of the plants, which compose the first line of defense, are intended to prevent the release of radioactive materials from the plant. The design objectives and the measures for keeping levels of radioactive materials in effluents to unrestricted areas as low as is reasonably achievable (ALARA) are specified in 10 CFR Part 50, Appendix I. There are additional measures that are designed to mitigate the consequences of failures in the first line of defense. These include the NRC's reactor site criteria in 10 CFR Part 100, which require the site to have certain characteristics that reduce the risk to the public and the potential impact of an accident, and emergency preparedness plans and protective action measures for the site and environs as set forth in 10 CFR 50.47; 10 CFR Part 50, Appendix E; and NUREG-0654/FEMA-REP-1 (NRC 1980). All of these safety features, measures, and plans make up the defense-in-depth philosophy to protect the health and safety of the public and the environment.

This section discusses (1) the types of radioactive materials, (2) the paths to the environment, (3) the relationship between radiation dose and health effects, and (4) the environmental impacts of postulated reactor accidents, both design-basis accidents (DBAs) and severe accidents. The environmental impacts of postulated accidents during transportation of spent fuel are discussed in Chapter 6.

The potential for dispersion of radioactive materials in the environment depends on the mechanical forces that physically transport the materials, and on the physical and chemical forms of the materials. Radioactive material exists in a variety of physical and chemical forms. The majority of the material in the fuel is in the form of nonvolatile solids. However, there is a significant amount of material that is in the form of volatile solids or gases. Gaseous radioactive materials include the chemically inert noble gases krypton and xenon, which have a high potential for release. Radioactive forms of iodine, which are created in substantial quantities in the fuel by fission, are volatile. Other radioactive materials formed during the routine operation of a nuclear power plant have lower volatilities and, therefore, have lower tendencies to escape from the fuel than the noble gases and iodines.

Radiation exposure to individuals is determined by their proximity to radioactive material, the duration of their exposure, and the extent to which they are shielded from the radiation. Pathways that lead to radiation exposure include external radiation from radioactive material in the air, on the ground, and in the water; the inhalation of radioactive material; and ingestion of food or water containing material initially deposited on the ground and in water.

The risks of health effects from radiation exposure are either too small to be observed or are non-existent below 0.1 Sv (10 rem) (HPS 2004). Incidences of cancer in the exposed general population may begin to develop after a lapse of 2 to 15 years (latent period) after exposure to higher levels of radiation and then level off over a period of about 30 years (plateau period). In the case of radiation exposure of fetuses, cancer may begin to develop as early as at birth (no latent period) to the age of 10.

Physiological effects are clinically detectable should individuals receive radiation exposure resulting in a dose greater than about 0.25 Sv (25 rem) over a short period of time (hours). Doses of about 2.5 to 5.0 Sv (250 to 500 rem) received over a relatively short period (hours to a few days) can be expected to cause some fatalities.

5.10.1 Design-Basis Accidents

SERI evaluated the potential consequences of postulated accidents to demonstrate that new units could be constructed and operated at the Grand Gulf ESP site without undue risk to the health and safety of the public. These evaluations use a set of surrogate DBAs that are representative for the range of reactor designs being considered for the ESP site and site-specific meteorological data. The set of accidents covers events that range from relatively high probability of occurrence with relatively low consequences to relatively low probability with high consequences.

The DBA review focuses on two light water reactor designs: the ABWR and the surrogate AP1000. The bases for analyses of postulated accidents for these designs are well established because they have been considered as part of the NRC's advanced reactor design certification process. Accidents for the other reactor designs listed in the application are not as well defined as those for the ABWR and the surrogate AP1000; acceptable assumptions and methodologies for the evaluation of postulated accidents have not been fully established. Because the source terms for accident analyses are generally proportional to the power level, for the purposes of this environmental impact evaluation, the potential consequences of accidents for the other reactor designs are expected to be bounded by those for the ABWR and surrogate AP1000 designs. For example, preliminary information on source terms for the IRIS and ACR-700 reactor designs indicates that the source terms for the surrogate AP1000 loss-of-coolant accident (LOCA) would bound the worst-case accident release for these advanced reactor designs. Similarly, the ABWR source terms are expected to bound the source terms for the Economic Simplified Boiling Water Reactor (ESBWR) design. The advanced gas reactor designs (GT-MHR and pebble bed modular reactor [PBMR]) postulate relatively small releases to the environment compared to water reactor technologies (SERI 2004h).

Should an application that references an ESP at the Grand Gulf ESP site be made to build and operate one of the designs other than an ABWR or surrogate AP1000, SERI would be required to show – and the staff would verify – that the radiological consequences of DBAs for the proposed reactor(s) are bounded by the consequences of DBAs evaluated in this environmental impact statement (EIS).

Potential consequences of DBAs are evaluated following procedures outlined in regulatory guides and standard review plans. The potential consequences of accidental releases depend on the specific radionuclides released, the amount of each radionuclide released, and meteorological conditions. The source terms for the ABWR design are based on TID-14844 (AEC 1962) guidance, and guidance on methods for evaluating potential accidents for the ABWR are set forth in NUREG-0800 (NRC 1987), Regulatory Guide 1.3 (NRC 1974a), and Regulatory Guide 1.25 (NRC 1974b). The source terms for the surrogate AP1000 reactor and methods for evaluating potential accidents are based on guidance in Regulatory Guide 1.183 (NRC 2000b).

For environmental reviews, consequences are evaluated assuming realistic meteorological conditions. Meteorological conditions are represented in these consequence analyses by an atmospheric dispersion factor, which is also referred to as χ/Q. Acceptable methods of calculating χ/Q for DBAs from meteorological data are set forth in Regulatory Guide 1.145 (NRC 1983).

SERI provided the staff with meteorological data for the Grand Gulf ESP site for 2002 and 2003. These data have been reviewed by the staff and found to be representative of the meteorological conditions at the site. The meteorological instrumentation and its maintenance are consistent with staff guidance, and the data quality is consistent with standards set forth in that guidance. Therefore, the data are considered acceptable for use in evaluation of the consequences of DBAs. The staff also reviewed SERI's procedures for calculating site-specific χ/Qs and found them to be consistent with staff guidance.

Table 5-10 lists χ/Q values pertinent to the evaluation of the suitability of the Grand Gulf ESP site. The first column lists the time periods and boundaries for which χ/Q values and dose estimates are needed. For the exclusion area boundary (EAB), the postulated DBA dose and its atmospheric dispersion factor are calculated for a short-term, i.e., 2 hours, and for the low population zone (LPZ), they are calculated for the course of the accident, i.e., 30 days (720 hours) composed of four time periods. The second column lists the χ/Q values calculated by SERI using the site meteorological information discussed in environmental report Section 2.7.5 (SERI 2004f) and the EAB and LPZ distances from Section 2.7.6 of the environmental report. No credit was taken for building wake. These χ/Q values are expected to be exceeded no more than five percent of the time.

Table 5-10. Atmospheric Dispersion Factors (χ/Q, s/m^3) for the Grand Gulf Early Site Permit Site Design Basis Accident Calculations

	Site	
Time Period[a] and Boundary	**Adverse**	**Typical**
0 to 2 hr, Exclusion Area Boundary	5.95×10^{-4}	8.82×10^{-5}
0 to 8 hr, Low Population Zone	8.83×10^{-5}	2.83×10^{-5}
8 to 24 hr, Low Population Zone	6.16×10^{-5}	2.21×10^{-5}
1 to 4 day, Low Population Zone	2.82×10^{-5}	1.29×10^{-5}
4 to 30 day, Low Population Zone	9.15×10^{-6}	5.95×10^{-6}

(a) Times are relative to the beginning of the release to the environment.

In its independent assessment, the staff evaluated SERI's process for deriving the site χ/Q values from site-specific information. The staff determined the process is consistent with NRC guidance (NRC 1983), but the χ/Q values are not acceptable for use in environmental reviews because they are for adverse meteorological conditions rather than typical conditions.

Using information provided by SERI and the procedure described in Regulatory Guide 1.145, the staff estimated site χ/Q values for typical meteorological conditions using the exclusion area boundary and low population zone distances given in the ESP application. The staff's estimates of χ/Q values for typical meteorological conditions are listed in the last column of Table 5-10. These values indicate the atmospheric dilution capability in the vicinity of the site. Small χ/Q values are associated with greater dilution capability. Thus, if a design χ/Q value for a specific reactor design identified as part of the CP or COL were greater than or equal to the site-specific χ/Q value, then atmospheric dispersion at the site is sufficient such that the doses predicted for postulated DBAs for the design would likely be below regulatory limits.

The staff concludes 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 χ/Q values falling within the bounds set by the site χ/Q values.

At the CP/COL stage, an applicant would need to demonstrate that the χ/Q values for reactor designs considered are bounded by the site χ/Q values. Additional evaluation will be needed if reactor design χ/Q values are not bounded by those of the site χ/Q values.

Tables 5-11 and 5-12 list the set of surrogate DBAs considered by SERI and present the staff's estimate of the environmental consequences of each DBA in terms of total effective dose equivalent (TEDE). TEDE is the sum of the committed effective dose equivalent (CEDE) from inhalation and the deep dose equivalent from external exposure. Dose conversion factors from Federal Guidance Report 11 (Eckerman et al. 1988) were used to calculate the CEDE. Similarly, dose conversion factors from Federal Guidance Report 12 (Eckerman and Ryman 1993) were used to calculate the deep dose equivalent.

Equivalent TEDE values were estimated for the ABWR by multiplying the thyroid dose by a factor of 0.03 (the organ weighting factor for the thyroid in the TEDE methodology) and adding the product to the whole body dose. The review criteria used in the staff's safety review of DBA doses are included in Tables 5-11 and 5-12 to illustrate how small the calculated environmental consequences (TEDE doses) are.

Table 5-11. Design Basis Accident Doses for an Advanced Boiling Water Reactor

		TEDE in Sv[a]		
Accident	**Standard Review Plan Section[b]**	**EAB**	**LPZ**	**Review Criterion**
Main Steam Line Break	15.6.4			
Pre-Existing Iodine Spike		1.4×10^{-3}	4.8×10^{-4}	2.5×10^{-1}[c]
Accident-Initiated Iodine Spike		7.0×10^{-5}	2.4×10^{-5}	2.5×10^{-2}[d]
Loss-of-Coolant Accident	15.6.5	5.9×10^{-3}	5.4×10^{-2}	2.5×10^{-1}[c]
Failure of Small Lines Carrying Primary Coolant Outside Containment	15.6.2	1.2×10^{-4}	4.2×10^{-5}	2.5×10^{-2}[d]
Fuel Handling	15.7.4	9.8×10^{-4}	3.3×10^{-4}	6.25×10^{-2}[d]

(a) To convert Sv to rem, multiply by 100
(b) NUREG-0800 (NRC 1987)
(c) 10 CFR 50.34(a)(1), 10 CFR 100.11, and 10 CFR 100.21
(d) Standard Review Plan criterion
EAB = exclusion area boundary
LPZ = low population zone
TEDE = total effective dose equivalent

In addition to the evaluation of the DBAs for the ABWR and surrogate AP1000 designs described above, SERI evaluated the consequences of a postulated LOCA for the Advanced Canada Deuterium Uranium Reactor (ACR-700) reactor design. The staff's estimates of the 0 to 2 hr TEDE at the EAB is 8.8×10^{-3} Sv (0.88 rem), and the estimate for TEDE for the LPZ is 1.7×10^{-2} Sv (1.7 rem). These TEDE values for the ACR-700 are well below the review criteria.

Table 5-12. Design Basis Accident Doses for a Surrogate AP1000 Reactor

Accident	Standard Review Plan Section[b]	TEDE in Sv[a]		
		EAB	LPZ	Review Criterion
Main Steam Line Break	15.1.5			
Pre-Existing Iodine Spike		9.6×10^{-4}	1.0×10^{-3}	2.5×10^{-1}[c]
Accident-Initiated Iodine Spike		1.1×10^{-3}	3.8×10^{-3}	2.5×10^{-2}[d]
Steam Generator Rupture	15.6.3			
Pre-Existing Iodine Spike		4.1×10^{-3}	7.5×10^{-4}	2.5×10^{-1}[c]
Accident-Initiated Iodine Spike		2.1×10^{-3}	5.3×10^{-4}	2.5×10^{-2}[d]
Loss-of-Coolant Accident	15.6.5	3.4×10^{-2}	2.2×10^{-2}	2.5×10^{-1}[c]
Rod Ejection	15.4.8	4.1×10^{-3}	3.7×10^{-3}	6.25×10^{-2}[d]
Reactor Coolant Pump Rotor Seizure (Locked Rotor)	15.3.3	3.5×10^{-3}	1.3×10^{-3}	2.5×10^{-2}[d]
Failure of Small Lines Carrying Primary Coolant Outside Containment	15.6.2	1.8×10^{-3}	6.4×10^{-4}	2.5×10^{-2}[d]
Fuel Handling	15.7.4	3.3×10^{-3}	1.3×10^{-3}	6.25×10^{-2}[d]

(a) To convert Sv to rem, multiply by 100
(b) NUREG-0800 (NRC 1987)
(c) 10 CFR 50.34(a)(1) and 10 CFR 100.21
(d) Standard Review Plan criterion
EAB = exclusion area boundary
LPZ = low population zone
TEDE = total effective dose equivalent

used in the staff's safety review of DBA doses (0.25 Sv [25 rem] for EAB and LPZ). This comparison is included to illustrate how small the calculated environmental consequences (TEDE doses) are.

In all cases, the calculated TEDE values are small – considerably smaller that the TEDE doses used as safety review criteria. The environmental impacts of DBAs have not been explicitly evaluated for gas-cooled reactors; however, the staff expects that releases to the environment under accident conditions would be small for such designs. At the CP/COL stage, an applicant would need to demonstrate that the doses for postulated DBAs for the actual reactor design remain bounded by the environmental impacts from the surrogate reactor designs considered in this EIS.

Although SERI chose to use the PPE approach in its ESP application, it based its evaluation of the environmental impact of DBAs on characteristics of the ABWR and the surrogate AP1000 reactor designs with the explicit assumption that the impact would bound the impact of other advanced LWR designs (SERI 2004h). The NRC staff reviewed the analysis in the environmental report, which is based on analyses performed for design certification of these reactor designs and found it appropriate for safety analyses, but overly conservative for environmental reviews. Therefore, the staff adjusted the results of the SERI analysis to reflect typical meteorological conditions. The results of both the SERI and the staff analyses indicate that the environmental risks associated with DBAs, should an advanced LWR were be located at the Grand Gulf ESP site, would be small compared to the TEDE doses used as safety review criteria. On this basis, the staff concludes that the consequences of DBAs at the Grand Gulf ESP site are of SMALL significance for advanced LWRs. The environmental impacts of DBAs have not been explicitly evaluated for gas-cooled reactors and will need to be evaluated at the CP/COL stage. For this evaluation to bound the reactor design selected at the CP/COL stage, an applicant would need to demonstrate that the environmental impacts of a design basis accident at the proposed Grand Gulf ESP site remain bounded by the environmental impacts for the surrogate designs considered in this EIS.

5.10.2 Severe Accidents

In its environmental report, SERI (2003c) bases its evaluation of the potential environmental consequences of severe accidents on the evaluation of potential consequences of severe accidents for current generation reactors presented in the GEIS (NRC 1996). Three pathways were considered: 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 melt-through with subsequent contamination of surface water by the groundwater.

In response to an NRC request for additional information dated May 19, 2004 (NRC 2004), SERI performed a site-specific analysis of the potential environmental consequences of postulated severe accidents at the Grand Gulf ESP site. Because the PPE does not include source terms for severe accidents, SERI used the source terms for the ABWR and surrogate AP1000 reactors. SERI used the MACCS2 computer code (Chanin et al. 1990; Jow et al. 1990) for the analysis. Input to the MACCS2 computer code and summary results of the analysis were submitted to the NRC in a letter dated August 10, 2004 (SERI 2004g).

The MACCS computer code was developed to evaluate the potential offsite consequences of severe accidents for the sites covered by NUREG-1150 (NRC 1990). MACCS2 (Chanin and Young 1997) is the current version of MACCS. The MACCS and MACCS2 codes evaluate the consequences of atmospheric releases of radioactive material following a severe accident. The pathways modeled include external exposure to the passing plume, exposure to material deposited on the ground and skin, inhalation of material in the passing plume and resuspended from the ground, and ingestion of contaminated food and surface water. The primary enhancements in MACCS2 are that MACCS2 has (1) a more flexible emergency response model, (2) an expanded library of radionuclides, and (3) a semidynamic food-chain model (Chanin and Young 1997).

Three types of severe accident consequences were assessed: (1) human health, (2) economic costs, and (3) land area affected by contamination. Human-health effects are expressed in terms of the number of cancers that might be expected if a severe accident were to occur. These effects are directly related to the cumulative radiation dose received by the general population. MACCS2 estimates both early cancer fatalities and latent fatalities. Early fatalities are related to high doses or dose rates and can be expected to occur within a year of exposure (Jow et al. 1990). Latent fatalities are related to exposure of a large number of people to low doses and dose rates and can be expected to occur after a latent period of several (2 to 15) years. Population health-risk estimates (latent and early cancers) are based on the population distribution within an 80-km (50-mi) radius of the plant, although early fatalities would be expected only in the population near the site. MACCS2 also calculates average individual health risks (early and latent fatalities) for individuals near the site. The risk of an early cancer fatality is calculated for individuals within 1.6 km (1 mi) and the risk of a latent cancer fatality is calculated for individuals within 16 km (10 mi). Economic costs of a severe accident include the costs associated with short-term relocation of people, decontamination of property and equipment, interdiction of food supplies, land and equipment use, and condemnation of property. The affected land area is a measure of the areal extent of the residual contamination following a severe accident.

Risk is the product of the frequency of an accident and the consequences of the accident. For example, the probability of a severe accident without loss of containment for an ABWR is estimated to be 1.34×10^{-7} per reactor year (Ryr^{-1}); and the cumulative population dose associated with a severe accident without loss of containment at the Grand Gulf ESP site is calculated to be 7.11×10^{1} person-Sv (7.11×10^{3} person-rem). The population dose risk for this class of accidents is the product of 1.34×10^{-7} Ryr^{-1} and 7.11×10^{1} person-Sv, or 9.53×10^{-6} person-Sv Ryr^{-1} (9.53×10^{-4} person-rem Ryr^{-1}). The following sections discuss the estimated risks associated with each pathway.

The risk presented in the tables that follow is risk per year of reactor operation. SERI has indicated the Grand Gulf ESP site could support reactors producing a total of 8600 MW(t). Based on this limit, the site could hold two ABWR or AP1000 reactors. The consequences of a severe accident would be the same regardless of whether one or two reactors were built. However, if two reactors were built, the risk would apply to each reactor, and the total risk for new reactors at the site would be twice the risk for a single reactor. Even if the risk values were doubled, the risks would still be significantly smaller than the risks associated with current-generation reactors.

5.10.2.1 Air Pathway

The MACCS2 code directly estimates consequences associated with releases to the air pathway. For the purposes of this analysis, the power levels of the ABWR and surrogate AP1000 reactors were scaled to 4300 MW(t) and 3415 MW(t), respectively (SERI 2004g). The results of the MACCS2 runs are presented in Tables 5-13 and 5-14. The core damage frequencies given in these tables are for internally initiated accident sequences while the plant is at power. Internally initiated accident sequences include sequences initiated by equipment failures, loss of offsite power, human error, etc. Based on insights from the review of the advanced LWR probabilistic risk assessments, the core damage frequencies for externally initiated events and during shutdown would be comparable to or lower than those for internally initiated events.

Tables 5-13 and 5-14 show 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. For perspective, Tables 5-15 and 5-16 compare the health risks from severe accidents for the ABWR or surrogate AP1000 reactors at the Grand Gulf ESP site with the risks for current-generation reactors at various sites.

In Table 5-15, the health risks estimated for the ABWR and surrogate AP1000 reactors at the Grand Gulf ESP site are compared with health risk estimates for the five reactors considered in NUREG-1150 (NRC 1990). Although risks associated with both internally and externally initiated events were considered for the Peach Bottom and Surry reactors in NUREG-1150, only risks associated with internally initiated events are presented in Table 5-16. The health risks shown for the ABWR and surrogate AP1000 reactors at the Grand Gulf ESP site are significantly lower than the risks associated with current-generation of operating reactors presented in NUREG-1150 (NRC 1990).

In addition, the last two columns of Table 5-15 provide average individual fatality risk estimates for comparison to the Commission's safety goals. The Commission has set safety goals for average individual early fatality and cancer fatality risks from reactor accidents in the Safety Goal Policy Statement (NRC 1986). The policy statement expressed the Commission's policy regarding the acceptance level of radiological risk from nuclear power plant operation as follows:

- Individual members of the public should be provided a level of protection from the consequences of nuclear power plant operation such that individuals bear no significant additional risk to life and health.

- Societal risks to life and health from nuclear power plant operation should be comparable to or less than the risks of generating electricity by viable competing technologies and should not be a significant addition to other societal risks.

Table 5-13. Mean Environmental Risk from Advanced Boiling Water Reactor Severe Accidents at the Grand Gulf Early Site Permit Site

Release Category Description (Accident Class)	Core Damage Frequency (Ryr^{-1})	Environmental Risk					
		Population Dose (person-Sv Ryr^{-1})[a]	Fatalities (Ryr^{-1})		Cost[d] (\$ Ryr^{-1})	Land Requiring Decontamination[e] (ha Ryr^{-1})	Population Dose from Water Ingestion (person-Sv Ryr^{-1})[a]
			Early[b]	Latent[c]			
0 No loss of containment	1.34×10^{-7}	9.53×10^{-6}	0	4.12×10^{-7}	3.05×10^{-2}	1.10×10^{-6}	3.52×10^{-8}
1 Transients followed by failure of high-pressure coolant makeup water and failure to depressurize in timely fashion	2.08×10^{-8}	1.27×10^{-6}	0	6.91×10^{-8}	6.98×10^{-3}	1.60×10^{-7}	5.55×10^{-9}
2 Short-term station blackout with reactor core isolation cooling (RCIC) failure, onsite power recovery in 8 hr	1.00×10^{-10}	2.43×10^{-9}	0	1.04×10^{-10}	1.79×10^{-6}	8.31×10^{-11}	5.69×10^{-12}
3 Station blackout with RCIC available for about 8 hr	1.00×10^{-10}	1.86×10^{-7}	0	8.61×10^{-9}	1.02×10^{-2}	5.79×10^{-7}	2.51×10^{-9}
4 Station blackout (more than 8 hr) with RCIC failure	1.00×10^{-10}	1.18×10^{-7}	0	5.25×10^{-9}	7.39×10^{-3}	4.11×10^{-7}	1.82×10^{-9}
5 Transients followed by failure of high pressure coolant makeup water, successful depressurization of reactor, failure of low-pressure coolant makeup water	1.00×10^{-10}	4.88×10^{-8}	0	2.00×10^{-9}	$6.4 1 \times 10^{-3}$	1.12×10^{-7}	6.03×10^{-10}

Table 5-13. (contd)

Release Category Description (Accident Class)	Core Damage Frequency (Ryr^{-1})	Population Dose (person-Sv Ryr^{-1})[a]	Fatalities (Ryr^{-1}) Early[b]	Fatalities (Ryr^{-1}) Latent[c]	Cost[d] (\$ Ryr^{-1})	Land Requiring Decontamination[e] (ha Ryr^{-1})	Population Dose from Water Ingestion (person-Sv Ryr^{-1})[a]
6 Transient, loss-of-coolant accident (LOCA), and anticipated transient without scram (ATWS) events with successful coolant makeup water, but potential prior failure of containment	1.00×10^{-10}	5.72×10^{-7}	0	2.61×10^{-8}	1.53×10^{-1}	1.06×10^{-5}	8.77×10^{-8}
7 Small/medium LOCA followed by failure of high-pressure coolant makeup water and failure to depressurize	3.91×10^{-10}	2.56×10^{-6}	0	1.15×10^{-7}	6.62×10^{-1}	4.34×10^{-5}	4.42×10^{-7}
8 LOCA followed by failure of high-pressure coolant makeup water	4.05×10^{-10}	4.24×10^{-6}	9.46×10^{-13}	1.93×10^{-7}	1.10×10^{-0}	5.24×10^{-5}	1.08×10^{-6}
9 ATWS followed by boron injection failure and successful high-pressure coolant makeup water	1.70×10^{-10}	2.29×10^{-6}	5.91×10^{-14}	1.13×10^{-7}	5.15×10^{-1}	2.18×10^{-5}	7.28×10^{-7}
Total	1.56×10^{-7}	2.08×10^{-5}	1.00×10^{-12}	9.45×10^{-7}	$2.49 \times 10^{+0}$	1.31×10^{-4}	2.39×10^{-6}

(a) To convert person-Sv to person-rem, multiply by 100.
(b) Early fatalities are fatalities related to high doses or dose rates that generally can be expected to occur within a year of the exposure (Jow et al. 1990).
(c) Latent fatalities are fatalities related to low doses or dose rates that could occur after a latent period of several (2 to 15) years.
(d) Cost risk includes costs associated with short-term relocation of people, decontamination, interdiction, and condemnation. It does not include costs associated with health effects (Jow et al. 1990)
(e) Land risk is farm land requiring decontamination prior to resumption of agricultural usage. To convert hectares (ha) to acres, multiply by 2.47.

Table 5-14. Mean Environmental Risk from the Surrogate AP1000 Severe Accidents at the Grand Gulf Early Site Permit Site

Release Category Description (Accident Class)		Core Damage Frequency (Ryr^{-1})	Environmental Risk: Population Dose (person-Sv Ryr^{-1})[(a)]	Fatalities (Ryr^{-1}): Early[(b)]	Fatalities (Ryr^{-1}): Latent[(c)]	Cost[(d)] ($ Ryr^{-1})	Land Requiring Decontamination[(e)] (ha Ryr^{-1})	Population Dose from Water Ingestion (person-Sv Ryr^{-1})[(a)]
CFI	Intermediate containment failure, after core relocation but before 24 hr	1.89×10^{-10}	7.49×10^{-7}	0	3.73×10^{-7}	1.27×10^{-1}	1.03×10^{-5}	8.18×10^{-8}
CFE	Early containment failure, after onset of core damage but before core relocation	7.47×10^{-9}	3.07×10^{-5}	0	1.46×10^{-6}	$5.81 \times 10^{+0}$	3.75×10^{-4}	6.08×10^{-6}
IC	Intact containment	2.21×10^{-7}	7.98×10^{-6}	0	3.98×10^{-7}	3.66×10^{-2}	2.48×10^{-6}	7.55×10^{-8}
BP	Containment bypass, fission products released directly to environment	1.05×10^{-8}	9.91×10^{-5}	0	4.72×10^{-6}	$1.93 \times 10^{+1}$	1.08×10^{-3}	3.86×10^{-5}
CI	Containment isolation failure occurs prior to onset of core damage	1.33×10^{-9}	4.90×10^{-6}	0	2.63×10^{-7}	8.66×10^{-1}	5.51×10^{-5}	8.47×10^{-7}
CFL	Late containment failure occurring after 24 hr	3.45×10^{-13}	1.83×10^{-9}	0	8.21×10^{-11}	3.81×10^{-4}	3.07×10^{-8}	1.69×10^{-11}
Total		2.40×10^{-7}	1.43×10^{-4}	$<1.00 \times 10^{-12}$	6.87×10^{-6}	$2.61 \times 10^{+1}$	1.53×10^{-3}	4.57×10^{-5}

(a) To convert person-Sv to person-rem, multiply by 100.
(b) Early fatalities are fatalities related to high doses or dose rates that generally can be expected to occur within a year of the exposure (Jow et al. 1990).
(c) Latent fatalities are fatalities related to low doses or dose rates that could occur after a latent period of several (2 to 15) years.
(d) Cost risk includes costs associated with short-term relocation of people, decontamination, interdiction, and condemnation. It does not include costs associated with health effects (Jow et al. 1990).
(e) Land risk is farm land requiring decontamination prior to resumption of agricultural usage. To convert hectares (ha) to acres, multiply by 2.47.

Table 5-15. Comparison of Environmental Risk for an Advanced Boiling Water Reactor or a Surrogate AP1000 at the Grand Gulf Early Site Permit Site with Risk for Five Sites Evaluated in NUREG-1150

Reactor Site	Core Damage Frequency (Ryr^{-1})	50-mi (80-km) Population Dose Risk (person-Sv Ryr^{-1})[(a)]	Fatalities (Ryr^{-1})		Average Individual Fatality Risk (Ryr^{-1})	
			Early	Latent	Early	Latent Cancer
Grand Gulf[(b)]	4.0×10^{-6}	5×10^{-1}	8×10^{-9}	9×10^{-4}	3×10^{-11}	3×10^{-10}
Peach Bottom[(b)]	4.5×10^{-6}	$7 \times 10^{+0}$	2×10^{-8}	5×10^{-3}	5×10^{-11}	4×10^{-10}
Sequoyah[(b)]	5.7×10^{-5}	$1 \times 10^{+1}$	3×10^{-5}	1×10^{-2}	1×10^{-8}	1×10^{-8}
Surry[(b)]	4.0×10^{-5}	$5 \times 10^{+0}$	2×10^{-6}	5×10^{-3}	2×10^{-8}	2×10^{-9}
Zion[(b)]	3.4×10^{-4}	$5 \times 10^{+1}$	1×10^{-4}	2×10^{-2}	9×10^{-9}	8×10^{-9}
ABWR[(c)]	1.6×10^{-7}	2×10^{-5}	1×10^{-12}	9×10^{-7}	2×10^{-14}	3×10^{-12}
AP1000[(c)]	2.4×10^{-7}	1×10^{-4}	$<1 \times 10^{-12}$	7×10^{-6}	0	2×10^{-11}

(a) To convert person-Sv to person-rem, multiply by 100.
(b) Risks were calculated using the MACCS code and presented in NUREG-1150 (NRC 1990).
(c) Calculated with MACCS2 code using Grand Gulf site-specific input.

The following quantitative health objectives are used in determining achievement of the safety goals:

- The risk to an average individual in the vicinity of a nuclear power plant of prompt fatalities that might result from reactor accidents should not exceed one-tenth of 1 percent (0.1 percent) of the sum of prompt fatality risks resulting from other accidents to which members of the U.S. population are generally exposed.

- The risk to the population in the area near a nuclear power plant of cancer fatalities that might result from nuclear power plant operation should not exceed one-tenth of 1 percent (0.1 percent) of the sum of cancer fatality risks resulting from all other causes.

These quantitative health objectives are translated into two numerical objectives as follows:

- The individual risk of a prompt fatality from all "other accidents to which members of the U.S. population are generally exposed," such as fatal automobile accidents, is about $5x10^{(-4)}$ per year. One-tenth of one percent of this figure implies that the individual risk of prompt fatality from a reactor accident should be less than $5x10^{(-7)}$ per reactor year.

- "The sum of cancer fatality risks resulting from all other causes" for an individual is taken to be the cancer fatality rate in the U.S. which is about 1 in 500 or $2x10^{(-3)}$ per year. One-tenth of 1 percent of this implies that the risk of cancer to the population in the area near a nuclear power plant because of its operation should be limited to $2x10^{(-6)}$ per reactor year.

The average individual early fatality risk is calculated using the population distribution within 1.6 km (1 mi) of the plant boundary. The average individual latent cancer fatality risk is calculated using the population distribution within 16 km (10 mi) of the plant. For the plants considered in NUREG-1150, these risks were well below the Commission's safety goals. 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.

The staff compared the core damage frequencies and population dose risk estimates for the ABWR and surrogate AP1000 reactors at the Grand Gulf ESP site with statistics summarizing the results of contemporary severe accident analyses performed for 28 current generation of operating reactors at 23 sites. The results of these analyses are included in the final site-specific Supplements 1 through 20 to the GEIS (NRC 1996), and in the environmental reports included with license renewal applications for those plants for which supplements have not been published. All of the analyses were completed after publication of NUREG-1150, and 23 of the analyses used MACCS2, which was released in 1997. Table 5-16 shows that the core damage frequencies estimated for the ABWR and surrogate AP1000 reactors are significantly

Table 5-16. Comparison of Environmental Risk from Severe Accidents Initiated by Internal Events for an Advanced Boiling Water Reactor and a Surrogate AP1000 at the Grand Gulf Early Site Permit Site with Risk Initiated by Internal Events

Reactor Site	Core Damage Frequency (yr^{-1})	50-mi (80-km) Population Dose Risk (person-Sv Ryr^{-1})[a]
Current Reactor Maximum[b]	2.4×10^{-4}	6.9×10^{-1}
Current Reactor Mean[b]	3.6×10^{-5}	1.5×10^{-1}
Current Reactor Median[b]	2.8×10^{-5}	1.4×10^{-1}
Current Reactor Minimum[b]	1.9×10^{-6}	5.5×10^{-3}
ABWR[c]	1.6×10^{-7}	2.1×10^{-5}
AP1000[c]	2.4×10^{-7}	1.4×10^{-4}

(a) To convert person-Sv to person-rem, multiply by 100.
(b) Based on MACCS and MACCS2 calculations for current plants undergoing operating license renewal.
(c) Calculated with MACCS2 code using Grand Gulf site-specific input.

lower than those of current generation reactors. Similarly, 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.

The population dose estimates and risks for the Grand Gulf ESP site in Tables 5-13 through 5-16 are based on the 2002 population for the region. Growth estimates provided by SERI indicate that the population in the region is expected to grow by a factor of 1.42 from 2002 to 2065 (SERI 2004g). The population risks for the ESP site may be multiplied by this factor to account for population growth. Even with this increase, the risks associated with either the ABWR or surrogate AP1000 reactors are low.

The staff compared the risk estimates given in Tables 5-13 and 5-14, the air pathway risks in Tables 5-15 and 5-16, and the average individual early fatality and average individual latent cancer fatality risks in Table 5-15 with the Commission's safety goals. Preliminary information on the IRIS and the ACR-700 reactor designs indicates that the surrogate AP1000 will likely bound the risk for these advanced reactor designs. Similarly, the ESBWR risk is expected to be bounded by the risk for the ABWR. Based on these comparisons, the staff concludes 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.

If, as stated in the environmental report, the releases from the gas-cooled reactor designs are bounded by the releases from the advanced LWR designs, then the site could be suitable for these gas-cooled reactors. The PPE does not contain specific parameters related to severe accidents for gas-cooled reactors, and the consequences of severe accidents have not been explicitly evaluated for gas-cooled reactors and would need to be evaluated at the CP/COL stage if such a design were selected. For the evaluation in this EIS to bound the reactor design selected at the CP/COL stage, an applicant would need to demonstrate that the environmental impacts of the air pathway releases for severe accidents at the Grand Gulf ESP site remains bounded by the environmental impacts from the surrogate designs.

5.10.2.2 *Surface Water Pathways*

Surface water pathways are an extension of the air pathway. These pathways cover the effects of radioactive material deposited on open bodies of water. The surface water pathways of interest include exposure to external radiation from submersion in water and activities near the water, ingestion of water, and ingestion of fish and other aquatic creatures. Of these pathways, the MACCS2 code only evaluates the ingestion of contaminated water. The risks associated with this surface water pathway calculated for the Grand Gulf ESP site are included in the last columns of Tables 5-13 and 5-14.

For each accident class, the population dose risk from ingestion of water is a small fraction of the dose risk from the air pathway. These dose estimates are conservative because there are no known downstream intakes within 160 km (100 mi) of the Grand Gulf ESP site that use the Mississippi River as a potable water supply. None of the public water supply systems in Mississippi that use surface water as a source are within 80 km (50 mi) of the ESP site (SERI 2003c), and there are only five public water supply systems in Louisiana within 80 km (50 mi) of the site that use surface water as a source (LDEQ 2001). Four of these withdraw water from Lake Bruin, which is about 13 km (8 mi) west-southwest of the site. The other water supply system that uses surface water is about 64 km (40 mi) to the south-southwest.

The Mississippi River is used for recreational activities including swimming and fishing. Doses from these surface water pathways are not modeled in MACCS or MACCS2. The GEIS (NRC 1996) considered typical population exposure risk for the aquatic food pathway for plants located on large rivers. For plants on large rivers, the population dose from the food pathway was well below the population dose from the air pathway. The proposed Grand Gulf ESP site is classified as being on a large river. Analysis of water-related exposure pathways at the Fermi reactor (NRC 1981b) suggests that population exposures from swimming are significantly lower than exposures from the aquatic ingestion pathway.

After considering the water ingestion dose estimates and the GEIS (NRC 1996), the staff concludes 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. In a similar fashion to the air pathway, the environmental impacts of the surface water pathways for other advanced LWRs are expected to be bounded by the ABWR and the surrogate AP1000. The environmental impacts of severe accidents for gas-cooled reactors have not been evaluated. The PPE does not contain specific parameters related to severe accidents for gas-cooled reactors, and the consequences of severe accidents for gas-cooled reactors will need to be evaluated at the CP/COL stage if such a design were selected. For this evaluation to bound the reactor design selected at the CP/COL stage, an applicant would need to demonstrate that the environmental impacts of the surface water pathway releases for severe accidents at the Grand Gulf ESP site remain bounded by the environmental impacts from the surrogate designs.

5.10.2.3 Groundwater Pathway

Neither MACCS nor MACCS2 evaluates the environmental risks associated with severe accident releases of radioactive material to groundwater. However, this pathway has been addressed in the GEIS in the context of renewal of licenses for the current generation reactors (NRC 1996). The GEIS assumes a 1×10^{-4} Ryr^{-1} probability of occurrence of a severe accident with a basemat melt-through leading to potential groundwater contamination, and the staff concluded that groundwater generally contributed a small fraction of the risk attributable to the atmospheric pathway. Although the staff assumed that the probability of occurrence of a release via the groundwater pathway is significantly larger than a release via the atmospheric pathway for either the ABWR or the surrogate AP1000, the groundwater pathway is more tortuous and affords a greater time for implementing protective actions and, therefore, results in a lower risk to the public. As a result, the staff concludes that the risks associated with releases to groundwater are small for the proposed Grand Gulf ESP site.

5.10.2.4 Summary of Severe Accident Impacts

Although SERI chose the PPE approach in the overall ESP application, it based its evaluation of the environmental impact of severe accidents on characteristics of the ABWR and the surrogate AP1000 reactor designs (SERI 2004g). The NRC staff reviewed the analysis in the environmental report and conducted its own confirmatory analysis using the MACCS2 code. The results of both the SERI analysis and the NRC analysis indicate that the environmental risks associated with severe accidents if an advanced LWR were to be located at the Grand Gulf ESP site would be small compared to risks associated with operation of current-generation reactors at the Grand Gulf site and other sites. These risks are well below the Commission's safety goals. On these bases, the staff concludes that the probability weighted consequences of severe accidents at the Grand Gulf ESP site are of SMALL significance for an advanced LWR. The environmental impacts of severe accidents for designs not evaluated in this EIS would need to be evaluated at the CP/COL stage. For this evaluation to bound the reactor design selected at the CP/COL stage, an applicant would need to demonstrate that the environmental impacts of severe accidents at the Grand Gulf ESP site remain bounded by the environmental impacts discussed herein.

5.10.3 Summary of Postulated Accident Impacts

The staff evaluated the environmental impacts from DBAs and severe accidents using the ABWR and the surrogate AP1000 to characterize the environmental impacts from advanced LWRs. As described previously, preliminary information on the IRIS and the ACR-700 reactor designs indicates that the surrogate AP1000 would likely bound the source terms for the design basis and severe accidents. Consequently, the staff considers it likely that doses from surrogate AP1000 DBAs would bound the doses from DBAs for the IRIS and ACR-700 designs, and that the probability weighted consequences of severe accidents for the surrogate AP1000 would bound the probability weighted consequences for IRIS and ACR-700 severe accidents. Similarly, the accident source terms, DBA doses, and probability weighted consequences of severe accidents for an ESBWR are expected to be bounded by those for an ABWR.

Based on the information provided by SERI and the staff's independent review, the staff concludes that the potential environmental impacts from a postulated accident from the operation of two additional nuclear power units would be SMALL for the operation of advanced LWRs. The staff did not explicitly evaluate the design basis or severe accident impacts for gas-cooled reactors, which would need to be evaluated at the CP/COL stage if such a design were selected. For this evaluation to bound the reactor design selected at the CP/COL stage, an applicant would need to demonstrate that the environmental impacts of design basis and severe accidents at the Grand Gulf ESP site remain bounded by the environmental impacts from the ABWR and surrogate AP1000 designs.

5.11 Measures and Controls to Limit Adverse Impacts During Operation

The following general measures and controls on which the staff relied in their evaluation of environmental impact during operation of the proposed new unit or units at the Grand Gulf ESP site include those for which SERI would be required by applicable permits (Federal, State, and local) and authorizations as well as the feasible measures and controls contained in Table 5.10-1 of the environmental report (ER) (SERI 2003c):

- Compliance with the applicable Federal, State, and local laws, ordinances, and regulations that prevent or minimize adverse environmental impact (for example, solid waste management, erosion and sediment control, air emission control, noise control, storm water management, spill response and cleanup, hazardous material management)

- Compliance with applicable requirements of permits and licenses required for operation (for example, NPDES permit, operating license).

Some of these permits or approvals include:

- Compliance with NPDES permit requirements imposed on water discharges from the new units (ER, Section 5.2)

- Compliance with MDEQ permit limits and regulations for installing and operating air emission sources (ER, Section 5.3)

- Compliance with SERI and Entergy procedures applicable to environmental control and management.

SERI specifically identified the following general plans or specific mitigation measures in its environmental report on which the staff relied in its evaluation:

- Incorporating drift eliminators into design of cooling towers to minimize potential for salt deposition (ER, Sections 5.1.1, 5.3.3)

- Maintaining natural drainage patterns as much as practicable (ER, Section 5.2.1)

- Maintaining sedimentation basins to minimize sedimentation to Hamilton Lake (ER, Section 5.2.1, 5.2.2)

- Disposing dredge spoils as required by ACE and MDEQ (ER, Section 5.2.2)

- Designing intake pipes/screens to minimize potential for impingement and entrainment (ER, Section 5.3.1)

- Maintaining/restoring bank stabilization following any construction on the river shore (ER, Section 5.3.2)

- Using proven industrial hygiene principles to reduce worker exposure to microorganisms (ER, Section 5.3.4)

- Treating effluents containing biocides or other chemicals prior to discharge, in compliance with NPDES permit requirements. Onsite sanitary waste treatment would include tertiary treatment. SERI would also develop and implement a Storm Water Pollution Prevention Plan to manage runoff (ER, Section 5.5.1)

- Collecting and storing chemical wastes and waste petroleum products; disposing or recycling offsite at licensed facilities (ER, Section 5.5.1)

- Developing and implementing ALARA requirements to mitigate occupational exposures to radioactive and mixed wastes (ER, Section 5.5.2)

- Instituting flexible work hours and additional road improvements, such as traffic lights or turn lanes, as needed to mitigate effects on local traffic (ER, Section 5.8.2)

- Increasing revenue to Claiborne County and the City of Port Gibson to support emergency services (ER, Section 5.8.2).

SERI evaluated the measures and controls shown in Table 5.10-1 of the environmental report (SERI 2003c) and considered them feasible from both a technical and economic standpoint. In addition, SERI expects that these measures and controls would be adequate for avoiding or mitigating potential adverse impact associated with operation of the new units. The staff considered these measures and controls in its evaluation of station operation impact.

5.12 Summary of Operational Impacts

Table 5-17 shows impact level categories as SMALL, MODERATE, or LARGE as a measure of their expected adverse impacts, if any. A brief statement in the "comments" column explains the basis for the impact level. Some impacts, such as the addition of tax revenue for the local economies, are likely to be beneficial. The beneficial aspect is also reflected in the "comments" column.

Table 5-17. Characterization of Operational Impacts at the Grand Gulf Early Site Permit Site

Category	Comments	Impact Level
Land use impacts		--
Site and vicinity	Operation of new units within existing site. Minimal impacts from cooling tower drift.	SMALL
Power transmission corridors	Upgrade of existing transmission corridors would be needed.	SMALL
Air quality impacts	Air quality impacts are expected to be negligible. Pollutants emitted during operations are considered to be insignificant and limits could be incorporated under existing Exclusionary Permit.	SMALL

Table 5-17. (contd)

Category	Comments	Impact Level
Water-related impacts		--
Water use	Water use from the Mississippi River would be a small fraction of even the lowest flows.	SMALL
Water quality	Impact on water quality would be small and would be regulated by the Mississippi Department of Environmental Quality.	SMALL
Hydrological alterations	No significant changes in surface hydrology would result from plant operation.	SMALL
Ecological impacts		--
Terrestrial ecosystems	No detectable impacts are expected.	SMALL
Aquatic ecosystems	Impact would be minimal because of the use of cooling towers	SMALL
Threatened and endangered species	No impacts to Federally listed or State-listed species are likely to be detectable	SMALL
Socioeconomic impacts		--
Physical impacts		SMALL
Workers/public	Workers would use protective equipment and receive training to mitigate any possible impact. The Grand Gulf location is relatively remote, so the public would not be affected.	–
Buildings	No impacts to onsite or offsite buildings.	–
Roads	Upgrades before or during construction would cover the lesser impact of operational work forces.	–
Aesthetics	Visual impacts would be minimal because of the remote location.	–
Demography	Number of new employees would be small in proportion to population base in the region. If in-migrating population settles according to current patterns for Grand Gulf Unit 1, the impact on Port Gibson could be moderate.	SMALL to MODERATE
Social and economic		LARGE Beneficial to SMALL Beneficial
Economy	Increased jobs would benefit the area economically, up to a moderate beneficial impact (Warren County) is possible.	–
Taxes	Depends on residence location and distribution of revenues (to county or state); generally impact is beneficial, especially for property taxes and employment. Beneficial impact of additional taxes would be small to large for Claiborne County.	–

Table 5-17. (contd)

Category	Comments	Impact Level
Infrastructure and community services		SMALL to MODERATE
Transportation	Improvements made for construction would be sufficient to cover any adverse impact from additional operational workers.	–
Recreation	Overall impacts to recreation would be minimal because of the remote location and fact that the proposed ESP facility would be operating in an area with an existing nuclear power facility.	–
Housing	Adequate housing is available in the region to handle operational workers.	–
Public services	Adequate in region for any population increase resulting from operation workforce. Claiborne County may be more affected by demands on police, fire, and medical resources.	–
Education	Current schools and planned additions would handle additional students. Claiborne County could be more affected if worker distribution is similar to that for existing Grand Gulf Unit 1.	–
Historic and cultural resources	A cultural resource program would be implemented for minimizing impacts from routine land disturbances.	SMALL
Environmental justice	Physical impacts would be small. Economic impacts vary from large beneficial to moderate adverse, depending on the how the new facility is treated for tax purposes.	LARGE Beneficial to MODERATE Adverse
Nonradiological health impacts	Health impacts would be monitored and controlled in accordance with Occupational Safety and Health regulations.	SMALL
Radiological health impacts	Doses to public and occupational workers would be monitored and controlled in accordance with NRC limits.	SMALL

Table 5-17. (contd)

Category	Comments	Impact Level
Impacts of postulated accidents		--
Design-basis accidents (DBAs)	Doses for advanced LWRs are expected to be a small fraction of the regulatory dose limits. An applicant would demonstrate that doses for postulated DBAs on chosen reactor designs are within regulatory limits.	SMALL
Severe accidents	Risks for advanced LWRs would be small. If gas-cooled reactor is selected at the construction permit/combined license stage, then an applicant would analyze the severe accident impact for gas-cooled reactors.	SMALL

5.13 References

10 CFR Part 20. Code of Federal Regulations, Title 10, *Energy*, Part 20, "Standards for Protection Against Radiation."

10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities."

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 100. Code of Federal Regulations, Title 10, *Energy*, Part 100, "Reactor Site Criteria."

18 CFR Part 35. Code of Federal Regulations, Title 18, *Conservation of Power and Water Resources*, Part 35, "Filing of Rate Schedules and Tariffs," Section 28(f), FERC Order No. 2003, "Standardization of Generator Interconnection Agreements and Procedures." 68 FR 49845 (August 19, 2003), FERC Statutes & Regulations ¶ 31, 146. Federal Energy Regulatory Commission, 2003.

24 CFR Part 51. Code of Federal Regulations, Title 24, *Housing and Urban Development*, Part 51, "Environmental Criteria and Standards."

36 CFR Part 800. Code of Federal Regulations, Title 36, *Parks, Forests, and Public Property*, Part 800, "Protection of Historic Properties."

40 CFR Part 9. Code of Federal Regulations, Title 40, *Protection of the Environment*, Part 9, "OMB Approvals Under the Paperwork Reduction Act."

40 CFR Part 122. Code of Federal Regulations, Title 40, *Protection of the Environment*, Part 122, "EPA Administered Permit Programs: the National Pollutant Discharge Elimination System."

40 CFR Part 190. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operation."

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69 FR 41576. July 9, 2004. "National Pollutant Discharge Elimination System-Final Regulations to Establish Requirements for Cooling Water Intake Structures at Phase II Existing Facilities; Final Rule." *Federal Register.*

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6.0 Fuel Cycle, Transportation, and Decommissioning

This chapter addresses 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. Distinctions between the impacts of advanced light water reactor (LWR) designs and the gas-cooled reactor designs are discussed.

In its evaluation of uranium fuel cycle impacts for the Grand Gulf ESP site, System Energy Resources, Inc. (SERI) used the plant parameter envelope (PPE) approach for the advanced LWR designs but not for the two gas-cooled reactors. In its evaluation of the impacts from transportation of radioactive materials SERI did not use the PPE approach, but rather evaluated each reactor design individually. SERI would, therefore, have to perform a new evaluation if a different design is proposed at the construction permit (CP) or combined license (COL) stage.

6.1 Fuel Cycle Impacts and Solid Waste Management

This section discusses the environmental impacts from the uranium fuel cycle and solid waste management for both the advanced LWR designs and gas-cooled reactor designs. The impacts of the two types of design are presented separately because Title 10 of the Code of Federal Regulations (CFR), Section 51.51 (10 CFR 51.51) provides specific criteria for evaluating the environmental impacts for only LWR designs.

6.1.1 Light-Water Reactors

The regulations in 10 CFR 51.51(a) state that

> Every environmental report prepared for the construction permit stage of a light-water-cooled nuclear power reactor, and submitted on or after September 4, 1979, shall take Table S–3, Table of Uranium Fuel Cycle Environmental Data, as the basis for evaluating the contribution of the environmental effects of uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, reprocessing of irradiated fuel, transportation of radioactive materials and management of low level waste and high level wastes related to uranium fuel cycle activities to the environmental costs of licensing the nuclear power reactor. Table S–3 shall be included in the environmental report and may be supplemented by a discussion of the environmental significance of the data set forth in the table as weighed in the analysis for the proposed facility.

The PPE for the new units at the Grand Gulf ESP site uses the bounding input parameters from the following LWR designs:

- Advanced Canada Deuterium Uranium Reactor (ACR-700) – This reactor, developed by Atomic Energy Canada Limited, is an evolutionary extension of CANDU 6 plant using very slightly enriched uranium fuel and light-water coolant.

- Advanced Boiling Water Reactor (ABWR) – This reactor, developed by General Electric Company, is a standardized plant that has been certified under the U.S. Nuclear Regulatory Commission (NRC) requirements in 10 CFR Part 52. The ABWR is fueled with slightly enriched uranium and uses a light-water cooling system.

- Advanced Pressurized Water Reactor (AP1000) – This is an earlier version of the AP1000 reactor final design developed by Westinghouse Electric Company and subsequently approved by the NRC, using slightly enriched uranium and a light-water cooling system. This design is not the AP1000 that has received final design approval from the NRC; therefore, this design will be referred to as the "surrogate AP1000."

- Economic Simplified Boiling Water Reactor (ESBWR) – This reactor, developed by General Electric Company, is fueled with slightly enriched uranium and uses a light-water cooling system.

- International Reactor Innovative and Secure (IRIS) next-generation pressurized water reactor (PWR) – This reactor, under development by a consortium led by Westinghouse Electric Company, is a modular LWR.

These light-water designs all use uranium dioxide fuel; therefore, Table S–3 can be used to assess environmental impacts. Table S–3 values are normalized for a reference 1000-MW(e) LWR at an 80 percent capacity factor. The 10 CFR 51.51(b) Table S–3 values are reproduced in Table 6-1. The PPE power rating for the Grand Gulf ESP site is 8600 MW(t) with a net electrical output of up to 3000 MW(e) (SERI 2003b).

Specific categories of natural resource use are included in Table S–3 (see Table 6-1). These categories relate to land-use, water consumption and thermal effluents, radioactive releases, burial of transuranic and high-level and low-level wastes, and radiation doses from transportation and occupational exposures. Originally, two fuel cycle options were considered, which differed in the treatment of spent fuel removed from a reactor. "No recycle" treats all spent fuel as waste to be stored at a Federal waste repository; "uranium only recycle" involves reprocessing spent fuel to recover unused uranium and return it to the system. Neither cycle involves the recovery of plutonium. The contributions in Table S–3 resulting from reprocessing, waste management, and transportation of wastes are maximized for either of the two fuel cycles (uranium only and no recycle); that is, the identified environmental impacts are based on the cycle that results in the greater impact. The uranium fuel cycle is defined as the total of those operations and processes associated with provision, utilization, and ultimate disposition of fuel for nuclear power reactors.

Table 6-1. Table S–3 from 10 CFR 51.51 (b), Table S–3 — Table of Uranium Fuel Cycle Environmental Data[1]

Environmental considerations	Total	Maximum effect per annual fuel requirement or reference reactor year of model 1,000 MWe LWR
Natural Resource Use		
Land (acres):		
Temporarily committed[2]	100	
Undisturbed area	79	
Disturbed area	22	Equivalent to a 110 MWe coal-fired power plant.
Permanently committed	13	
Overburden moved (millions of MT)	2.8	Equivalent to 95 MWe coal-fired power plant.
Water (millions of gallons):		
Discharged to air	160	=2 percent of model 1,000 MWe LWR with cooling tower.
Discharged to water bodies	11,090	
Discharged to ground	127	
Total	11,377	<4 percent of model 1,000 MWe LWR with once-through cooling.
Fossil fuel:		
Electrical energy (thousands of MW-hr)	323	<5 percent of model 1,000 MWe LWR output.
Equivalent coal (thousands of MT)	118	Equivalent to the consumption of a 45 MWe coal-fired power plant.
Natural gas (millions of standard cubic feet)	135	<0.4 percent of model 1,000 MWe energy output.
Effluents–Chemical (MT)		
Gases (including entrainment):[3]		
SO_x	4,400	
NO_x[4]	1,190	Equivalent to emissions from 45 MWe coal-fired plant for a year.
Hydrocarbons	14	
CO	29.6	
Particulates	1,154	

Table 6-1. (contd)

Environmental considerations	Total	Maximum effect per annual fuel requirement or reference reactor year of model 1,000 MWe LWR
Other gases:		
F	.67	Principally from UF_6 production, enrichment, and reprocessing. Concentration within range of state standards—below level that has effects on human health.
HCl	.014	
Liquids:		
SO^-_4	9.9	From enrichment, fuel fabrication, and reprocessing steps. Components that constitute a potential for adverse environmental effect are present in dilute concentrations and receive additional dilution by receiving bodies of water to levels below permissible standards. The constituents that require dilution and the flow of dilution water are: NH_3–600 cfs., NO_3–20 cfs., Fluoride–70 cfs.
NO^-_3	25.8	
Fluoride	12.9	
Ca^{++}	5.4	
Cl^-	8.5	
Na^+	12.1	
NH_3	10.0	
Fe	.4	
Tailings solutions (thousands of MT)	240	From mills only—no significant effluents to environment.
Solids	91,000	Principally from mills-no significant effluents to environment.
Effluents—Radiological (curies)		
Gases (including entrainment):		
Rn–222	......	Presently under reconsideration by the Commission.
Ra–226	.02	
Th–230	.02	
Uranium	.034	
Tritium (thousands)	18.1	
C–14	24	
Kr–85 (thousands)	400	
Ru–106	.14	Principally from fuel reprocessing plants.
I–129	1.3	
I–131	.83	
Tc–99	......	Presently under consideration by the Commission.
Fission products and transuranics	.203	
Liquids:		
Uranium and daughters	2.1	Principally from milling—included tailings liquor and returned to ground—no effluents; therefore, no effect on environment.
Ra–226	.0034	From UF_6 production.
Th–230	.0015	
Th–234	.01	From fuel fabrication plants—concentration 10 percent of 10 CFR 20 for total processing 26 annual fuel requirements for model LWR.
Fission and activation products	5.9×10^{-6}	
Solids (buried on site):		

Table 6-1. (contd)

Environmental considerations	Total	Maximum effect per annual fuel requirement or reference reactor year of model 1,000 MWe LWR
Other than high level (shallow)	11,300	9,100 Ci comes from low level reactor wastes and 1,500 Ci comes from reactor decontamination and decommissioning—buried at land burial facilities. 600 Ci comes from mills—included in tailings returned to ground. Approximately 60 Ci comes from conversion and spent fuel storage. No significant effluent to the environment.
TRU and HLW (deep)	1.1×10^7	Buried at Federal Repository.
Effluents—thermal (billions of British thermal units)	4,063	<5 percent of model 1,000 MWe LWR
Transportation (person-rem):		
Exposure of workers and general public	2.5	
Occupational exposure (person-rem)	22.6	From reprocessing and waste management.

[1] In some cases where no entry appears it is clear from the background documents that the matter was addressed and that, in effect, the Table should be read as if a specific zero entry had been made. However, there are other areas that are not addressed at all in the Table. Table S–3 does not include health effects from the effluents described in the Table, or estimates of releases of Radon-222 from the uranium fuel cycle or estimates of Technetium-99 released from waste management or reprocessing activities. These issues may be the subject of litigation in the individual licensing proceedings.

Data supporting this table are given in the "Environmental Survey of the Uranium Fuel Cycle," WASH–1248, April 1974; the "Environmental Survey of the Reprocessing and Waste Management Portion of the LWR Fuel Cycle," NUREG–0116 (Supp.1 to WASH–1248, NRC 1976); the "Public Comments and Task Force Responses Regarding the Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle," NUREG–0216 (Supp. 2 to WASH–1248) (NRC 1977b); and in the record of the final rulemaking pertaining to Uranium Fuel Cycle Impacts from Spent Fuel Reprocessing and Radioactive Waste Management, Docket RM–50–3. The contributions from reprocessing, waste management and transportation of wastes are maximized for either of the two fuel cycles (uranium only and no recycle). The contribution from transportation excludes transportation of cold fuel to a reactor and of irradiated fuel and radioactive wastes from a reactor which are considered in Table S–4 of §51.20(g). The contributions from the other steps of the fuel cycle are given in columns A-E of Table S–3A of WASH-1248.

[2] The contributions to temporarily committed land from reprocessing are not prorated over 30 years, since the complete temporary impact accrues regardless of whether the plant services one reactor for one year or 57 reactors for 30 years.

[3] Estimated effluents based upon combustion of equivalent coal for power generation.

[4] 1.2 percent from natural gas use and process.

Because current Federal policy does not consistently support reprocessing spent fuel, only the no-recycle option is considered here. This option is presented schematically in Figure 6-1. Natural uranium is mined in either open-pit or underground mines or by an in situ leach solution mining process. In situ leach mining, the primary form of mining in the United States today, involves injecting a lixiviant solution into the uranium ore body to dissolve uranium and then pumping the solution to the surface for further processing. The ore or in situ leach solution is transferred to mills where it is processed to produce uranium oxide or "yellowcake." A conversion facility prepares the uranium oxide from the mills for enrichment by converting it to uranium hexafluoride, which is then processed to separate the relatively nonfissile isotope uranium-238 from the more fissile isotope uranium-235. At a fuel-fabrication facility, the enriched uranium, which is approximately 5 percent uranium-235, is then converted to uranium dioxide (UO_2). The UO_2 is pelletized, sintered, and inserted into tubes to form fuel assemblies. The fuel assemblies are placed in the reactor to produce power. When the content of the uranium-235 reaches a point where the nuclear reactor has become inefficient with respect to neutron economy, the fuel assemblies are withdrawn from the reactor. After onsite storage for sufficient time to allow for short-lived fission product decay and to reduce the heat generation rate, the fuel assemblies would be transferred to a waste repository for internment. Disposal of spent fuel elements in a repository constitutes the final step in the no-recycle option.

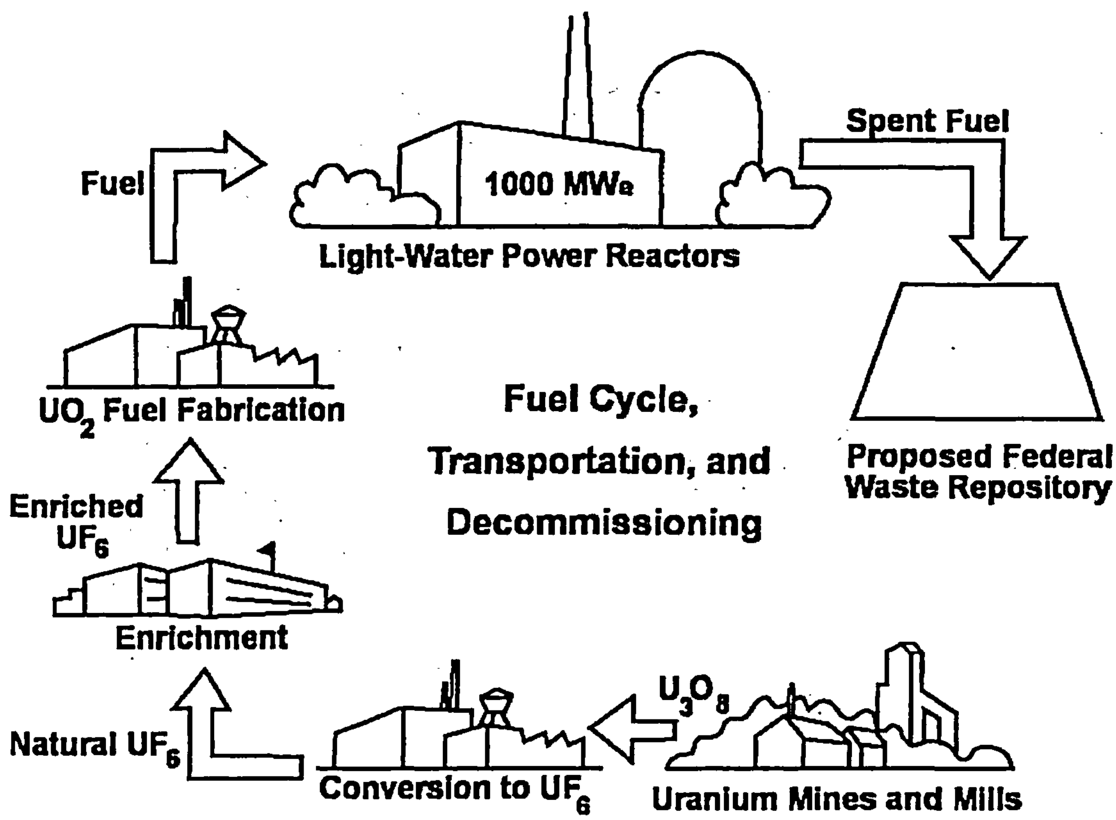

Figure 6-1. The Uranium Fuel Cycle: No-Recycle Option (derived from NRC 2000)

The following assessment of the environmental impacts of the fuel cycle as related to the operation of the proposed project is based on the values given in Table S–3 (see Table 6-1) and the staff's analysis of the radiological impact from radon and technetium. In NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (NRC 1996), the staff provides a detailed analysis of the environmental impacts from the uranium fuel cycle. Although NUREG-1437 is specific to the impacts related to license renewal, the information is relevant to this review because the advanced LWR designs considered here use the same type of fuel; the staff's analyses in Section 6.2.3 of NUREG-1437 are summarized and incorporated by reference here.

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). In the following review and evaluation of the environmental impacts of the fuel cycle, the staff considered the capacity factor in the PPE of 95 percent with a total net electric output of 3000 MW(e) for the ESP site (SERI 2003b); this results in approximately four times the impact values in Table S–3 (see Table 6-1). Throughout this chapter this will be referred to as the 1000-MW(e) LWR-scaled model, reflecting 3000 MW(e) for the site.

Recent changes in the fuel cycle may have some bearing on environmental impacts; however, as discussed below, the staff is confident that the contemporary fuel cycle impacts below are those identified in Table S–3.

The values in Table S–3 were calculated from industry averages for the performance of each type of facility or operation within the fuel cycle. Recognizing that this approach meant that there would be a range of reasonable values for each estimate, the staff followed the policy of choosing the assumptions or factors to be applied so that the calculated values would not be underestimated. This approach was intended to ensure that the actual environmental impacts would be less than the quantities shown in Table S–3 for all LWR nuclear power plants within the widest range of operating conditions. Many subtle fuel cycle parameters and interactions were recognized by the staff as being less than the precision of the estimates and were not considered or were considered but had no effect on the Table S–3 calculations. For example, to determine the quantity of fuel required for a year's operation of a nuclear power plant in Table S–3, the staff defined the model reactor as a 1000-MW(e) light-water-cooled reactor operating at 80-percent capacity with a 12-month fuel reloading cycle and an average fuel burnup of 33,000 MWd/MTU. This is a "reactor reference year" or "reference reactor-year" depending on the source (either Table S–3 or NUREG-1437), but it has the same meaning. The sum of the initial fuel loading plus all of the reloads for the lifetime of the reactor can be divided by the now more likely 60-year (40-year initial license term and 20-year license renewal term) lifetime to obtain an average annual fuel requirement. This was done for both boiling water reactors (BWRs) and PWRs; the higher annual requirement, 35 metric tonnes (MT) of uranium made into fuel for a BWR, was chosen in NUREG-1437 as the basis for the reference reactor-year. A number of fuel management improvements have been adopted by nuclear power plants to achieve higher performance and to reduce fuel and separative work (enrichment) requirements. Since Table S–3 was promulgated, these improvements have reduced the annual fuel requirement.

Another change is the elimination of the U.S. restrictions on the importation of foreign uranium. The economic conditions of the uranium market now and in the foreseeable future favor full utilization of foreign uranium at the expense of the domestic uranium industry. These market conditions have forced the closing of most U.S. uranium mines and mills, substantially reducing the environmental impacts in the United States from these activities. However, the Table S–3 estimates have not been reduced accordingly to ensure that these impacts, which have been experienced in the past and may be fully experienced again in the future, are considered.

Section 6.2 of NUREG-1437 discusses the sensitivity to recent changes in the fuel cycle on the environmental impacts in greater detail.

6.1.1.1 Land Use

The total annual land requirement for the fuel cycle supporting the 1000-MW(e) LWR-scaled model is about 184 ha (452 ac). Approximately 20 ha (52 ac) are permanently committed land, and 164 ha (400 ac) are temporarily committed. A "temporary" land commitment is a commitment for the life of the specific fuel cycle plant (e.g., a mill, enrichment plant, or succeeding plants). Following completion of decommissioning, such land can be released for unrestricted use. "Permanent" commitments represent land that may not be released for use after plant shutdown and/or decommissioning because decommissioning activities do not result in removal of sufficient radioactive material to meet the limits in 10 CFR Part 20, Subpart E for release of that area for unrestricted use. Of the 164 ha (400 ac) of temporarily committed land, 128 ha (316 ac) are undisturbed and 36 ha (88 ac) are disturbed. In comparison, a coal-fired power plant of 3200-MW(e) capacity using strip-mined coal requires the disturbance of about 324 ha (800 ac) per year for fuel alone. The staff concludes that the impacts on land-use to support the 1000-MW(e) LWR-scaled model would be small.

6.1.1.2 Water Use

Principal water use for the fuel cycle supporting a 1000-MW(e) LWR-scaled model is that required to remove waste heat from the power stations supplying electrical energy to the enrichment step of this cycle. Scaling from Table S–3, of the total annual water use of 1.78×10^8 m^3 (4.55×10^{10} gal), about 1.6×10^8 m^3 (4.44×10^{10} gal) are required for the removal of waste heat, assuming that these plants use once-through cooling. Other water uses involve the discharge to air (e.g., evaporation losses in process cooling) of about

2.42×10^6 m^3/yr (6.4×10^8 gal/yr) and water discharged to ground (e.g., mine drainage) of about 1.92×10^6 m^3/yr (5.1×10^8 gal/yr) relative to the water use and thermal discharges.

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. The consumptive water use of 2.42×10^6 m^3/yr (6.4×10^8 gal/yr) is about 2 percent of the 1000-MW(e) LWR-scaled model using cooling towers. 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. Under this condition, thermal effluents would be negligible. The staff concludes that the impacts on water use for these combinations of thermal loadings and water consumption would be small relative to the water use and thermal discharges.

6.1.1.3 Fossil Fuel Impacts

Electric energy and process heat are required during various phases of the fuel cycle process. The electric energy is usually produced by the combustion of fossil fuel at conventional power plants. Electric energy associated with the fuel cycle represents about 5 percent of the annual electric power production of the reference 1000-MW(e) LWR. Process heat is primarily generated by the combustion of natural gas. This gas consumption, if used to generate electricity, would be less than 0.4 percent of the electrical output from the scaled model plant. The staff concludes that the fossil fuel impacts from the direct and indirect consumption of electric energy for fuel cycle operations would be small relative to the net power production of the proposed project.

6.1.1.4 Chemical Effluents

The quantities of chemical, gaseous, and particulate effluents from fuel cycle processes are given in Table S–3 (see Table 6-1) for the reference 1000-MW(e) LWR. The quantities of effluents would be approximately four times greater for the reference 1000-MW(e) LWR-scaled model. The principal effluents are SO_x, NO_x, and particulates. Based on data in *The Seventh Annual Report of the Council on Environmental Quality*, these emissions constitute a small additional atmospheric loading in comparison with the emissions from the stationary fuel combustion and transportation sectors in the United States. The fuel cycle emissions constitute about 0.08 percent of the annual national releases for each of these effluents (CEQ 1976).

Liquid chemical effluents produced in fuel cycle processes are related to fuel enrichment and fabrication and may be released to receiving waters. These effluents are usually present in dilute concentrations such that only small amounts of dilution water are required to reach levels of concentration that are within established standards. Table S–3 (see Table 6-1) specifies the amount of dilution water required for specific constituents. Additionally, all liquid discharges into the navigable waters of the United States from plants associated with the fuel cycle operations will be subject to requirements and limitations set by an appropriate Federal, State, regional, local, or affected Native American tribal regulatory agency.

Tailings solutions and solids are generated during the milling process and are not released in quantities sufficient to have a significant impact on the environment.

The staff determined that the impacts of these chemical effluents would be small.

6.1.1.5 Radioactive Effluents

Radioactive effluents estimated to be released to the environment from waste management activities and certain other phases of the fuel cycle process are set forth in Table S–3 (see Table 6-1). Using these data, the staff has calculated the 100-year environmental dose commitment to the U.S. population from the LWR-supporting fuel cycle for 1 year of operation of the 1000-MW(e) LWR-scaled model. This calculation estimates that the overall whole body gaseous dose commitment to the U.S. population from the fuel cycle (excluding reactor releases and the dose commitments resulting from radon-222 and technetium-99) would be approximately 16 person-Sv (1600 person-rem) per year of operation of the 1000-MW(e) LWR-scaled model; this reference reactor year is scaled to reflect the total electric power rating for the site for a year.

The additional whole body dose commitment to the U.S. population from radioactive liquid effluents from all fuel cycle operations other than reactor operation would be approximately 8 person-Sv (800 person-rem) per year of operation of the 1000 MW(e) LWR-scaled model. 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.

Currently, the radiological impacts associated with radon-222 and technetium-99 release are not addressed in Table S–3. Principal radon releases occur during mining and milling operations and as emissions from mill tailings, whereas principal technetium-99 releases occur from gaseous diffusion enrichment facilities. SERI provided an assessment of radon-222 and technetium-99 in its response to a request for additional information on February 3, 2005 (SERI 2005). This evaluation relied on the information discussed in NUREG-1437.

In Section 6.2 of NUREG-1437, the staff estimated the radon-222 releases from mining and milling operation, and from mill tailings for each year of operations of the reference 1000-MW(e) LWR. The estimated releases of radon-222 for the reference reactor year for the 1000-MW(e) LWR-scaled model, or for the total electric power rating for the site for a year, is approximately

7.7×10^{14} Bq (20,800 Ci). Of this total, about 78 percent would be from mining, 15 percent from milling operations, 7 percent from inactive tails prior to stabilization. For radon releases from stabilized tailings, the staff assumed that the scaled model would result in an emission of 1.5×10^{11} Bq (4 Ci) per site year; i.e., four times the NUREG-1437 estimate for the reference reactor year. The major risks from radon-222 are from exposure to the bone and the lung, although there is a small risk from exposure to the whole body. The organ-specific dose weighting factors from 10 CFR 20.1003 were applied to the bone and lung doses to estimate the 100-year dose commitment from radon-222 to the whole body. The estimated 100-year environmental dose commitment 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) to the whole body. From stabilized tailings piles, the estimated 100-year environmental dose commitment would be approximately 0.93 person-Sv (93 person-rem) to the whole body. Additional insights regarding National policy/resource perspectives regarding institutional controls comparisons with routine radon-222 exposure and risk, and long-term releases from stabilized tailings piles are discussed in NUREG-1437. SERI provided an assessment of radon-222 and technetium-99 in its response to a request for additional information on February 3, 2005 (SERI 2005). This evaluation relied on the information discussed in NUREG-1437.

Also as discussed in NUREG-1437, the staff considered the potential health effects associated with the releases of technetium-99. The estimated releases of technetium-99 for the reference reactor-year for the 1000 MW(e) LWR-scaled model are 1.1×10^{9} Bq (0.03 Ci) from chemical processing of recycled uranium hexafluoride before it enters the isotope enrichment cascade and 7.4×10^{8} Bq (0.02 Ci) into the groundwater from a repository. The major risks from technetium-99 are from exposure of the gastrointestinal tract and kidney, although there is a small risk from exposure to the whole body. Applying the organ-specific dose weighting factors from 10 CFR 20.1003 to the gastrointestinal tract and kidney doses, the total-body 100-year dose commitment from technetium-99 to the whole body was estimated to be 4 person-Sv (400 person-rem) for the 1000 MW(e) LWR-scaled model.

Although radiation may cause cancers at high doses and high dose rates, currently there are no data that unequivocally establish the occurrence of cancer following exposure to low doses and dose rates, below about 100 mSv (10,000 mrem). However, radiation protection experts conservatively assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. Simply stated, any increase in dose, no matter how small, results in an incremental increase in health risk. This theory is accepted by the NRC as a conservative model for estimating health risks from radiation exposure, recognizing that the model probably overestimates those risks.

Based on this model, the staff estimated the risk to the public from radiation exposure using the nominal probability coefficient for total detriment (730 fatal cancers, nonfatal cancers, and severe hereditary effects per 10,000 person-Sv [1,000,000 person-rem]) from International Commission on Radiation Protection Publication 60 (ICRP 1990). This coefficient was multiplied by the sum of the estimated whole body population doses discussed above, approximately 65 person-Sv/yr (6500 person-rem/yr), to calculate that the U.S. population would incur a total of approximately 4.8 fatal cancers, nonfatal cancers, and severe hereditary effects annually. This risk is 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.

Radon releases from tailings are indistinguishable from background radiation levels at a few km from the tailings pile (at less than one km in some cases). The public dose limit in the U.S. Environmental Protection Agency's (EPA's) regulation, 40 CFR Part 190, is 0.25 mSv/yr (25 mrem/yr) to the whole body from the entire fuel cycle, but most NRC licensees have airborne effluents resulting in doses of less than 0.01 mSv/yr (1 mrem/yr) (61 FR 65120).

In addition, at the request of the U.S. Congress, the National Cancer Institute (NCI) conducted a study and published, "Cancer in Populations Living Near Nuclear Facilities," in 1990 (NCI 1990). This report included an evaluation of health statistics around all nuclear power plants, as well as several other nuclear fuel cycle facilities, in operation in the United States in 1981 and found "no evidence that an excess occurrence of cancer has resulted from living near nuclear facilities" (NCI 1990). The radiation dose to an individual is only a very fraction of the radioactive dose contribution to the population from the complete uranium fuel cycle. The contribution to the average dose received by an individual as been reported in NCRP Report 93 (NCRP 1987) and is listed in Table 6-2.

Based on the analyses presented above, the staff concludes that the environmental impacts of radioactive effluents from the fuel cycle are small.

6.1.1.6 Radioactive Waste

The quantities of buried radioactive waste material (low-level, high-level, and transuranic wastes) are specified in Table S–3 (see Table 6-1). For low-level waste disposal at land burial facilities, the Commission notes in Table S–3 that there will be no significant radioactive releases to the environment. For high-level and transuranic wastes, the Commission notes that these are to be buried at a repository, such as the candidate repository at Yucca Mountain, and that no release to the environment is expected to be associated with such disposal, although it has been assumed that all of the gaseous and volatile radionuclides contained in the spent fuel are released to the atmosphere before the disposal of the waste. In NUREG-0116 (NRC 1976),

Table 6-2. Comparison of Annual Average Dose Received by an Individual from All Sources

Source	Dose (mSv/yr)[a]	Percent of Total
Natural		
Radon	2	55
Cosmic	0.27	8
Terrestrial	0.28	8
Internal (body)	0.39	11
Total natural sources	3	82
Artificial		
Medical x-ray	0.39	11
Nuclear medicine	0.14	4
Consumer products	0.10	3
Total artificial sources	0.63	18
Other		
Occupational	0.009	<0.30
Nuclear fuel cycle	<0.01	<0.03
Fallout	<0.01	<0.03
Miscellaneous sources	<0.01	<0.03

(a) To convert mSv/yr to mrem/yr, multiply by 100.
Source: NCRP 1987

which provides background and context for the high-level and transuranic Table S–3 values established by the Commission, the staff indicates that these high-level and transuranic wastes will be buried and will not be released to the environment.

On February 15, 2002, subsequent to receipt of a recommendation by Secretary Abraham, U.S. Department of Energy, the President recommended the Yucca Mountain site for the development of a repository for the geologic disposal of spent nuclear fuel and high-level nuclear waste.

The EPA developed Yucca Mountain-specific repository standards which were subsequently adopted by the NRC in 10 CFR Part 63. In an opinion, issued July 9, 2004, the U.S. Court of Appeals for the District of Columbia Circuit (the Court) vacated EPA's radiation protection standards for the candidate repository, which required compliance with certain dose limits over a 10,000-year period. The Court's decision also vacated the compliance period in NRC's licensing criteria for the candidate repository in 10 CFR Part 63.

Therefore, for the high-level waste and spent fuel disposal component of the fuel cycle, there is some uncertainty with respect to regulatory limits for offsite releases of radionuclides for the current candidate repository site. However, prior to promulgation of the affected provisions of the Commission's regulations, the staff assumed that limits are developed along the line of the

1995 National Academy of Sciences report, *Technical Bases for Yucca Mountain Standards*, and that in accordance with the Commission's Waste Confidence Decision, 10 CFR 51.23, a repository can and likely will be developed at some site, which will comply with such limits, with peak doses to virtually all individuals of 1 mSv (100 mrem) per year or less (NAS 1995; NRC 1996).

Despite the current uncertainty with respect to these rules, some judgement as to regulatory National Environmental Policy Act of 1969 (NEPA) implications of offsite radiological impacts of spent fuel and high-level waste disposal should be made. The staff concludes that these impacts are acceptable in that the impacts would not be sufficiently large to require the NEPA conclusion that the construction and operation of new units at the Grand Gulf ESP site should be prohibited.

Section 6.2 of NUREG-1437 (NRC 1996), describes the generation, storage, and ultimate disposal of low-level waste, mixed waste, and spent fuel from power reactors. For the reasons stated above, the staff concludes that the environmental impacts of radioactive waste disposal are small.

6.1.1.7 Occupational Dose

In the review and evaluation of the environmental impacts of the fuel cycle, the staff considered the higher capacity factor in the PPE of 95 percent with a total net electric output of 3000 MW(e) for the ESP site (SERI 2003c). This is referred to as the 1000-MW(e) LWR-scaled model. 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). The environmental impact from this occupational dose is considered small because the dose to any individual worker is maintained within the limits of 10 CFR Part 20 (0.05 Sv/yr [5 rem/yr]).

6.1.1.8 Transportation

The transportation dose to workers and the public totals about 0.25 person-Sv (25 person-rem) annually for the reference 1000-MW(e) LWR per Table S–3 (see Table 6-1). This corresponds to a dose of 1 person-Sv (100 person-rem) for the 1000-MW(e) LWR-scaled model. For comparative purposes, 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). On this basis of this comparison, the staff concludes that environmental impacts of transportation would be small.

6.1.1.9 Conclusion

The staff evaluated the environmental impacts of the uranium fuel cycle as given in Table S–3 (see Table 6-1), considered the effects of radon-222 and technetium-99, and appropriately scaled the impacts for the 1000-MW(e) LWR-scaled model. Based on this evaluation, the staff concludes that the impacts would be SMALL, and mitigation would not be warranted.

6.1.2 Gas-Cooled Reactors

The gas-cooled reactors analyzed for the uranium fuel cycle are:

- Gas Turbine Modular Helium Reactor (GT-MHR) – This reactor, developed by General Atomics, is a modular helium-cooled graphite-moderated reactor.

- Pebble Bed Modular Reactor (PBMR) – This reactor, developed by PBMR (Pty) Ltd., is a modular graphite-moderated helium-cooled gas turbine reactor.

Table S–3 from 10 CFR 51.51(a) can be used as a basis for bounding the environmental impacts from the uranium fuel cycle only for LWRs. SERI performed an assessment of the environmental impacts of the fuel cycle for gas-cooled reactor designs by comparing key parameters for these reactor designs to those used to generate the impacts in Table S–3 (SERI 2003c). Key parameters are energy usage, material involved, and number of shipments for each major fuel cycle activity (i.e., mining, milling, conversion, enrichment, fuel fabrication, and radioactive waste disposal). SERI sought to demonstrate in the 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*, (AEC 1974) and its Supplement 1 (NUREG-0116, NRC 1976) for Table S–3.

As discussed in Section 6.1, the fuel cycle impacts in Table S–3 (see Table 6-1) were 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). This is termed the "reference reactor year." For the purposes of evaluating fuel cycle impacts for the Grand Gulf ESP site, it was assumed that the additional LWR site-wide fuel impacts would be based on a total net electric output of 3000 MW(e) at 95 percent annual capacity factor. This was termed the 1000-MW(e) LWR-scaled model and resulted in a factor about four times (i.e., 3000/800) the impacts in Table S–3.

One of the other-than-LWRs considered by SERI, the GT-MHR, is a four-module, 2400-MW(t), nominal 1140-MW(e) unit assumed to operate at an annual capacity factor of 88 percent for a net electric output of 1032 MW(e). Therefore, the maximum number of GT-MHR units that could be sited at the Grand Gulf ESP site and approximately meet the 3000 MW(e) total net electric output PPE for the site is three (i.e., 3 x 1032). This would result in a factor of almost four (i.e., 3096/800) for comparison with Table S–3 and LWRs.

The second other-than-LWR considered by SERI, the PBMR, is an eight module, 3200-MW(t), nominal 1320-MW(e) unit assumed to operate at an annual capacity factor of 95 percent for a net electric output of 1253 MW(e). Therefore, the comparable number of PBMR units to remain below the 3000 MW(e) total net electric output PPE for the site is two (i.e., 2 x 1253); it would result in about a factor of four (i.e., 3096/800) for comparison with Table S–3 and LWRs.

SERI (2003c) compared the impacts in the Table S–3 LWR with those of the gas-cooled reactor designs. The comparison used an annual fuel loading as a starting point and then proceeded in reverse direction through the fuel cycle (fuel fabrication, enrichment, conversion, milling, mining, radioactive waste). Table 6-3 provides an estimate of the impacts for each phase of the uranium fuel cycle assuming that the Grand Gulf ESP site would host two GT-MHR units or one PBMR unit with the multiplier factors described above.

6.1.2.1 Fuel Fabrication

The quantity of UO_2 required for reactor fuel is a key parameter. The more UO_2 required, the greater the environmental impacts (meaning, more energy, greater emissions, and increased water usage). The 1000-MW(e) LWR-scaled model described in Section 6.1.1 would require the equivalent of 160 MT of enriched UO_2 annually. This compares to 25 to 30 MT of enriched UO_2 annually for the gas-cooled reactor technologies (see Table 6-3).

GT-MHR fuel consists of microspheres of uranium oxycarbide coated with multiple layers of pyrocarbon and silicon carbide referred to as TRISO coating. Two types of microspheres are used in the GT-MHR fuel, one enriched to 19.8 percent uranium-235 and one with natural uranium. The microspheres and graphite shims are bound together into a rod-shaped compact, which is stacked into graphite blocks referred to as fuel elements. A reactor core consists of 1020 fuel elements.

PBMR fuel consists of UO_2 kernels (enriched to 12.9 percent uranium-235) that are TRISO-coated, similar to the GT-MHR fuel. The TRISO-coated particles are imbedded into a graphite matrix to form a fuel sphere that is 60 mm in diameter. Each fuel sphere contains approximately 15,000 TRISO-coated particles. Approximately 260,000 fuel spheres make up a core of a single reactor module.

Table 6-3. Fuel Cycle Environmental Impacts from Gas-Cooled Reactor Designs for the Grand Gulf Early Site Permit Site

Reactor Technology Facility/Activity	GT-MHR 4 Modules (2400 MW(t) total ≈1140 MW(e) total 88 percent capacity: multiplier=4)	PBMR 8 Modules (3200 MW(t) total ≈1320 MW(e) total 95 percent capacity: multiplier=3)
Mining Operations		
Annual ore supply (million MT)	1.35	1.01
Milling Operations		
Annual yellowcake (MT)	1200	900
UF_6 Production		
Annual UF_6 (MT)	1520	1140
Enrichment Operations		
Enriched UF_6 (MT)	32	37
Annual separative work units (MT)	800	600
Fuel Fabrication Plant Operations		
Enriched UO_2 (MT)	25	30
Annual fuel loading (MT Uranium)	22	25
Solid Radioactive Waste		
Annual low-level waste from reactor operations	4400 Ci[(a)]; 400 m^3	200 Ci; 2400 drums[(a)]
Low-level waste from reactor decontamination and decommissioning (Ci per reference reactor-year)	Data not available	Data not available

Notes:
- The enrichment separative work units (SWU) calculation was performed using the United States Enrichment Corporation, Inc. (USEC) SWU calculator and assumes a 0.30 percent tails assay.
- The information on the reference reactor (mining, milling, UF_6, enrichment, fuel fabrication values) was taken from NUREG-0116, Table 3.2, (NRC 1976) no recycling.
- The information on the reference reactor (solid radioactive waste) was taken from 10 CFR 51.51, Table S–3.
- The calculated information on the reference reactor uses the same methodology as for the reactor technologies.
- The normalized information is based on 1000 MW(e) and the reactor vendor-supplied unit capacity factor.
- For the new reactor technologies, the annual fuel loading was provided by the reactor vendor.
- The USEC SWU calculator also calculated the kgs of U feed. This number was multiplied by 1.48 to get the necessary amount of UF_6.
- The annual yellowcake number was generated using the relationship 2.61285 lb. of U_3O_8 to 1 kg U of UF_6; 1.185 kgs of U_3O_8 to 1.48 kg.
- The annual ore supply was generated assuming an 0.1 percent ore body and a 90 percent recovery efficiency.
- Co-60 with a 5.26 year half-life and Fe-55 with a 2.73 year half-life are the main nuclides listed for the PBMR decontamination and decommissioning waste.

(a) To convert from Ci to Bq, multiply by 3.7×10^{10}.

Sources: 10 CFR 51.51(b), Table S–3 Table of Uranium Fuel Cycle Environmental Data.

The fuel described above for gas-cooled reactors is fabricated differently than fuel for LWRs. There are no currently operating large-scale fuel fabrication facilities producing gas-cooled reactor fuels in the United States; thus, a direct comparison of environmental impacts is not possible. Based on some environmental impacts from a small-scale fuel fabrication facility producing gas-cooled reactor fuel, SERI concluded that the environmental impacts from producing gas-cooled reactor fuel would be "not inconsistent" with those of LWRs (SERI 2003c). By comparison with the fuel fabrication impacts for LWR technologies, the staff concludes that the environmental impacts from producing gas-cooled reactor fuel likely would be small, but these impacts will need to be assessed at the construction permit or combined operating license stage, when the staff will consider the environmental data that are available on a large-scale, fuel-fabrication facility for gas-cooled reactors.

6.1.2.2 Enrichment

SERI (2003c) identified two quantities of interest for enrichment. These were (1) the amount of energy required to enrich the fuel measured in separative work units (SWUs), and (2) the amount of UF_6 needed. A SWU is a measure of energy required to enrich the fuel. The major environmental impacts for the entire uranium fuel cycle are from the emissions of the fossil fuel plants used to supply energy for the gaseous diffusion plants that enrich the uranium. An enrichment technology developed since the impacts in Table S–3 (see Table 6-1) were developed and evaluated includes the gas centrifuge process that uses 90 percent less energy than the gaseous diffusion process.

To produce 160 MT of enriched UO_2 for the 1000-MW(e) LWR-scaled model, the enrichment plant needs to produce about 210 MT of UF_6, which requires approximately 500 MT of SWUs (SERI 2003c). For gas-cooled reactor technologies, the needed enriched UF_6 ranges from 32 to 37 MT of UF_6. The amount of energy to produce these quantities of enriched UF_6 for the gas-cooled reactor designs range from 600-800 MT of SWU. The upper range is up to 60 percent higher than the energy required for the reference LWR. SERI (2003c) concluded that the large reduction in energy associated with using an alternate enrichment technology (for example, centrifuge) and its associated environmental impacts would more than offset the increase in SWUs. The staff concludes 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 these impacts will need to be assessed at the construction permit or combined operating license stage, when the staff will consider impacts from the enrichment technology in use at that time.

6.1.2.3 Uranium Hexafluoride Production – Conversion

There are two uranium conversion processes: a wet and a dry process. In NUREG-1437 (NRC 1996), the NRC stated that environmental releases from the conversion facilities are small compared to the overall fuel cycle impacts and that changing from 100 percent use of one process to 100 percent use of the other would make no significant difference in the overall impacts. Similar conversion technologies would be used today to produce UF_6 as were considered when determining the environmental impacts that were part of Table S–3 of 10 CFR 51.51(b) (see Table 6-1).

The conversion facility would need to produce 1440 MT of UF_6 annually for the reference 1000-MW(e) LWR-scaled model compared to 1140 to 1520 MT of UF_6 for the gas-cooled reactors based on the SWU calculator (SERI 2003c); see Table 6-3, footnote (a) above. The other-than-LWR values are comparable to the amount of UF_6 required for the 1000 MW(e) LWR-scaled model; therefore, the associated environmental impacts are expected to be comparable. On this basis, the staff concludes that the environmental impacts from producing UF_6 for gas-cooled reactors would be small.

6.1.2.4 Uranium Milling

Annual yellowcake (U_3O_8) production is the metric of interest for uranium milling. Plants requiring less yellowcake production than the reference plant would require less energy, have fewer emissions, and use less water.

The uranium mill for the 1000-MW(e) LWR-scaled model would produce about 1200 MT of yellowcake. The uranium mill for the gas-cooled reactor technologies would need to produce 900 to 1200 MT of yellowcake, which is less than the amount of yellowcake needed for the 1000 MW(e) LWR-scaled model (SERI 2003c). On this basis, the staff concludes that the environmental impacts from uranium milling for the gas-cooled reactors would be small.

6.1.2.5 Uranium Mining

Annual ore supply is the metric of interest for uranium mining. The less ore mined, the smaller the environmental impacts (i.e., less energy used, fewer emissions, less water usage). For the 1000-MW(e) LWR-scaled model, 1.1 million MT of raw ore would be required to produce 1200 MT of yellowcake. For the gas-cooled reactor technologies, the scaled ore requirements range from 1.01 to 1.35 million MT of ore, a range that is comparable to the amount of ore required for the reference 1000-MW(e) LWR-scaled model. For this reason, the staff concludes that the environmental impacts from uranium mining for the gas-cooled reactors would be small.

6.1.2.6 Solid Low-Level Radioactive Waste – Operations

Table S–3 (see Table 6-1) of 10 CFR 51.51(b) states that there are 3.4×10^{14} Bq (9100 Ci) of low-level waste generated annually from operations of the reference LWR; the 1000 MW(e) LWR-scaled model would result in 1.35×10^{15} Bq (36,400 Ci) of low-level waste annually. Gas-cooled reactor technologies are projected to generate 7.4×10^{12} Bq to 1×10^{14} Bq (200 to 4400 Ci) of low-level waste scaled annually, far below the amounts generated by the reference LWR (SERI 2003c). For this reason, the staff concludes that the environmental impacts from low-level radioactive waste operations for gas-cooled reactors would be small.

6.1.2.7 Solid Low-Level Radioactive Waste – Decontamination and Decommissioning

In Table S–3 (see Table 6-1), the Commission states that 5.6×10^{13} Bq (1500 Ci) per reference reactor year "...comes from reactor decontamination and decommissioning - buried at land burial facilities." SERI (2003c) noted that gas-cooled reactor technologies would (1) generate less waste than the reference 1000-MW(e) LWR, and (2) produce less heavy metal radioactive waste because of the higher thermal efficiency and higher fuel burnup. The gas-cooled reactor designs are also more compact than the reference LWR design, which would be expected to result in less decontamination and decommissioning waste (SERI 2003c). SERI expects that low-level waste impact from decontamination and decommissioning will be comparable to or less than that of the reference LWR (SERI 2003c). On this basis, the staff concludes that the environmental impacts from solid low-level radioactive waste generated during decontamination and decommissioning for gas-cooled reactors would likely be small, but these impacts will need to be assessed again at the construction permit or combined operating license stage.

6.1.2.8 Conclusions

The staff concludes that the environmental impacts from the uranium fuel cycle activities and solid waste management activities for the proposed gas-cooled reactors would be SMALL. However, because of the uncertainty in the final design of the gas-cooled reactors and the change in technology that could be applied to uranium fuel cycle activities, additional reviews would be needed at the construction permit or combined operating license stage in the following areas: fuel fabrication, enrichment, and solid low-level waste operation during decontamination and decommissioning.

6.2 Transportation of Radioactive Materials

This section addresses both 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. Distinctions between transportation impacts of advanced LWR designs and gas-cooled reactor designs are discussed.

The NRC evaluated the environmental effects of transportation of fuel and waste for light-water-cooled nuclear power reactors in WASH-1238 (AEC 1972) and NUREG-75/038 (NRC 1975) and found the impact to be SMALL. These documents provided the basis for Table S–4 in 10 CFR 51.52, which summarizes the environmental impacts of transportation of fuel and waste to and from one LWR of 3000 to 5000 MW(t) (1000 to 1500 MW(e)). Impacts are provided for normal conditions of transport and accidents in transport for a reference 1100-MW(e) LWR.

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. Dose to the public along the route and dose to onlookers both were estimated to result in a collective dose of 0.03 person-Sv (3 person-rem) per reference reactor year. Doses to the public during accident conditions were determined to be small. 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. Subsequent reviews of transportation impacts in NUREG-0170 (NRC 1977a) and Sprung et al. (2000) concluded that impacts were bounded by Table S–4.

In accordance with 10 CFR 51.52(a), a full description and detailed analysis of transportation impacts is not required when licensing an LWR (i.e., impacts are assumed bounded by Table S–4) if an LWR meets the following criteria:

- The reactor has a core thermal power level not exceeding 3800 MW(t).

- Fuel is in the form of sintered UO_2 pellets having a uranium-235 enrichment not exceeding 4 percent by weight, and pellets are encapsulated in zirconium-clad fuel rods.

- Average level of irradiation of the fuel from the reactor does not exceed 33,000 MWd/MT, and no irradiated fuel assembly is shipped until at least 90 days after it is discharged from the reactor.

- With the exception of irradiated fuel, all radioactive waste shipped from the reactor is packaged and in solid form.

- Unirradiated fuel is shipped to the reactor by truck; irradiated fuel is shipped from the reactor by truck, rail, or barge; and radioactive waste other than irradiated fuel is shipped from the reactor by truck or rail.

The environmental impacts of the transportation of fuel and radioactive wastes to and from nuclear power facilities were resolved generically in 10 CFR 51.52, provided that the specific conditions in the rule (see above) are met; if not, then a full description and detailed analysis is required for initial licensing. Once licensed, the NRC may consider requests to operate at conditions above those in the facility's licensing basis, for example, higher burnups, enrichments, or thermal power levels above 33,000 MWd/MTU, 4 percent, and 3800 MW(t), respectively. The rule has not been changed for the initial licensing of nuclear power facilities, and departures from the conditions itemized in the rule that were found to be acceptable for licensed facilities cannot serve as the basis for initial licensing.

SERI has not identified a specific reactor design for the Grand Gulf ESP site but used bounding parameters from seven reactor designs. Five of the designs are LWRs and include the ACR-700 (3964 MW(t)/unit); the ABWR (4300 MW(t)/unit); the AP1000 (6800 MW(t)/unit); the ESBWR (4000 MW(t)/unit), and the IRIS (3000 MW(t)/unit). For the ACR-700 reactor design, two reactors make up a unit. For the IRIS design, three reactors (modules) make up a unit. For the remaining LWR designs, one reactor makes up a unit. To make comparisons to Table S–4, the environmental impacts are normalized to a reference reactor year. The reference reactor is an 1100 MW(e) reactor that has an 80 percent capacity factor, for a total electrical output of 880 MW(e) per year. The environmental impacts can be adjusted to calculate impacts per site by multiplying the normalized impacts by the ratio of the total electrical output for the advanced reactor sites to the electrical output of the reference reactor.

None of the proposed LWR designs meet all the conditions in 10 CFR 51.52(a); therefore, a full description and detailed analysis are required for each LWR design. This conclusion is based on the following:

- ACR-700, ABWR, surrogate AP1000, and ESBWR designs exceed the 3800-MW(t) core thermal power-level limit.

- ABWR, surrogate AP1000, ESBWR, and IRIS designs require fuel that exceeds the uranium-235 enrichment of 4 percent.

- ABWR, surrogate AP1000, ESBWR, and IRIS designs are expected to exceed the average irradiation level of 33,000 MWd/MTU.

The remaining two designs are gas-cooled reactors: the GT-MHR and the PBMR. Each GT-MHR unit is a four-module, 2400-MW(t), 1140-MW(e) gas-cooled reactor designed to operate at a unit capacity factor of 88 percent. Each PBMR is an eight-module, 3200-MW(t), 1320-MW(e) gas-cooled reactor designed to operate at a unit capacity factor of 95 percent. These compare to the reference reactor in WASH-1238 (AEC 1972), which is a single-unit, 1100-MW(e) LWR with a unit capacity factor of 80 percent. The gas-cooled reactor designs do not meet the conditions in 10 CFR 51.52 because these reactors are not LWR designs upon which Table S–4 impacts were based. Therefore, a full description and detailed analysis was required for each gas-cooled reactor design. This was provided by SERI in its response to a request for additional information on September 30, 2004 (SERI 2004f).

SERI used a sensitivity analysis to show that transportation impacts from advanced LWR designs would be bounded by the criteria identified in Table S–4 (SERI 2003c). SERI referenced the related discussion and information in NUREG-1437, Addendum 1 (NRC 1999) to support its basis for exceeding 4 percent uranium-235 enrichment and 33,000 MWd/MTU. However, as discussed above, NUREG-1437, Addendum 1 applies to reactors that are listed in NUREG-1437, Appendix A and not to any other reactor designs.

SERI also used a sensitivity analysis to show that transportation impacts from the advanced gas-cooled reactor designs would be bounded by the criteria identified in Table S–4 (SERI 2003c); however, as discussed previously, this type of analysis does not adequately meet the requirements of 10 CFR 51.52. SERI (2003c) identified the major contributors to transportation risk to be the number and type of shipment (shipment risk) and the kind of material being shipped (material risk). Its evaluation of shipment risk showed fewer shipments of unirradiated fuel, spent fuel, and low-level waste would be required for the advanced gas-cooled reactors compared to the reference LWR when averaged over 40 years of operation. Regarding material risk, SERI (2004f) concluded the following:

- The estimated total spent fuel radioactive inventory and fission product inventory was less for the gas-cooled reactors when compared to the reference LWR.
- Actinide inventories would be greater for the gas-cooled reactors (55 to 65 percent greater) because of the increased burnup for these types of reactors; however, actinides are not major contributors to dose during transportation accidents.
- Gas-cooled reactors would generate fewer kilowatts of decay heat per MTU and fewer kilowatts of decay heat per truck cask at the time of shipment.

6.2.1 Transportation of Unirradiated Fuel

The staff performed an independent review of the environmental impacts of transporting unirradiated (fresh) fuel to the Grand Gulf ESP site. Environmental impacts of normal operating conditions and transportation accidents are discussed in this section. Appendix H provides the details of the analysis.

6.2.1.1 Normal Conditions

Normal conditions, sometimes referred to as “incident-free” transportation, are transportation activities in which shipments reach their destination without releasing any radioactive cargo to the environment. Impacts from these shipments would be from the low levels of radiation that penetrate the unirradiated fuel shipping casks.

Truck Shipments

Table 6-4 provides an estimate of the number of truck shipments of unirradiated fuel for each advanced reactor design compared to those of the reference 1100-MW(e) reactor specified in WASH-1238 (AEC 1972). Estimates are normalized for an equivalent 1100-MW(e) electric generating capacity. The basis for the shipment estimates can be found in Appendix H. Only the ACR-700, PBMR, and GT-MHR reactor designs exceeded the number of truck shipments of unirradiated fuel estimated for the reference LWR in WASH-1238. The largest number of shipments, in excess of 700 shipments over 40 years, is for the PBMR. However, this equates to far less than the one truck shipment per day specified in Table S–4 of 10 CFR 51.52.

Shipping Mode and Weight Limits

In 10 CFR 51.52, a condition is identified that states all unirradiated fuel be shipped to the reactor by truck. In information provided by SERI, SERI specifies that unirradiated fuel will be shipped to the reactor site by truck for all reactor designs that it references (INEEL 2003). In addition, 10 CFR 51.52 includes a condition that the truck shipments not exceed 33,100 kg (73,000 lbs), as governed by Federal or State gross vehicle weight restrictions. All the advanced reactor designs would meet this weight restriction for unirradiated fuel (INEEL 2003).

Radiological Doses to Transport Workers and the Public

10 CFR 51.52, Table S–4, includes conditions related to radiological dose to transport workers and members of the public along transport routes. These doses are a function of many variables, including the radiation dose rate emitted from the unirradiated fuel shipments, the number of exposed individuals and their locations relative to the shipment, the time in transit (including travel and stop times), and the number of shipments to which the individuals are exposed. For this environmental impact statement (EIS), the radiological dose impacts of the transportation of unirradiated fuel were calculated for the worker and the public using the RADTRAN 5 computer code (Neuhauser et al. 2003). Details of the calculations are found in Appendix H.

Table 6-5 presents the radiological impacts to workers, onlookers (members of the public), and members of the public (along the route) for the advanced reactor designs. The cumulative annual dose estimates were normalized for an equivalent 1100 MW(e) generating capacity. The staff performed an independent review and determined that all dose estimates are bounded by the Table S–4 conditions of 0.04 person-Sv/yr (4 person-rem/yr) to transportation workers, 0.03 person-Sv/yr (3 person-rem/yr) to onlookers, and 0.03 person-Sv/yr (3 person-rem/yr) to members of the public along the route.

Table 6-4. Numbers of Truck Shipments of Unirradiated Fuel for Each Advanced Reactor Type

Reactor Type	Number of Shipments per Site: Initial Core[a]	Annual Reload	Total[b]	Site Electric Generation, MW(e)[c]	Capacity Factor[c]	Normalized, Shipments per 1100 MW(e)[d,e]
Reference LWR (WASH-1238)	18	6	252	1100	0.8	252
ABWR/ESBWR[d,e]	30	6.1	267	1500[f]	0.95	165
AP1000	14	3.8	161	1150[f]	0.95	130
ACR-700	30	15.4	628	1462[g]	0.9	420
IRIS	34	4.3	201	1005[h]	0.96	184
GT-MHR	51	20	831	1140[i]	0.88	729
PBMR	44	20	824	1320[j]	0.95	579

NOTE: The reference LWR shipment values have all been normalized to 880-MW(e) net electrical generation.
(a) Shipments of the initial core have been rounded up to the next highest whole number.
(b) Total shipments of fresh fuel over a 40-year plant lifetime (i.e., initial core load plus 39 years of average annual reload quantities).
(c) Unit capacities and capacity factors were taken from INEEL (2003).
(d) Normalized to net electric output for WASH-1238 reference LWR (i.e., 1100-MW[e] reactor at 80 percent or net electrical output of 880 MW[e]).
(e) Ranges of capacities are given in INEEL (2003) for these reactor fresh fuel shipments. The fresh fuel shipment data for these reactors were derived using the upper limit of the ranges.
(f) The ABWR/ESBWR site includes one reactor at 1500 MW(e) and the surrogate AP1000 site includes one reactor at 1150 MW(e).
(g) The ACR-700 site includes two reactors at 731 MW(e) per reactor.
(h) The IRIS site includes three reactors at 335 MW(e) per reactor.
(i) The GT-MHR site includes four reactors at 285 MW(e) per reactor.
(j) The PBMR site includes eight reactors at 165 MW(e) per reactor.

Although radiation may cause cancers at high doses and high dose rates, currently there are no data that unequivocally establish the occurrence of cancer following exposure to low doses and dose rates, below about 100 mSv (10,000 mrem). However, radiation protection experts conservatively assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. Simply stated, any increase in dose, no matter how small, results in an incremental increase in health risk. This model is accepted by the NRC as a conservative model for estimating health risks from radiation exposure, recognizing that the model probably overestimates those risks.

Table 6-5. Radiological Impacts of Transporting Unirradiated Fuel to Advanced Reactor Sites

Plant Type	Normalized Average Annual Shipments	Cumulative Annual Dose, person-Sv/yr per 1100 MW(e)[(a)]		
		Workers	Public - Onlockers	Public - Along Route
Reference LWR (WASH-1238)	6.1	1.1×10^{-4}	4.2×10^{-4}	1.0×10^{-5}
ABWR/ESBWR	4.2	7.1×10^{-5}	2.7×10^{-4}	6.6×10^{-6}
AP1000	3.3	5.6×10^{-5}	2.2×10^{-4}	5.2×10^{-6}
ACR-700	10.5	1.8×10^{-4}	7.0×10^{-4}	1.7×10^{-5}
IRIS	4.6	7.9×10^{-5}	3.1×10^{-4}	7.4×10^{-6}
GT-MHR	18.2	3.1×10^{-4}	1.2×10^{-3}	2.9×10^{-5}
PBMR	14.5	2.5×10^{-4}	9.6×10^{-4}	2.3×10^{-5}
10 CFR 51.52, Table S–4 Condition	<1 per day	4.0×10^{-2}	3.0×10^{-2}	3.0×10^{-2}

(a) Multiply person-Sv/yr times 100 to obtain doses in person-rem/yr.

Based on this model, the staff estimates the risk to the public from radiation exposure using the nominal probability coefficient for total detriment (730 fatal cancers, nonfatal cancers, and severe hereditary effects per 10,000 person-Sv [1,000,000 person-rem]) from International Commission on Radiation Protection Publication 60 (ICRP 1990). All the public doses presented in Table 6-5 are less than 0.001 person-Sv/yr (0.1 person-rem/yr); therefore, the total detriment estimates associated with these doses would all be less than 1×10^{-4} fatal cancers, nonfatal cancers, and severe hereditary effects per year. These risks are very small compared to the fatal cancers, nonfatal cancers, and severe hereditary effects that the same population would incur annually from exposure to natural sources of radiation.

6.2.1.2 Accidents

Accident risks are the product of accident frequency times consequence. Accident frequencies for transportation of fuel to and from future reactors are expected to be lower that those used in the analysis in WASH-1238 (AEC 1972), which forms the basis for Table S–4 of 10 CFR 51.52, because of improvements in highway safety and security and an expected decrease in traffic accident, injury, and fatality rates. Consequences of accidents that are severe enough to result in a release of unirradiated fuel particles to the environment are not significantly different for advanced LWRs from current-generation LWRs because the fuel form, cladding, and packaging are similar to those analyzed in WASH-1238. Consequently, the impacts of accidents during transport of unirradiated fuel for advanced LWRs to the SERI ESP site are expected to be smaller than the impacts listed in Table S–4 for current-generation LWRs.

With respect to the advanced gas-cooled reactors, accident rates (accidents per unit distance) and associated accident frequencies (accidents per year) would be expected to follow the same trends as for LWRs (i.e., overall reduction relative to the accident rates used in the WASH-1238 analysis). The consequences of accidents involving gas-cooled reactor unirradiated fuel, however, are more uncertain. The staff assumed that the gas-cooled reactor unirradiated fuel shipments would have the same abilities as LWR unirradiated fuel to maintain functional integrity following a traffic accident. This assumption is considered to be conservative because gas-cooled reactor fuel operates at significantly higher temperatures, and thus maintains integrity under more severe thermal conditions than LWR fuel. Detailed information about the behavior of the gas-cooled reactor fuel under impact conditions was not available. However, packaging systems for unirradiated gas-cooled reactor fuel will be required to meet the same requirements as unirradiated LWR fuel packages. Properly designed and manufactured packaging systems are the most effective means of preventing damage and dispersal of the contained materials under accident conditions. Consequently, it is expected that packaging systems for unirradiated gas-cooled reactor fuels would provide equivalent release (i.e., consequence) prevention and mitigation to those designed for unirradiated LWR fuels. In addition, the fuel forms for the gas-cooled reactors are similar to those for LWRs (i.e., UO_2 for the PBMR and uranium oxycarbide for the GT-MHR versus UO_2 for LWRs) thus, the failure resistance provided by unirradiated gas-cooled reactor fuels is not expected to be significantly lower than that for LWRs. Based on the assumption that unirradiated gas-cooled and LWR fuels and associated packaging systems would provide equivalent resistance to thermal and impact conditions, the staff concludes that the impacts of accidents involving unirradiated gas-cooled reactor fuel would not be significantly different than for LWR unirradiated fuel and will be within the impacts listed in Table S–4 for current-generation LWRs. However, these impacts will need to be assessed at the construction permit or combined operating license stage when specific information is available regarding other-than-LWR fuel performance, if SERI references such designs.

6.2.2 Transportation of Spent Fuel

The staff performed an independent review of the environmental impacts of transporting spent fuel from the proposed new nuclear units at the Grand Gulf ESP site to a spent fuel disposal repository. The Yucca Mountain, Nevada, location is a possible location for a geologic repository. The staff considers that an estimate of the impacts of the transportation of spent fuel to a possible repository in Nevada to be a reasonable bounding estimate of the transportation impacts to a monitored retrievable storage facility because of the distances involved and the representative exposure of members of the public in urban, suburban, and rural areas. Environmental impacts of normal operating conditions and transportation accidents are discussed in this section.

This analysis is based on shipment of spent fuel by legal-weight trucks in casks with characteristics similar to casks currently available (i.e., massive, heavily shielded, cylindrical metal pressure vessels). Each shipment is assumed to consist of a single shipping cask loaded on a modified trailer. These assumptions are consistent with assumptions made in the evaluation of the environmental impacts of transportation of spent fuel in Addendum 1 to NUREG-1437 (NRC 1999). These assumptions are conservative because the alternative assumptions involve rail transportation or heavy-haul trucks, which would reduce the overall number of spent fuel shipments (NRC 1999).

Environmental impacts of transportation of spent fuel were calculated by the NRC staff using the RADTRAN 5 computer code (Neuhauser et al. 2003). Routing and population data used in the RADTRAN 5 for truck shipments were obtained from the TRAGIS routing code (Johnson and Michelbaugh 2000). The population data in the TRAGIS code are based on the 2000 census.

The staff's evaluation reviewed the impacts of spent fuel shipments originating from the primary ESP location (in other words, the Grand Gulf ESP site) and the following alternative sites: James A. FitzPatrick Nuclear Power Plant and Pilgrim Nuclear Station. Another alternative site, River Bend Station, was considered by SERI in its environmental report, but was not evaluated by the staff because the route characteristics of distance and population would not be significantly different to produce results different from the Grand Gulf ESP site.

6.2.2.1 Normal Conditions

Normal conditions, sometimes referred to as "incident-free" transportation, are transportation activities in which shipments reach their destination without releasing any radioactive cargo to the environment. Impacts from these shipments would be from the low levels of radiation that penetrate the heavily shielded spent fuel shipping cask. Radiation doses will occur to (1) persons residing along the transportation corridors between the ESP site and the proposed repository; (2) persons in vehicles passing a spent fuel shipment; (3) persons at vehicle stops for refueling, rest, and vehicle inspections; and (4) transportation crew workers.

Shipping casks have not been designed for the advanced reactor designs. Information in INEEL (2003) indicated that advanced LWR fuel designs would not be significantly different from existing LWR designs; therefore, the characteristics of current shipping cask designs were used for the analysis for advanced LWR designs. No information is available on spent fuel shipping cask designs for the gas-cooled reactors. For purposes of this analysis, their design performance was assumed to be the same as those used for the existing LWRs. Spent fuel shipping cask designs for gas-cooled reactors will be evaluated at the construction permit or combined operating license stage if SERI references such designs.

Radiation doses are a function of many parameters, including vehicle speed, traffic count, dose rate at 1 m from the vehicle, packaging dimensions, number of persons in the truck crew, stop time, and population density at stops. For a listing of the values for these and other parameters, refer to Appendix H. Table 6-6 presents radiation dose estimates to the transport workers and the public for the primary and alternative ESP sites. Doses are presented on a per-shipment basis. The per-shipment dose estimates are independent of reactor technology because they were calculated based on an assumed external radiation dose rate emitted from the cask, which was fixed at the regulatory maximum limit for the advanced reactor designs (i.e., 0.1 mSv/hr [10 mrem/hr] at 2 m).

Table 6-6. Routine (Incident-Free) Radiation Doses to Transport Workers and the Public from Shipping Spent Fuel from Potential Early Site Permit Sites to a Spent Fuel Disposal Facility

	Population Dose, person-Sv/shipment[a]		
ESP Site	**Crew**	**Onlookers**	**Along Route**
Grand Gulf[b] ESP Site	8.7×10^{-4}	2.8×10^{-5}	7.0×10^{-5}
James A.FitzPatrick Nuclear Power Station	9.8×10^{-4}	3.5×10^{-3}	9.5×10^{-5}
Pilgrim Nuclear Station	1.1×10^{-1}	3.9×10^{-1}	1.2×10^{-2}

(a) Multiply person-Sv/yr times 100 to obtain doses in person-rem/yr.
(b) Doses for the River Bend alternative site can be assumed to be bounded by the values for the proposed Grand Gulf ESP site because differences in route characteristics are minimal.

Population dose estimates per reference reactor year are presented in Table 6-7 for specific advanced reactor designs. Population doses were calculated by multiplying the number of spent fuel shipments per year for each advanced reactor design times the dose per shipment from Table 6-6. Population doses were normalized to the reference LWR design in WASH-1238 (880 net MW(e)). This corresponds to an 1100-MW(e) LWR operating at 80 percent capacity. Appendix H provides the basis upon which the number of spent fuel shipments was derived for each advanced reactor design.

The bounding cumulative doses to the exposed population given in Table S–4 are

- 0.04 person-Sv (4 person-rem) per reference reactor-year to transport workers
- 0.03 person-Sv (3 person-rem) per reference reactor-year to general public (onlookers)

- 0.03 person-Sv (3 person-rem) per reference reactor-year to general public (along route).

Population doses to the crew and the onlookers for all the reactor types, including the reference reactor found in Table 6-7, exceed Table S–4 values. Two key reasons for the higher population doses relative to Table S–4 are the higher number of spent fuel shipments estimated for some of the reactor technologies and the longer shipping distances assumed for the analyses (i.e., to a possible repository in Nevada) than were used in WASH-1238. WASH-1238 used a "typical" distance for a spent fuel shipment of 1600 km (1000 mi), whereas the shipping distances used in this assessment ranged from about 3000 km (1800 mi) to 4700 km (2900 mi). The higher numbers of shipments are based on spent fuel shipping casks designed to transport shorter-cooled fuel (150 days out of the reactor). It was assumed in this analysis that the shipping cask capacities are 0.5 MTU/shipment, roughly equivalent to one PWR or two BWR spent fuel assemblies per shipment.

Newer shipping cask designs are based on longer-cooled spent fuel (5 years out of reactor) and have larger capacities than those used in this assessment. DOE (2002) spent fuel shipping cask capacities were approximately 1.8 MTU/shipment, or up to four PWR or nine BWR fuel assemblies per shipment. Use of the newer shipping cask designs will reduce the number of spent fuel shipments and the associated environmental impacts. On balance, if the population doses are adjusted for the shipping distance and shipping cask capacity, the routine population doses from spent fuel shipments from all reactor types and all sites fall within Table S–4 requirements.

Other conservative assumptions in the staff's calculation include:

- <u>Use of the regulatory maximum dose rate (0.1 mSv/hr [10 mrem/hr] at 2 m) in the RADTRAN 5 calculations</u>. The shipping casks assumed in the EIS prepared in support of the application for a geologic repository at the proposed Yucca Mountain site (DOE 2002) were designed to transport spent fuel that has cooled for five years. In reality, most spent fuel will have cooled for much longer than five years before it is shipped to a possible geologic repository. Sprung et al. (2000) developed a probabilistic distribution of dose rates based on fuel cooling times that indicates that approximately three-fourths of the spent fuel to be transported to a possible geologic repository will have dose rates less than half of the regulatory limit. Consequently, the estimated population doses in Table 6-7 could be divided in half if more realistic dose rate projections are used.

Table 6-7. Routine (Incident-Free) Population Doses from Spent Fuel Transportation, Normalized to Reference Light-Water Reactor

Reactor Type	Reference LWR (WASH-1238)			ABWR/ESBWR			AP1000			ACR-700		
No Shipments per Year	60			41			40			90		
	Environmental Effects, person-Sv[a] per reference reactor-year											
Reactor Site	Crew	Onlookers	Along Route	Crew	Onlookers	Along Route	Crew	Onlookers	Along Route	Crew	Onlookers	Along Route
Grand Gulf	5.2×10^{-2}	1.7×10^{-1}	4.2×10^{-3}	3.5×10^{-2}	1.2×10^{-1}	2.8×10^{-3}	3.4×10^{-2}	1.1×10^{-1}	2.7×10^{-3}	7.8×10^{-2}	2.5×10^{-1}	6.2×10^{-3}
FitzPatrick	5.9×10^{-2}	2.1×10^{-1}	5.7×10^{-3}	4.0×10^{-2}	1.4×10^{-1}	3.9×10^{-3}	3.9×10^{-2}	1.4×10^{-1}	3.8×10^{-3}	8.8×10^{-2}	3.1×10^{-1}	8.5×10^{-3}
Pilgrim	6.5×10^{-2}	2.3×10^{-1}	7.0×10^{-3}	4.4×10^{-2}	1.6×10^{-1}	4.8×10^{-3}	4.3×10^{-2}	1.5×10^{-1}	4.6×10^{-3}	9.8×10^{-2}	3.5×10^{-1}	1.0×10^{-3}

Reactor Type	IRIS			GT-MHR			PBMR		
No Shipments per Year	35			34			12		
	Environmental Effects, person-Sv[a] per reference reactor-year								
Reactor Site	Crew	Onlookers	Along Route	Crew	Onlookers	Along Route	Crew	Onlookers	Along Route
Grand Gulf	3.0×10^{-2}	9.8×10^{-2}	2.4×10^{-3}	2.9×10^{-2}	9.4×10^{-2}	2.3×10^{-3}	9.7×10^{-3}	3.2×10^{-2}	7.8×10^{-4}
FitzPatrick	3.4×10^{-2}	1.2×10^{-1}	3.3×10^{-3}	3.3×10^{-2}	1.2×10^{-1}	3.2×10^{-3}	1.1×10^{-2}	3.9×10^{-2}	1.1×10^{-3}
Pilgrim	3.8×10^{-2}	1.3×10^{-1}	4.0×10^{-3}	3.6×10^{-2}	1.3×10^{-1}	3.9×10^{-3}	1.2×10^{-3}	4.3×10^{-2}	1.3×10^{-4}

(a) Multiply person-Sv/yr times 100 to obtain dose in mrem/yr.

- Use of 30 minutes as the average time at a truck stop in the calculations. Many stops made for actual spent fuel shipments are short-duration stops (i.e., 10 minutes) for brief visual inspections of the cargo (checking the cask tie-downs). These stops typically occur in minimally populated areas, such as an overpass or freeway ramp in an unpopulated area. Furthermore, empirical data provided in Griego et al. (1996) indicate that a 30-minute stop is toward the high end of the stop-time distribution. Average stop times observed by Griego et al. (1996) are on the order of 18 minutes. Based on these observations, it was concluded that the stop model assumptions used in this study overestimate public doses at stops by at least a factor of two. Consequently, the doses to onlookers given in Table 6-7 could be reduced by a factor of two to reflect more realistic truck shipping conditions.

SERI performed its own RADTRAN 5 calculations looking at the impact of "incident-free" transport of spent fuel to a spent fuel disposal facility. The assumed transport of spent fuel originated from the Maine Yankee Nuclear Plant (a distance further than the Grand Gulf ESP site) and terminated at a disposal facility assumed to be at Yucca Mountain, Nevada. Dose estimates per shipment were similar to those calculated by the staff.

Although radiation may cause cancers at high doses and high dose rates, currently there are no data that unequivocally establish the occurrence of cancer following exposure to low doses and dose rates, below about 100 mSv (10,000 mrem). However, radiation protection experts conservatively assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. Simply stated, any increase in dose, no matter how small, results in an incremental increase in health risk. This theory is accepted by the NRC as a conservative model for estimating health risks from radiation exposure, recognizing that the model probably overestimates those risks.

Based on this model, the staff estimates the risk to the public from radiation exposure using the nominal probability coefficient for total detriment (730 fatal cancers, nonfatal cancers, and severe hereditary effects per 10,000 person-Sv [1,000,000 person-rem]) from International Commission on Radiation Protection Publication 60 (ICRP 1990). All the population doses presented in Table 6-7 are less than one person-Sv/yr (100 person-rem/yr); therefore, the total detriment estimates associated with these population doses would all be less than 0.1 fatal cancers, nonfatal cancers, and severe hereditary effects per year. These risks are very small compared to the fatal cancers, nonfatal cancers, and severe hereditary effects that the same population would incur annually from exposure to natural sources of radiation.

6.2.2.2 Accidents

As discussed previously, the staff used the RADTRAN 5 computer code to estimate impacts of transportation accidents involving spent fuel shipments. RADTRAN 5 considers a spectrum of potential transportation accidents, ranging from those with high frequencies and low consequences (e.g., "fender benders") to those with low frequencies and high consequences (i.e., accidents in which the shipping container is exposed to severe mechanical and thermal conditions). Details of the analysis are discussed in Appendix H.

Radionuclide inventories are important parameters in the calculation of accident risks. The radionuclide inventories used in this analysis were from *Early Site Permit Environmental Report Sections and Supporting Documentation* (INEEL 2003). This report included hundreds of radionuclides for each advanced reactor type. A screening analysis was conducted to select the dominant contributors to accident risks to simplify the RADTRAN 5 calculations. The screening identified the radionuclides that would contribute more than 99.999 percent of the dose from inhalation of radionuclides released following a transportation accident. The dominant radionuclides are similar regardless of the fuel type (i.e., advanced LWR fuel or gas-cooled reactor fuel). Spent fuel inventories used in the staff analysis are presented in Table 6-8. No radionuclide inventory data were presented in INEEL (2003) for the ACR-700 and IRIS advanced reactors; therefore, transportation accident risks were not quantified for these reactor types and would need to be assessed at the construction permit or combined operating license stage if SERI referenced either of these designs.

Table 6-8. Radionuclide Inventories Used in Transportation Accident Risk Calculations for Each Advanced Reactor Type, Bq/MTU[(a)]

Radionuclide	ABWR and ESBWR Inventory	AP1000 Inventory	GT-MHR Inventory	PBMR Inventory
Am-241	4.96×10^{13}	2.69×10^{13}	8.18×10^{13}	7.55×10^{13}
Am-242m	1.24×10^{12}	4.85×10^{11}	5.03×10^{11}	8.51×10^{11}
Am-243	1.20×10^{12}	1.24×10^{12}	5.14×10^{11}	4.77×10^{12}
Ce-144	4.22×10^{14}	3.28×10^{14}	2.15×10^{15}	1.19×10^{15}
Cm-242	2.04×10^{12}	1.05×10^{12}	1.51×10^{12}	2.78×10^{12}
Cm-243	1.37×10^{12}	1.14×10^{12}	2.02×10^{11}	1.96×10^{12}
Cm-244	1.80×10^{14}	2.87×10^{14}	2.83×10^{13}	5.48×10^{14}
Cm-245	2.43×10^{10}	4.48×10^{10}	1.65×10^{8}	5.29×10^{10}
Co-60	1.01×10^{14}	(b)	(b)	(b)
Cs-134	1.78×10^{15}	1.78×10^{15}	2.21×10^{15}	4.03×10^{15}

Table 6-8. (contd)

Radionuclide	ABWR and ESBWR Inventory	AP1000 Inventory	GT-MHR Inventory	PBMR Inventory
Cs-137	4.59×10^{15}	3.44×10^{15}	1.08×10^{16}	1.41×10^{16}
Eu-154	3.81×10^{14}	3.38×10^{14}	3.23×10^{14}	3.74×10^{14}
Eu-155	1.93×10^{14}	1.71×10^{14}	8.77×10^{13}	1.08×10^{14}
Pm-147	1.25×10^{15}	6.51×10^{14}	6.92×10^{15}	5.07×10^{15}
Pu-238	2.27×10^{14}	2.25×10^{14}	1.17×10^{14}	4.55×10^{14}
Pu-239	1.43×10^{13}	9.44×10^{12}	2.25×10^{13}	1.11×10^{13}
Pu-240	2.28×10^{13}	2.01×10^{13}	3.96×10^{13}	3.32×10^{13}
Pu-241	4.51×10^{15}	2.58×10^{15}	8.33×10^{15}	7.18×10^{15}
Pu-242	8.29×10^{10}	6.73×10^{10}	1.56×10^{11}	4.51×10^{11}
Ru-106	6.07×10^{14}	5.74×10^{14}	1.48×10^{15}	1.68×10^{15}
Sb-125	1.99×10^{14}	1.42×10^{14}	2.21×10^{14}	2.51×10^{14}
Sr-90	3.27×10^{15}	2.29×10^{15}	8.95×10^{15}	1.08×10^{16}
Y-90	3.27×10^{15}	2.29×10^{15}	8.95×10^{15}	1.08×10^{16}

(a) To convert Bq/MTU to Ci/MTU, divide the value by 3.7×10^{10}.
(b) Cobalt-60 is an activation product. Only the ABWR/ESBWR submittal in INEEL (2003) provided inventory data for activation products.

Massive shipping casks are used to transport spent fuel because of the radiation shielding and accident resistance required by 10 CFR Part 71. Spent fuel shipping casks must be certified Type B packaging systems, meaning they must withstand a series of severe hypothetical accident conditions with essentially no loss of containment or shielding capability. According to Sprung et al. (2000), the probability of encountering accident conditions that would lead to shipping cask failure is less than 0.01 percent (i.e., more than 99.99 percent of all accidents would result in no release of radioactive material from the shipping cask). The staff assumed that shipping casks for advanced reactor spent fuels will provide equivalent mechanical and thermal protection of the spent fuel cargo.

The RADTRAN 5 accident risk calculations were performed using unit radionuclide inventories (Bq/MTU) for the spent fuel shipments from the various reactor types. The resulting risk estimates were then multiplied by assumed annual spent fuel shipments (MTU/yr) to derive estimates of the annual accident risks associated with spent fuel shipments from each potential ESP site. As was done for routine exposures, the staff assumed that the numbers of shipments of spent fuel per year are equivalent to the annual discharge quantities.

For this assessment, release fractions for current-generation LWR fuels were used to approximate the impacts from the advanced reactor spent fuel shipments. This assumes that the fuel materials and containment systems (i.e., cladding, fuel coatings) behave similarly to current LWR fuel under applied mechanical and thermal conditions. Because of the lack of experimental data on gas-cooled reactor fuels, it is currently not known if this approach is bounding. However, gas-cooled reactors operate at much higher temperatures than LWRs; therefore, high temperature conditions anticipated in transportation accident fires should have less of an effect on radionuclide releases than they do for LWR fuels. Thus, smaller release fractions are anticipated for advanced gas-cooled reactor fuels than for LWR fuels subjected to thermal transients.

RADTRAN 5 calculated the population dose from the released radioactive material for five possible exposure pathways. These pathways are:

(1) external dose from exposure to the passing cloud of radioactive material

(2) external dose from the radionuclides deposited on the ground by the passing plume (the staff's analysis included the radiation exposure from this pathway even though the area surrounding a potential accidental release would be evacuated and decontaminated, thus preventing long-term exposures from this pathway)

(3) internal dose from inhalation of airborne radioactive contaminants

(4) internal dose from resuspension of radioactive materials that were deposited on the ground (the staff's analysis included the radiation exposures from this pathway even though evacuation and decontamination of the area surrounding a potential accidental release would prevent long-term exposures)

(5) internal dose from ingestion of contaminated food (the staff's analysis assumed interdiction of foodstuffs and evacuation after an accident thus, no internal dose from ingestion of contaminated foods was calculated).

Table 6-9 presents the environmental consequences of transportation accidents when shipping spent fuel from the proposed Grand Gulf ESP site and alternative sites to a spent fuel repository assumed to be at Yucca Mountain, Nevada. The shipping distances and population distribution information for the routes were the same as those used for the normal "incident-free" conditions (for details, see Appendix H). The table presents estimates of population dose (person-Sv/ reference reactor-year) for several of the advanced reactor designs. These values are normalized to the WASH-1238 reference reactor (880-MW(e) net electrical generation, 1100-MW(e) reactor operating at 80 percent capacity).

Table 6-9. Annual Spent Fuel Transportation Accident Impacts for Advanced Reactors, Normalized to Reference 1000-MW(e) Light-Water Reactor Net Electrical Generation

	Advanced Reactor Type			
	ABWR/ESBWR	**AP1000**	**GT-MHR**	**PBMR**
MTU/yr	20.3	19.7	6.0	5.8
	Population Dose, person-Sv/per reference reactor-year[(a)]			
GGNS[(b)]	4.2×10^{-6}	3.7×10^{-7}	1.7×10^{-7}	2.7×10^{-7}
FitzPatrick	3.8×10^{-6}	3.3×10^{-7}	1.5×10^{-7}	2.5×10^{-7}
Pilgrim	8.1×10^{-6}	7.2×10^{-7}	3.5×10^{-7}	5.4×10^{-7}

(a) Multiply person-Sv/yr times 100 to obtain person-rem/yr.
(b) Doses for the River Bend alternative site can be assumed to be bounded by the values for the proposed Grand Gulf ESP site because differences in route characteristics are minimal.

Although radiation may cause cancers at high doses and high dose rates, currently there are no data that unequivocally establish the occurrence of cancer following exposure to low doses and dose rates, below about 100 mSv (10,000 mrem). People living in areas such as Denver, Colorado, who are exposed to high levels of background radiation, above 10 mSv/yr (1000 mrem/yr), have shown no adverse biological effects. However, radiation protection experts conservatively assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect, and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. Simply stated, any increase in dose, no matter how small, results in an incremental increase in health risk. This theory is accepted by the NRC as a conservative model for estimating health risks from radiation exposure, recognizing that the model probably overestimates those risks.

Based on this model, the staff estimates the risk to the public from radiation exposure using the nominal probability coefficient for total detriment (730 fatal cancers, nonfatal cancers, and severe hereditary effects per 10,000 person-Sv [1,000,000 person-rem]) from International Commission on Radiation Protection Publication 60 (ICRP 1990). All the population doses presented in Table 6-9 are less than 1.0×10^{-5} person-Sv (1.0×10^{-3} person-rem) per reference reactor year (100 person-rem/yr); therefore, the total detriment estimates associated with these population doses would all be less than 1.0×10^{-6} fatal cancers, nonfatal cancers, and severe hereditary effects per reference reactor year. These risks are quite small compared to the fatal cancers, nonfatal cancers, and severe hereditary effects that the same population would incur annually from exposure to natural sources of radiation.

6.2.2.3 Conclusion

Considering the uncertainties in the data and computational methods, the staff concludes that the overall transportation accident risks associated with advanced reactor spent fuel shipments are likely to be SMALL and are consistent with the risks associated with transportation of spent fuel from current-generation reactors presented in Table S–4 of 10 CFR 51.52.

6.2.3 Transportation of Radioactive Waste

This section discusses the environmental effects of transporting waste from ESP sites. The environmental conditions listed in 10 CFR 51.52 that apply to shipments of radioactive waste are as follows:

- Radioactive waste (except spent fuel) is packaged in solid form.
- Radioactive waste (except spent fuel) is shipped from the reactor by truck or rail.
- The weight limitation is 33,100 kg (73,000 lb) per truck and 100 tons per cask per railcar.
- The traffic density limitation is less than one truck shipment per day or three railcars per month.

In INEEL (2003), the U.S. Department of Energy indicates that all the radioactive waste would be transported by truck, and it plans to solidify and package its waste regardless of which advanced reactor technology it chooses. In addition, waste from any of the advanced reactor technologies would be subject to NRC (10 CFR Part 71) and U.S. Department of Transportation (DOT) (49 CFR Parts 173 and 178) regulations for the shipment of radioactive material. Radioactive waste from any of the advanced reactor technologies are expected to be capable of being shipped in compliance with Federal or State weight restrictions.

Table 6-10 presents estimates of annual waste volumes and annual waste shipment numbers for the advanced reactor types normalized to the reference 1100-MW(e) LWR defined in WASH-1238 (AEC 1972). Annual waste volumes and waste shipments for the advanced reactor technologies were less than the 1100-MW(e) reference reactor that was the basis for Table S-4 for all designs except the PBMR. As shown in the table, only the PBMR would be expected to generate a larger volume of radioactive waste than the reference LWR in

Table 6-10. Summary of Radioactive Waste Shipments for Advanced Reactors

Reactor Type	INEEL (2003) Waste Generation Information	Annual Waste Volume, m^3/yr per site	Electrical Output, MW(e) per site	Normalized Rate, m^3/1100 MW(e) reactor (880 MW(e) net)[a]	Shipments/ 1100 MW(e) (880 MW(e) net) Electrical Output[b]
Reference LWR (WASH-1238)	100 m^3/yr per reactor	108	1100	108	46
ABWR	100 m^3/yr per reactor	100	1500[c]	62	27
ESBWR	100 m^3/yr per reactor	100	1500[c]	62	27
AP1000	55 m^3/yr per reactor	56	1150[c]	45	20
ACR-700	47.5 m^3/yr per reactor	95	1462[d]	64	28
IRIS	25 m^3/yr per reactor	74	1005[e]	67	29
GT-MHR	98 m^3/yr (4 reactors)	98	1140[f]	86	37[h]
PBMR	100 drums/yr per reactor	168	1320[g]	118	51[h]

Conversions: 1 m^3 = 35.31 ft^3. Drum volume = 210 liters (0.21 m^3).

(a) Capacity factors used to normalize the waste generation rates to an equivalent electrical generation output are given in Table 6-3 for each reactor type. All are normalized to 880-MW(e) net electrical output (1100-MW[e] plant with an 80-percent capacity factor).

(b) The number of shipments per 1100 MW(e) was calculated assuming the WASH-1238 average waste shipment capacity of 2.34 m^3 per shipment (108 m^3/yr divided by 46 shipments/yr).

(c) The ABWR and ESBWR sites include one reactor at 1500 MW(e) and the surrogate AP1000 site includes one reactor at 1150 MW(e).

(d) The ACR-700 site includes two reactors at 731 MW(e) per reactor.

(e) The IRIS site includes three reactors at 335 MW(e) per reactor.

(f) The GT-MHR site includes four reactors at 285 MW(e) per reactor.

(g) The PBMR site includes eight reactors at 165 MW(e) per reactor.

(h) SERI states in INEEL (2003) that 90 percent of the waste could be shipped on trucks carrying 28 m^3 (1000 ft^3) of waste and the remaining 10 percent in shipments carrying 5.7 m^3 (200 ft^3) of radioactive waste. This would result in six to seven shipments per year after normalization to the reference LWR electrical output.

WASH-1238. However, the GT-MHR and PBMR information in INEEL (2003) assumed that SERI would ship wastes using two different packaging systems: one that hauls 28.3 m^3 per shipment (1000 ft^3 per shipment) and one that hauls 5.7 m^3 per shipment (200 ft^3 per shipment). Under those conditions, the number of shipments of radioactive waste per year, normalized to

1100 MW(e) electric generation capacity, would be about six shipments per year per 1100 MW(e) (880 net MW(e)) for the GT-MHR and seven shipments per year per 1100 MW(e) for the PBMR. These estimates are well below the reference LWR (46 shipments per year per 1100 MW(e)).

All the estimates are well below the one truck shipment per day condition given in 10 CFR 51.52, Table S–4. Doubling the shipment estimates to account for empty return shipments is still well below the one-shipment-per-day condition.

6.2.4 Conclusions

An analysis was conducted of the impacts of transporting unirradiated fuel to advanced reactor sites and spent fuel and wastes from advanced reactor sites to disposal facilities. To make comparisons to Table S–4, the environmental impacts are normalized to a reference reactor-year. The reference reactor is an 1100-MW(e) reactor that has an 80-percent capacity factor, for a total electrical output of 880 MW(e) per year. The environmental impacts can be adjusted to calculate impacts per site by multiplying the normalized impacts by the ratio of the total electric output for the advanced reactor sites to the electric output of the reference reactor.

Considering the uncertainties in the data and computational methods, the staff concludes 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 associated with transportation of fuel and radioactive wastes from current-generation reactors presented in Table S–4 of 10 CFR 51.52. For gas-cooled designs, the impacts are likely to be SMALL, based on the following assumptions:

- Unirradiated and spent fuel from gas-cooled reactors have the same abilities as LWR unirradiated and spent fuel to maintain integrity following a traffic accident.

- Shipping cask design assumptions (for example, cask capacities) are equal to or bounded by the assumptions in this analysis.

- Fresh fuel initial core/refueling requirement, spent fuel generation rates, and radioactive waste generation rate assumptions are equal to or bounded by the assumptions in this analysis.

- Shipping cask capacities and accident source terms, including spent fuel inventories, severity fractions, and release fractions, are equal to or bounded by the assumptions in this analysis.

6.3 Decommissioning Impacts

At the end of the operating life of a power reactor, the NRC regulations require that the facility undergo decommissioning. Decommissioning is the removal of a facility safely from service and the reduction of residual radioactivity to a level that permits termination of the NRC license. The regulations governing decommissioning of power reactors are found in 10 CFR 50.75 and 50.82.

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, (NRC 2002). If SERI applies for a license to operate additional units at SERI, there is a requirement to provide a report containing a certification that financial assurance for radiological decommissioning will be provided. At the time an application is submitted, the requirements in 10 CFR 50.33, 50.75, and 52.77 (and any other applicable requirements) will have to be met.

At the ESP stage, SERI is not required to submit information regarding the process of decommissioning, such as the method chosen for decommissioning, the schedule, or any other aspect of planning for decommissioning. The regulatory requirements on decommissioning activities are expected to limit the impacts of decommissioning to a SMALL impact. For the new nuclear unit, if LWR designs are chosen or if other-than-LWRs that were considered in NUREG-0586, Supplement 1 are chosen, the impacts from decommissioning are expected to be within the bounds described in NUREG-0586, Supplement 1. In such cases, the staff expects the impact from decommissioning to be SMALL. However, for whatever design that is selected, the impacts from decommissioning will have to be assessed at the construction permit or combined operating license stage.

6.4 References

10 CFR Part 20. Code of Federal Regulations, Title 10, *Energy*, Part 20, "Standards for Protection Against Radiation."

10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities."

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 52. Code of Federal Regulations, Title 10, *Energy*, Part 52, "Early Site Permits, Standard Design Certifications, and Combined Licenses for Nuclear Power Plants."

10 CFR Part 63. Code of federal Regulations, Title 10, *Energy*, Part 63, "Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada."

10 CFR Part 71. Code of Federal Regulations, Title 10, *Energy*, Part 71, "Packaging and Transportation of Radioactive Material."

40 CFR Part 190. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations."

49 CFR Part 173. Code of Federal Regulations, Title 49, *Transportation*, Part 173, "Shippers - General Requirements for Shipments and Packaging."

49 CFR Part 178. Code of Federal Regulations, Title 49, *Transportation*, Part 178 "Specifications for Packaging."

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7.0 Cumulative Impacts

The staff considered the potential cumulative impacts of constructing and operating one or more nuclear power units at the proposed Grand Gulf early site permit (ESP) site. For purposes of this analysis, past actions were those related to the existing Grand Gulf Nuclear Station (GGNS). Present actions are those related to the resources at the time of the ESP application until the start of construction. Future actions are those that are reasonably foreseeable through construction and operation of the Grand Gulf ESP unit or units, including decommissioning. The geographical area over which past, present, and future actions could contribute to cumulative impacts depends on the type of action considered and is described below for each impact area.

The impacts of the proposed action, as described in Chapters 4 and 5, are combined 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 regardless of what agency (Federal or non-Federal) or person undertakes such other actions. These combined impacts are defined as "cumulative" in Title 40 of the Code of Federal Regulations (CFR) Section 1508.7 and include individually minor but collectively significant actions taking place over a period of time. It is possible an impact that may be SMALL by itself could result in a MODERATE or LARGE impact when considered in combination with the impacts of other actions on the affected resource. Likewise, if a resource is regionally declining or imperiled, even a SMALL individual impact could be important it if contributes to or accelerates the overall resource decline.

7.1 Land Use

For the purpose of this analysis, the geographic area considered for cumulative impacts to land use resulting from construction and operation of the proposed Grand Gulf ESP facility encompasses Claiborne County, Mississippi.

The staff reviewed the available information on the impacts on land use of constructing one or more additional nuclear units at the Grand Gulf ESP site (SERI 2003c). Cumulative impacts for land use include possible additional growth and land conversions to accommodate new workers and services. However, the impacts are expected to be minor as the construction work force and the operations work force are expected to be drawn from an area much wider than Claiborne County, to include the larger cities of Vicksburg, Natchez, and Jackson, Mississippi. Because the work force will be dispersed over these larger cities in the labor supply region, the induced impacts on land use (resulting from either construction or operations of one or more new units at the Grand Gulf ESP site) can be easily absorbed in that wider region. Based on the information provided by System Energy Resources, Inc. (SERI), and its own independent review, the staff concludes that the cumulative land-use impacts would be SMALL, and mitigation would not be warranted.

7.2 Air Quality

The Grand Gulf ESP site is in an area that is in attainment for criteria pollutants. Construction activities at the site may reduce air quality if unmitigated. However, SERI has included mitigation measures to minimize the impact of construction activities on air quality in its environmental report (SERI 2003c). Considering the limited duration of construction activities and the mitigation measures described by SERI, the staff concludes that the impacts of construction activities on air quality would be small. Given this conclusion and the current air quality, the staff concludes the cumulative impacts of construction activities would be SMALL, and any additional mitigation would not be warranted.

Operation of new nuclear units at the Grand Gulf ESP site would result in increases in some pollutant emissions at the site. Emissions for each unit would be approximately the same as the emissions for the existing GGNS. However, because of the magnitude and intermittent nature of the emissions, the staff concludes that the impacts of operation of new nuclear units at the Grand Gulf ESP site would be SMALL. These same factors lead the staff to conclude that the cumulative impacts of the operation of new unit and the existing unit on air quality would be SMALL, and additional mitigation would not be warranted.

Heat, water vapor, and drift plumes from cooling towers associated with operation of new nuclear units at the Grand Gulf ESP site may, on occasion, merge with the plumes from the existing GGNS cooling tower. The staff considers it unlikely that the impacts of the merged plumes on air quality would be significantly different from the impacts of the plume from the GGNS cooling tower. The staff concludes that the air-quality impacts of cooling towers for new nuclear units at the Grand Gulf ESP site would be SMALL. The staff also concludes the cumulative impacts on air quality of plumes from the cooling towers would be SMALL, and additional mitigation would not be warranted.

7.3 Water Use and Quality

The assessments performed by the staff and described in Sections 4.3 and 5.3 related to impacts of construction and operation of the proposed Grand Gulf ESP facility explicitly considered the cumulative impacts of the existing GGNS facility. For instance, the Cornell Mixing Zone Expert System (CORMIX) model assessment described in Section 5.3.2 estimated the combined discharges of the existing GGNS facility and the proposed ESP facility. By assuming steady-state conditions at a distant future state, the staff adopted a conservative approach to processes that may change incrementally over time. For instance, groundwater drawdown considerations reflected the steady-state drawdown based on population projections well into the future.

7.3.1 Surface Water Use

The watersheds contributing flow to the two streams in the Grand Gulf ESP site are nearly contained within the proposed ESP site, and the remaining drainage area outside the ESP site area would not be expected to change significantly. Therefore, changes in surface water supply outside the site would not alter the surface water conditions of the site's two streams.

Even with alterations in climate patterns and further demands for water upstream of the Grand Gulf ESP site, the Mississippi River is expected to remain the largest and most significant waterway in the United States. Continued regulation of the flow and management of the shoreline by the U.S. Army Corps of Engineers is expected to preserve the course and flow of the Mississippi. No activity at the Grand Gulf ESP site by itself, nor other activities outside the site, would be expected to alter fundamentally the character of the Mississippi River.

Based on the above, the staff concludes that the cumulative impacts of surface water use at the Grand Gulf ESP site would be SMALL, and further mitigation would not be warranted.

7.3.2 Groundwater Use

The staff found that the information provided by SERI (2003c) was not adequate to reliably assess the potential incremental drawdown of the groundwater elevation associated with groundwater wells proposed in the Catahoula formation for the Grand Gulf ESP facility. However, the staff concluded that, for both construction and operational water needs, properly treated surface water from the Mississippi River could be used should the Catahoula prove to be inadequate. The applicant for a construction permit or combined license would be required to provide additional information on the suitability of the Catahoula formation as a source for such water.

On the basis of the above, the staff concludes that the cumulative impacts of groundwater use at the Grand Gulf ESP site would be SMALL, and further mitigation would not be warranted.

7.3.3 Surface Water Quality

As noted above, the watersheds contributing flow to the two streams in the Grand Gulf ESP site are nearly contained within the ESP site, and the land use of the remaining drainage area outside the site would not be expected to change significantly. Therefore, changes in surface water quality outside the site would not alter the surface water quality of the site's two streams.

The Mississippi River is such a critical national resource that efforts to preserve or improve its quality are expected. Activities at the Grand Gulf ESP site would not fundamentally alter the quality of the Mississippi River because of its vast flow.

Based on the above, the staff concludes that the cumulative impacts on surface water quality at the Grand Gulf ESP site would be SMALL, and further mitigation would not be warranted.

7.3.4 Groundwater Quality

The Catahoula aquifer has been identified by the U.S. Environmental Protection Agency (EPA) Administrator as a sole-source aquifer (EPA 1998). As such, activities over the Catahoula are receiving special attention to protect its quality. The staff identified no cumulative changes that are likely to result in a change of the groundwater quality. Therefore, the staff concludes that the cumulative impacts on groundwater quality at the Grand Gulf ESP site would be SMALL, and further mitigation would not be warranted.

7.4 Terrestrial Ecosystem

Construction and operation of one or more new units at the Grand Gulf ESP site were evaluated to determine the magnitude of their contribution to regional cumulative adverse impacts to terrestrial ecological resources. Determinations for construction were made for important terrestrial species (animal and plant) and habitats (as defined in NRC 2000) by evaluating the effect of construction in light of other past, present, and future actions in the region. Determinations for operation were made for resource attributes normally affected by cooling tower operation, transmission line operation, and right-of-way maintenance. For this analysis, the geographic region encompassing past, present, and foreseeable future actions is the area immediately surrounding the Grand Gulf ESP site, including adjoining sections of the Mississippi River bottomland and loess bluffs to the north and south and west into Louisiana, and the area surrounding the existing GGNS Unit 1 transmission corridors.

The area around the Grand Gulf ESP site and GGNS Unit 1 transmission corridors is rural. Land cover currently consists primarily of upland and bottomland hardwood forests and secondarily of agricultural fields and pasture. Because agriculture is not the primary land use in the area, this area likely has incurred only relatively minor losses of terrestrial plant and animal species and habitats during agricultural conversion, which means most of the species affected likely still occur in neighboring forested areas. Construction of the proposed unit or units at the Grand Gulf ESP site would disturb 59 ha (145 ac) of upland hardwood forest and 22 ha (55 ac) of bottomland hardwood forest for permanent structures and facilities and equipment staging and borrow areas. Construction could also necessitate doubling the width of the existing GGNS Unit 1 transmission corridors, which could disturb up to 391 ha (966 ac) of hardwood forest. During the review for this ESP application, no other present or future actions in the region were identified that could significantly affect terrestrial species or habitats.

Construction of the proposed unit or units and anticipated expansion of the existing GGNS Unit 1 transmission corridors would destroy forest in an area known to have been used historically by the Louisiana black bear (*Ursus americanus luteolus*), a Federally threatened species. The Louisiana black bear has been observed near and on the Grand Gulf ESP site and likely still occurs on the site and in the vicinity. Construction could destroy or displace bears and reduce the suitability of habitat (for example, via fragmentation) or preclude it from future use (for example, via replacement with facilities). This possibility appears greatest in the bottomland area (along the Mississippi River) of the Grand Gulf ESP site, the portion of the site most likely to be used by bears. However, such an impact would be unlikely, given the relatively small amount of bottomland forested wetland that would be disturbed (22 ha [55 ac]). Nonetheless, because of the relatively large amount of forest (mostly upland) that would be disturbed by possible expansion of the GGNS Unit 1 power transmission corridors (427 ha [1056 ac]), the staff concludes that the overall contribution of construction to cumulative losses of important species and habitats in the region would be MODERATE.

During the review of the SERI ESP application, no other past, present, or future actions in the region were identified that could significantly affect wildlife and wildlife habitat in ways similar to those associated with the Grand Gulf ESP facility cooling operation (cooling tower noise; adverse effect on crops, ornamental vegetation, and native plants from cooling tower salt drift; and birds colliding with cooling towers). Thus, because these impacts were considered negligible for the Grand Gulf ESP facility, the cumulative adverse impact of these types of activities in the region would also be considered minor. Consequently, the staff concludes the contribution of the Grand Gulf ESP facility cooling operation to the cumulative impacts to wildlife and wildlife habitat in the region would be SMALL.

During the review of the ESP application, no other past, present, or future actions in the region were identified that could significantly affect wildlife and wildlife habitat in ways similar to those associated with Grand Gulf ESP facility transmission line operation and corridor maintenance (birds colliding with transmission lines; flora and fauna affected by electromagnetic fields and corridor maintenance; and floodplains and wetlands affected by corridor maintenance). Thus, because these impacts were considered negligible for the Grand Gulf ESP facility, the cumulative adverse impacts of these types of activities in the region would also be minor. Consequently, the staff concludes that the contribution of the operation and maintenance of the transmission lines and the maintenance of the transmission corridors to the cumulative impacts to wildlife and wildlife habitat in the region would be SMALL.

In summary, the staff concludes the contribution of construction of the Grand Gulf ESP facility (including possible expansion of the GGNS Unit 1 transmission corridors) to the cumulative impacts on terrestrial ecological resources in the region would be MODERATE, primarily because of the relatively large amount of mostly upland forest that would be disturbed. Therefore, the staff concludes that mitigation measures (for example, reforestation in temporary construction areas) are warranted. The staff also concludes the contribution of operation (including operation of the cooling tower operation and the upgraded GGNS Unit 1 transmission lines and maintenance of the associated expanded power transmission corridors) and eventual decommissioning of the facility to the cumulative impacts on terrestrial ecological resources in the region would be SMALL, and that additional mitigation measures would not be warranted.

7.5 Aquatic Ecosystem

The staff evaluated the magnitude of impacts to regional aquatic ecological resources from construction and operation of one or more new units at the Grand Gulf ESP site. Determinations for construction were made for the generic categories of important aquatic species (animal and plant) and habitats (as defined by NRC 2000) by evaluating the effect of construction in light of other past, present, and future actions in the region. Determinations for operation were made for resource attributes normally affected by the cooling water system. This includes an evaluation of the potential effect of water intake, consumption, and discharge. For this analysis, the geographic region encompassing past, present, and foreseeable future actions is the area immediately surrounding the Grand Gulf ESP site, including adjoining sections of the Mississippi River and the area surrounding the existing GGNS.

From an aquatic ecological perspective, the construction of GGNS Unit 1 in the 1970s did not change the Mississippi River significantly. The construction of radial wells, which collect makeup water by extracting groundwater near the river shoreline, and the discharge structure only caused temporary disruption of the shoreline habitat. While pre-construction surveys indicated that organisms living in the shoreline habitat were few, the stabilization of the banks with concrete mats (completed by the late 1970s along the entire reach of the river in the vicinity of the Grand Gulf site) further limited habitat for benthic organisms in the shoreline region. Few other changes have affected the river habitat since the construction of GGNS Unit 1, outside of the occasional dredging activities.

Construction related to the Grand Gulf ESP facility intake and discharge systems would have minimal and temporary impacts on aquatic organisms. No species of special interest or

Federally or State-listed threatened and endangered species are expected to be affected by construction activities. The staff concludes the overall contribution of construction to cumulative losses of aquatic organisms in the region would be SMALL, and no further mitigation would be needed beyond that identified in Section 4.4.2.

The staff considered the potential cumulative impacts related to water use and to impingement and entrainment of aquatic organisms. GGNS Unit 1 uses radial wells, which do not impinge or entrain aquatic organisms. Operation of the proposed ESP facility intake structure would lead to some future impingement and entrainment of aquatic organisms. Future actions for this analysis are considered to be those for operation of the proposed facility through a complete license term and the time for the licensee to complete decommissioning of the new nuclear units.

Current plans include the use of an intake structure that is of similar design to the ones used at River Bend Station. The location of the intake structure near the entrance of the embayment and off the bottom of the river would likely decrease impingement by removing the structure from areas with a higher concentration of fish. The water consumed for the proposed facility would be approximately 0.2 percent of the flow of the river at extreme low-flow conditions. The intake screens would be sized so the average intake through the screen would have a flow velocity of less than or equal to 0.15 m/s (0.5 fps). Based on these design plans, impingement and entrainment during operation of the proposed facility would be minimal.

Operation of the proposed intake structure would not be expected to affect species of special interest or Federally or State-listed threatened and endangered species. Decommissioning of the proposed facility would result in the cessation of water consumption from the river and the impingement and entrainment impact would end. Therefore, the staff concludes the contribution of the cooling water intake operation from one or two new nuclear units to the cumulative impact on aquatic organisms in the region would be SMALL, and further mitigation would not be warranted.

The staff also considered the potential cumulative impacts related to water discharge. The geographical area over which the cumulative effects were considered for past, present, and future actions is the Mississippi River. Since the operation of GGNS Unit 1 began, heated effluent has been discharged into the river. The size of the plume that includes the combined discharge from both GGNS Unit 1 and the proposed Grand Gulf ESP facility would be small in comparison to the length and width of the Mississippi River along the Grand Gulf site. Operation of the proposed discharge structure would not be expected to affect species of special interest or Federally or State-listed threatened and endangered species.

The amount of water, its temperature and chemical composition, are regulated by the Mississippi Department of Environmental Quality (MDEQ) through the National Pollutant

Discharge Elimination System (NPDES) permit program. The MDEQ regulates point sources discharging pollutants to ensure the protection and propagation of a balanced, indigenous population of fish, shellfish, and other aquatic organisms. The MDEQ is required to take into consideration the cumulative impacts of multiple discharges to the same body of water. Discharges from all sources on the Grand Gulf site and other area facilities would be included in the review and development of permit requirements for a new nuclear unit or units. Additionally, all NPDES permits must be renewed every 5 years, allowing MDEQ to ensure the permit limits provide the appropriate level of protection to the environment. During the review of the proposed Grand Gulf ESP site, the impacts from discharge of heated effluent (for example, water temperature, dissolved oxygen, thermal stratification, impact to fauna), cold shock, and chemical treatment of the cooling water were considered. Because the NPDES permit issued by MDEQ would govern the operational impacts to the aquatic environment whether the facility operates alone or jointly with GGNS Unit 1 under a cumulative effect scenario, the operational impacts of water discharge on aquatic organisms would be SMALL.

In summary, the staff concludes the contribution of construction of the Grand Gulf ESP facility to the cumulative impacts on aquatic ecological resources in the region would be SMALL, and further mitigation measures are not warranted. The staff also concludes the contribution of operation (including operation of the intake structure) and eventual decommissioning of the facility to the cumulative impacts on aquatic ecological resources in the region would be SMALL, and mitigation measures would not be warranted.

7.6 Socioeconomics, Historic and Cultural Resources, Environmental Justice

Much of the analyses of socioeconomic impacts presented in Sections 4.5 and 5.5 already incorporate cumulative impact analysis because the metrics used for analysis only make sense when placed in the total or cumulative context. For instance, the impact of the total number of additional housing units that may be needed can only be evaluated with respect to the total number that will be available in the affected area. Therefore, the geographical area of the cumulative analysis varies depending on the particular impacts considered, and may depend on specific boundaries, such as taxation jurisdictions, or may be distance-related, as in the case of environmental justice.

Given the current plans and construction activities for road improvements in the region of the Grand Gulf ESP, the potential cumulative increase in the number of vehicles during a combined outage, construction, and permanent workforce egress and ingress into the site are unlikely to have an adverse impact on the local road system.

The construction and operation of additional units at the Grand Gulf ESP site would not be likely to add to any cumulative socioeconomic impacts beyond those already evaluated in Sections 4.5 and 5.5. In other words, the impacts of issues such as transportation or taxes are not likely to be detectable beyond the regions previously evaluated and will quickly decrease with increasing distance from the site. The staff concludes that construction impacts would generally be SMALL, but there are exceptions if more workers than expected settle in Claiborne County and Jefferson County, in which case a MODERATE impact level may be reached for the impacts on roads, housing, and some public services. In terms of beneficial effects, the impacts on regional economies would be MODERATE in Warren County and tax revenues benefit to Claiborne County would be beneficially SMALL to LARGE, depending on how taxation of the new units is resolved by the State of Mississippi.

With regard to historic and cultural resources, the construction and operation of the proposed additional units at the Grand Gulf ESP site would not add to the cumulative impacts to these resources beyond those identified in Sections 4.6 and 5.6. SERI will have procedures to ensure that either known or newly discovered historic and cultural sites would not be inadvertently affected during onsite activities that involve land disturbances. Construction, operation, and maintenance of the new facility would not affect land outside the bounds of current GGNS facility operations. Therefore, any additional cumulative impacts would be negligible.

The staff found no unusual resource dependencies or practices or environmental pathways through which minority or low-income populations would be disproportionately affected. As a result, the cumulative environmental impacts related to environmental justice would be SMALL. If tax revenues dramatically increase, the residents of Claiborne County (who are disproportionately minority and low-income) would enjoy LARGE beneficial tax revenue impacts. However, if significant demands are placed on Claiborne County services as a result of more workers than expected settling in the county (without a corresponding increase in tax revenues), the socioeconomic impacts of reduced services or higher taxes would fall disproportionately on the residents of the county, who are predominantly low-income and minority people. In that case, the environmental justice impacts would be MODERATE.

Based on the above considerations, the staff concludes that construction and operation of additional units at the Grand Gulf ESP site could make a detectable contribution to the cumulative effect associated with any of the socioeconomic issues, including environmental justice and historic and cultural resources. Therefore, the overall cumulative impacts would be SMALL to MODERATE, and, if Claiborne County is not permitted to add the new facilities to its tax base, mitigation measures such as assistance with infrastructure and public services in Claiborne County may be warranted.

7.7 Nonradiological Health

In Section 5.8.1, the cumulative health impacts of construction and operation of the existing GGNS Unit 1 and proposed ESP unit(s) on the ambient temperature of the Mississippi River with regard to potential formation of thermophilic microorganisms were evaluated. The evaluation showed that the addition of the Grand Gulf ESP unit(s), which would use cooling towers as the source of cooling, would not be a significant impact because the discharge is into a large river. SERI currently uses biocides to reduce hazards from microbiological organisms in the cooling towers for GGNS Unit 1, and has committed to employ appropriate industrial hygiene practices to protect the occupational workers from the effect of thermophilic microorganisms in the cooling towers for the new unit(s). Health risk to workers is expected to be dominated by occupational injuries at rates below the average U.S. industrial rates. Health impacts to the public and workers from noise, dust emissions, and acute and chronic electromagnetic fields were also evaluated and found to be small. The staff concludes that the cumulative impacts to nonradiological health would be SMALL, and further mitigation would not be warranted.

7.8 Radiological Impacts of Normal Operations

The 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. As described in Section 5.9, the public and occupational doses predicted from the proposed operation of the Grand Gulf ESP unit or units would be well below regulatory limits and standards. For purposes of this analysis, the area within 80-km (50-mi) of the Grand Gulf ESP site was included. As stated in Section 2.5, SERI has conducted a radiological environmental monitoring program (REMP) around the Grand Gulf site since 1978. The REMP measures radiation and radioactive materials from all sources including GGNS. The U.S. Nuclear Regulatory Commission and the State would regulate any reasonably foreseeable future actions that could contribute to the cumulative radiological impact.

Therefore, the staff concludes that the cumulative radiological impacts of operation, including decommissioning, of the Grand Gulf ESP facility and the existing operating GGNS Unit 1 would be SMALL, and additional mitigation would not be warranted.

7.9 Staff Conclusions and Recommendations

The staff evaluated in a cumulative sense the potential impacts resulting from construction and operation, including decommissioning, of one or more new nuclear units at the Grand Gulf ESP site. For the duration of the proposed action (from 2030 to 2070), the evaluation took into account the potential impacts from factors known or likely to affect the environment. This included considering conditions at the site and surrounding vicinity from past, present, and future human activities.

For each impact area, the staff concludes the potential cumulative impacts resulting from construction and operation are generally SMALL, and further mitigation would not be warranted. However, several areas (ecological impacts from construction, physical socioeconomic impacts, and environmental justice) have the potential for a MODERATE impact. In these cases, mitigation measures may be warranted, including habitat restoration and assistance with infrastructure and public services in Claiborne County.

7.10 References

40 CFR Part 1508. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 1508, "Council on Environment Quality."

System Energy Resources, Inc. (SERI). 2003c. "Part 3 Environmental Report." *Grand Gulf Site Early Site Permit Application*, Jackson, Mississippi. Available at http://www.nrc.gov/reading-rm/adams.html, Accession No. ML032960315.

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8.0 Environmental Impacts of the Alternatives

This chapter describes alternatives to the proposed action and discusses the environmental impacts of those alternatives. The evaluation of alternative sites is a two-step process, as set forth in NUREG-1555, Section 9.3 (NRC 2000), and stems from the U.S. Nuclear Regulatory Commission (NRC) decision related to licensing the Seabrook Nuclear Power Plant. See Public Service Co. of New Hampshire (Seabrook Station, Units 1 and 2), CLI-77-8, 5 NRC 503, 526-30 (1977). The first step looks at a full suite of environmental issues, using reconnaissance-level information to determine if any of the alternative sites are environmentally preferable to the proposed Grand Gulf early site permit (ESP) site. If an alternative site appears environmentally preferable to the proposed site, the analysis proceeds to the second step. If not, then the evaluation of alternative sites ends at the first step. The second step considers economic, technological, and institutional factors among the environmentally preferred sites to determine if any is obviously superior to the proposed site. If there is no obviously superior site, then the proposed site prevails. A staff conclusion that an alternative site is obviously superior to System Energy Resources, Inc.'s (SERI's) proposed ESP site would normally lead to a recommendation that the ESP application be denied.

The environmental impacts of the alternatives are evaluated using the NRC's three-level standard of significance – SMALL, MODERATE, or LARGE – developed using Council on Environmental Quality guidelines and set forth in the footnotes to Table B-1 of Title 10 of the Code of Federal Regulations (CFR) Part 51, Subpart A, Appendix B. The impact categories evaluated in this chapter are the same as those used in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999)[a] with the additional impact category of environmental justice. While the GEIS was developed for license renewal, it provides useful information for this review and is referenced throughout this chapter.

Because 10 CFR 52.17(a)(2) does not require an environmental report or environmental impact statement (EIS) for an ESP to include consideration of the benefits of construction and operation of a new reactor or reactors at the ESP site, this EIS does not consider such matters. Accordingly, should the NRC issue an ESP for the Grand Gulf ESP site, these matters will be considered in the EIS for any construction permit (CP) or combined license (COL) application that references such an ESP.

Section 8.1 discusses the no-action alternative. Section 8.2 addresses alternative energy sources. Section 8.3 examines plant design alternatives. Section 8.4 reviews SERI's region of interest (ROI) and examines its suitability and the suitability of SERI's alternative site-selection

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

process. It describes the method Entergy Nuclear used to select the candidate and alternative sites. Entergy Nuclear, a division of Entergy, documented the process used to identify alternative sites in the *Early Site Permit Selection Committee Notebook* (Entergy Nuclear 2001). Section 8.4 also examines issues that are common to all of the alternative sites and addresses them collectively for all the alternative sites, and evaluates the selected alternative sites individually. Section 8.5 summarizes the environmental impacts for the alternative sites. The comparison of the alternative sites with the Grand Gulf ESP site is made in Chapter 9.

8.1 No-Action Alternative

For purposes of this ESP application, the no-action alternative refers to a scenario in which the NRC would deny the ESP request. Upon such a denial, the construction and operation of one or two new nuclear units at the proposed ESP location in accordance with the 10 CFR Part 52 process referencing an approved ESP would not occur.

The no-action alternative generally consists of two parts. First, the no-action alternative would include a scenario in which the NRC would not issue the ESP. There are no environmental impacts associated with not issuing the ESP, except that the impacts associated with site-preparation and preliminary work that could be allowed pursuant to 10 CFR 52.17(c) and 10 CFR 52.25(a) would be avoided. SERI has chosen not to include a site redress plan in its application, and therefore, is not permitted to undertake site preparation and preliminary work pursuant to 10 CFR 52.17(c).

Second, given that the EIS addresses the environmental effects of construction and operation as directed by the Commission in 10 CFR 52.18, the no-action alternative would result in no such construction and operation. Therefore, the impacts predicted in this EIS would not occur.

In this context, the no-action alternative would accomplish none of the benefits intended by the ESP process, which would include

- early resolution of siting issues prior to large investments of financial capital and human resources in new plant design and construction

- early resolution of issues on the environmental impacts of construction and operation of reactors that fall within the plant parameters

- the ability to bank sites on which nuclear plants may be located

- the facilitation of future decisions on whether to construct new nuclear power generation facilities.

8.2 Energy Alternatives

This section examines the potential environmental impacts associated with electric generating sources other than a new nuclear generation facility at the Grand Gulf ESP site; purchasing electric power from other sources to replace power that would have been generated by a new nuclear facility at the ESP site; a combination of new generating capacity and conservation measures; and other generation alternatives that were deemed not to be viable replacements for a new nuclear facility at the ESP site. Section 8.2.1 discusses energy alternatives not requiring new generating capacity. Section 8.2.2 discusses energy alternatives requiring new generating capacity. Other alternatives are discussed in Section 8.2.3. A combination of alternatives is discussed in Section 8.2.4. Section 8.2.5 compares the environmental impacts from new nuclear, coal-fired, and natural gas-fired generating units at the Grand Gulf ESP site.

In Section 9.2.2.2 of its ESP application, SERI established a target value for the desired electrical output of 2000 MW(e) for a new nuclear generating facility constructed at the Grand Gulf ESP site and used this value in their analysis of energy alternatives (SERI 2003c). The staff also used this level in Section 8.2 for analyzing the potential environmental impacts of alternative energy sources. The 2000 MW(e) output level is lower than the 3000 MW(e) maximum output level used in the analysis of construction and operation impacts in Chapters 4 and 5. The 3000 MW(e) figure derives from the SERI plant parameter envelope (PPE) (see Appendix I).

8.2.1 Alternatives Not Requiring New Generating Capacity

Four alternatives to the proposed action that do not require SERI to construct new generating capacity are to

- purchase the needed electric power from other suppliers
- reactivate retired power plants
- extend the operating life of existing power plants
- implement conservation or demand side management programs.

The viability of all four of the preceding alternatives depends on when SERI would seek a CP or a COL from NRC (assuming an ESP is granted). For example, the energy conservation potential in a region and the status of existing and retired nuclear power plants will vary over time. At the present time, no information is available on when SERI would seek to construct a new nuclear power facility at the Grand Gulf ESP site if it receives an ESP. If SERI is granted an ESP, the duration of the permit would be for 10 to 20 years (10 CFR 52.27(a)). In addition, if SERI is granted an ESP, it may apply for renewal of the permit under the procedures in 10 CFR 52.29 to 52.33.

The viability of the four alternatives also depends on whether the nuclear units SERI would seek to build at the Grand Gulf ESP site would be merchant or regulated facilities. Merchant power facilities generate electricity to sell on the open market to any buyer willing to pay the price asked by the facility owner. Owners of regulated nuclear power facilities are generally obligated to sell electricity to all buyers in the designated service area, usually at a price approved by a regulatory body. In return for assuming this obligation, the owners of regulated nuclear power facilities generally receive a guarantee that the approved price can provide a rate of return commensurate with the risk/return of comparable investments. SERI has indicated its intent that a new nuclear power facility built at the ESP location would be a merchant facility operated in a baseload manner to provide electricity to the competitive marketplace (SERI 2003c). However, SERI also stated that it is possible that a new nuclear facility constructed at the Grand Gulf ESP site could be operated as a regulated facility (SERI 2003c).

Because of the uncertainty in 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, energy alternatives not requiring new generating capacity are not evaluated further in this EIS. The four alternatives above would be evaluated by NRC in the future if SERI receives an ESP and elects to apply for a COL to construct and operate new nuclear units at the site under the procedures at 10 CFR Part 52 Subpart C, or a CP under the procedures at 10 CFR Part 50.

If power to replace the capacity of a new nuclear unit were to be purchased from sources within the United States or from a foreign country, the generating technology likely would be one of those described in the GEIS for license renewal (probably coal, natural gas, or nuclear) (NRC 1996). The description of the environmental impacts of other technologies described in the GEIS for license renewal is representative of the impacts associated with the construction and the operation of a new nuclear unit or units at the Grand Gulf ESP site. Under the purchased power alternative, the environmental impacts of power production would still occur, but would be located elsewhere within the region, nation, or in another country.

If the purchased power alternative is implemented, the only environmental unknown is whether new transmission line rights-of-way would be required. The construction of these lines could have both environmental and aesthetic consequences, particularly if new rights-of-way have to be acquired. The staff concludes that the local environmental impacts from purchased power would be SMALL when existing transmission line rights-of-way are used and could range from SMALL to LARGE if acquisition of new rights-of-way is required. The environmental impacts of power generation would depend on the generation technology and location of the generation site and, therefore, are unknown.

Nuclear power facilities are initially licensed for a period of 40 years. The license can be renewed for up to 20 years, and NRC regulations permit additional license renewal. SERI did not consider nuclear power plant license renewal in its environmental report. While SERI does not hold operating licenses for other nuclear power plants, it is a subsidiary of Entergy Corporation and other Entergy Corporation subsidiaries hold operating licenses for nuclear power plants around the country. A number of these plants have had operating licenses renewed and others are expected to seek license renewal.

The environmental impacts of continued operation of a nuclear power plant are significantly less that construction of a new plant. However, continued operation of an existing nuclear plant does not provide additional generating capacity.

Fossil plants slated for refurbishment, predominately coal- and natural gas-fired plants, tend to be ones that are old enough to have difficulty in economically meeting today's restrictions on air contaminant emissions and, as a result, would require extensive refurbishing to meet the more restrictive environmental standards at great economic cost. As a result, SERI concluded that the environmental impacts of a refurbishment scenario are bounded by the coal- and natural gas-fired alternatives.

The staff believes that it is unreasonable for an applicant to request a CP or a COL if power could be purchased from other electricity suppliers at a reasonable cost, or if the power could be obtained by reactivating one or more of SERI's retired generating plants or by extending the life of one or more existing generating plants.

The staff also notes that any plants considered for reactivation or an extended service life would likely be coal-fired or natural gas-fired plants. The environmental impacts of coal-fired and natural gas-fired plants are discussed in Section 8.2.2. SERI evaluated conservation, purchased power, and extension of plant life as alternatives to one or more new nuclear units at the SERI ESP site. The staff reviewed SERI's evaluation and concludes that these alternatives are not reasonable alternatives to providing new power generation capacity.

8.2.2 Alternatives Requiring New Generating Capacity

In keeping with the NRC's evaluation of alternatives to license renewal, a reasonable set of energy alternatives to the construction and operation of one or more new nuclear units at the Grand Gulf ESP site should be limited to analysis of discrete power generation sources and those power generation technologies that are technically reasonable and commercially viable

(NRC 1996). The current mix of power generation options in Mississippi is one indicator of the feasible choices for power generation technology within the State.

This section discusses the environmental impacts of those energy alternatives to the proposed action that would require SERI to construct new generating capacity, and is limited to the individual alternatives that are viable: coal-fired and natural gas-fired generation. The impacts discussed in this section are estimates based on present technology. It is not known with certainty when one or more new nuclear generating units might be constructed at the Grand Gulf ESP site.

The staff assumed that new generation capacity would be located at the Grand Gulf ESP site for the coal-fired and natural gas-fired alternatives. Consistent with the cooling system assumption made by SERI for siting a new nuclear generating plant at the Grand Gulf ESP site (SERI 2003c), a closed-cycle cooling system using either natural draft or mechanical cooling towers is also assumed for the coal-fired and natural gas-fired alternatives. For the purpose of its ESP application, SERI assumed that no new electric power transmission lines would be needed to serve a new generating facility located at the Grand Gulf ESP site (SERI 2003c), albeit that improvements may be necessary within the existing corridors. Given the original plan for the Grand Gulf site was for multiple units, the staff finds this reasonable. The analysis of alternative energy sources provided by SERI in its application draws on the information in Sections 8.2.1 and 8.2.2 of the supplemental EIS prepared by NRC related to the application to renew the operating licenses for Peach Bottom Atomic Power Station, Units 2 and 3 (NRC 2003).

Each year, the Energy Information Administration (EIA), a component of the U.S. Department of Energy (DOE), issues an annual energy outlook. In its *Annual Energy Outlook 2004*, the EIA reference case projects that combined-cycle, combustion turbine, or distributed generation technology fueled by natural gas is likely to account for approximately 62 percent of new electricity-generating capacity added between 2002 and 2025 (DOE/EIA 2004). Combined-cycle technology can be used to meet baseload requirements. In the combined-cycle unit, hot combustion gases in a combustion turbine rotate the turbine to generate electricity. Waste combustion heat from the combustion turbine is routed through a heat-recovery boiler to make steam to generate additional electricity.

Coal-fired plants are projected by EIA to account for approximately 33 percent of new capacity during this period. Coal-fired plants are generally used to meet baseload requirements.

Renewable energy sources, primarily wind and biomass units, are projected by EIA to account for the remaining 5 percent of capacity additions. The EIA projections are based on the assumption that providers of new generating capacity will seek to minimize cost while meeting applicable environmental requirements. Combined-cycle plants are projected by EIA to have the lowest levelized generation cost for new plants in 2010 (DOE/EIA 2004), while coal-fired plants are projected to have the lowest levelized generation cost for new plants in 2025 (DOE/EIA 2004). EIA projects that oil-fired plants will account for no new generation capacity in the United States through the year 2025, except for limited industrial combined heat and power applications because of higher fuel costs and lower efficiencies (DOE/EIA 2004).

8.2.2.1 Coal-Fired Power Generation

SERI chose to evaluate coal-fired generation in its environmental report. The staff assumed construction of four 509 MW(e) coal-fired units at the Grand Gulf ESP site. These assumptions are consistent with the application submitted by SERI (SERI 2003c). The plant is assumed to have an operating life of 40 years.

Coal and lime (calcium oxide) or limestone (calcium carbonate) for a coal-fired plant would be delivered to the plant by railroad or barge. Currently there is no rail service to the Grand Gulf site or in the vicinity of the site (SERI 2003c). SERI estimates that the 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 (SERI 2003c). Lime or limestone, used in the scrubbing process for control of sulfur dioxide emissions, is injected as a slurry into the hot effluent combustion gases to remove entrained sulfur dioxide. The lime-based scrubbing solution reacts with sulfur dioxide to form calcium sulfite, which precipitates and is removed from the process as sludge. SERI estimates that approximately 223,000 MT (246,000 tons) of lime would be used annually for flue gas desulfurization (SERI 2003c).

Air Quality

SERI has assumed a plant design that would minimize air emissions through a combination of boiler technology and post-combustion pollutant removal. SERI estimates the coal-fired alternative emissions for sulfur oxides (SO_x), nitrogen oxides (NO_x), carbon monoxide (CO), and particulate matter (PM) to be as follows:

- SO_x – 12,100 MT (13,340 tons) per year
- NO_x – 11,600 MT (12,800 tons) per year
- CO – 1500 MT (1650 tons) per year
- PM – 350 MT (390 tons) per year.

The impacts to air quality from coal-fired generation would vary considerably from those of nuclear generation because of emissions of SO_x, NO_x, CO, PM, and hazardous air pollutants such as mercury. A coal-fired plant would also have unregulated carbon dioxide emissions that could contribute to global warming.

The acid rain requirements of the Clean Air Act capped the nation's sulfur dioxide emissions from power plants. SERI would have to obtain sufficient pollution credits either from a set-aside pool or purchases on the open market to cover annual emissions from the plant. The market-based allowance system used for sulfur dioxide emissions is not used for NO_x emissions. A new coal-fired power plant would be subject to the new source performance standard for such plants (40 CFR 60.44a(d)(1)), which limits the discharge of any gases that contain NO_x (expressed as nitrogen dioxide) to 200 ng/J (1.6 lb/MWh) of gross energy output, based on a 30-day rolling average.

A new coal-fired generation plant would likely need a prevention of significant deterioration permit and an operating permit under the Clean Air Act. The plant would need to comply with the new source performance standards for such plants in 40 CFR Part 60 Subpart Da. The standards establish emission limits for particulate matter and opacity (40 CFR 60.42a), sulfur dioxide (40 CFR 60.43a), and nitrogen oxide (40 CFR 60.44a).

The U.S. Environmental Protection Agency (EPA) has various regulatory requirements for visibility protection in 40 CFR Part 51, Subpart P, including a specific requirement for review of any new major stationary source in an area designated as attainment or unclassified for criteria pollutants under the Clean Air Act (40 CFR 51.307(a)). Criteria pollutants under the Clean Air Act are lead, ozone, particulates, carbon monoxide, nitrogen oxide, and sulfur dioxide. Ambient air quality standards for criteria pollutants are in 40 CFR Part 50. The Grand Gulf ESP site is in an area designated as attainment or unclassified for criteria pollutants (40 CFR 81.325).

Section 169A of the Clean Air Act (42 USC 7491) establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when impairment occurs because of air pollution resulting from human activities. In addition, EPA regulations provide that, for each mandatory Class I Federal area located within a State, the State must establish goals that provide for reasonable progress toward achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for those days on which visibility is most impaired over the period of the implementation plan and ensure no degradation in visibility for the least visibility-impaired days over the same period (40 CFR 51.308(d)(1)). If a new coal-fired power station were located close to a mandatory Class I area, additional air pollution control requirements could be imposed. There are no mandatory Class I Federal areas in Mississippi.

The GEIS for license renewal (NRC 1996) did not quantify emissions from coal-fired power plants, but implied that air impacts would be substantial. The GEIS also mentioned global warming from unregulated carbon dioxide emissions and acid rain from sulfur oxides and nitrogen oxide emissions as a potential impact (NRC 1996). Adverse human health effects, such as cancer and emphysema, have been associated with the products of coal combustion. Overall, the staff concludes that air quality impacts from coal-fired generation would be MODERATE. The impacts would be clearly noticeable, but would not destabilize air quality.

Waste Management

The GEIS for license renewal (NRC 1996) and NRC experience from license renewal analyses indicates that coal combustion generates waste in the form of ash, and equipment for controlling air pollution generates additional ash, spent selective catalytic reduction (SCR) catalyst, and scrubber sludge. SERI estimates that a 2000 MW(e) coal-fired plant would generate approximately 710,000 MT (780,000 tons) of ash and spent catalyst and an additional 660,000 MT (730,000 tons) of scrubber sludge annually.

In May 2000, EPA issued a "Notice of Regulatory Determination on Wastes from the Combustion of Fossil Fuels" (65 FR 32214). EPA concluded that some form of National regulation is warranted to address coal combustion waste products because of health concerns. Accordingly, EPA announced its intention to issue regulations for disposal of coal-combustion waste under subtitle D of the Resource Conservation and Recovery Act (RCRA 1976).

Waste impacts to groundwater and surface water could extend beyond the operating life of the plant if leachate and runoff from the waste storage area occurs. Disposal of the waste could noticeably affect land use and groundwater quality, but with appropriate management and monitoring, it would not destabilize any resources. After closure of the waste site and revegetation, the land could be available for other uses. Construction-related debris would be generated during plant construction activities.

For the reasons stated above, the staff concludes that the impacts from waste generated at a coal-fired plant would be MODERATE. The impacts would be clearly noticeable, but would not destabilize any important resource.

Human Health

Coal-fired power generation introduces worker risks from coal and limestone mining, worker and public risk from coal and lime/limestone transportation, worker and public risk from disposal of coal-combustion waste, and public risk from inhalation of stack emissions. In addition, the discharges of uranium and thorium from coal-fired plants can potentially produce radiological doses in excess of those arising from nuclear power plant operations (Gabbard 1993).

Regulatory agencies, including the EPA and State agencies, base air emission standards and requirements on human health impacts. These agencies also impose site-specific emission limits as needed to protect human health. The EPA has recently concluded that certain segments of the U.S. population (such as the developing fetus and subsistence fish-eating populations) are believed to be at potential risk of adverse health effects caused by exposures to mercury from sources such as coal-fired power plants. However, given the regulatory oversight exercised by the EPA and by State agencies, the staff concludes that the human health impacts from radiological doses and inhaled toxins and particulates generated from coal-fired generation would be SMALL.

Other Impacts

Approximately 610 ha (1500 ac) of land would need 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. Given the proximity of the ESP site to the Mississippi River, ash, scrubber sludge, and spent SCR catalyst (used for control of nitrogen oxide emissions) would likely be disposed of offsite. Disposal of ash and sludge over a 40-year plant life would require approximately 320 ha (790 ac) of the 600 ha (1500 ac). Additional land may be needed in the site vicinity for infrastructure facilities, rail spur, and cooling water intake and discharge facilities. Total land requirements would be approximately 1085 ha (2680 ac) (SERI 2003c). Additional land adjacent to the ESP site would likely need to be acquired by SERI if the coal alternative were to be implemented. The ESP site consists of approximately 850 ha (2100 ac), about half of which lies in seasonally flooded bottomlands (SERI 2003c). Land use changes would occur offsite in an undetermined coal-mining area to supply coal for the plant. Overall, the staff concludes that the land-use impacts would be MODERATE.

The coal-fired generation alternative would introduce impacts from construction and new incremental impacts from operations. The impacts could include wildlife habitat loss and fragmentation, reduced productivity, and a local reduction in biological diversity. The impacts could occur at the ESP site and at the sites used for coal and limestone mining. Extraction of cooling makeup water could have adverse impacts on aquatic resources. Construction and maintenance of a rail spur and, if needed, new or improved transmission lines would have ecological impacts. Cooling tower drift would have minimal impacts on terrestrial ecology. Disposal of fly ash could affect water quality and the aquatic environment. The impacts to threatened and endangered species at the ESP site would be similar to the impacts from a new nuclear facility. Overall, the staff concludes that the ecological impacts would be MODERATE to LARGE.

The impacts on water use and quality from constructing and operating a coal-fired plant at the ESP site would be comparable to the impacts associated with a new nuclear facility. Cooling water would likely be withdrawn directly from the Mississippi River or from collector wells located in the floodplain. Closed-cycle cooling with cooling towers is assumed. Plant discharges would consist mostly of cooling tower blowdown, characterized primarily by an increased temperature and concentration of dissolved solids relative to the receiving water body and intermittent low concentrations of biocides (for example, chlorine). Treated process waste streams and sanitary wastewater may also be discharged. All discharges would be regulated by the Mississippi Department of Environmental Quality (MDEQ) through a National Pollution Discharge Elimination System (NPDES) permit. Indirectly, water quality could be affected by acids and mercury from air emissions. Water would be consumed because of evaporation from the cooling towers. In the GEIS for license renewal the staff determined that some erosion and sedimentation would likely occur during construction (NRC 1996). Overall, the staff concludes that the water use and quality impacts would be SMALL.

Socioeconomic impacts would result from the approximately 300 workers needed to operate the coal-fired facility, demands on housing and public services during construction, and the loss of jobs after construction. Overall, the staff concludes that these impacts would be SMALL to MODERATE, resulting from the mitigating influence of the site's proximity to the surrounding population area and the relatively small number of workers needed to operate the plant. The plant would pay property taxes to Claiborne County. Considering the population and economic condition of the County, the staff concludes that the taxes would have a MODERATE to LARGE beneficial impact on the County.

The four coal-fired power block units would be as much as 60 m (200 ft) tall and would be visible offsite during daylight hours. The four exhaust stacks would be as much as 180 m (600 ft) high. The stacks and associated emissions would likely be visible in daylight hours for distances greater than 16 km (10 mi). Cooling towers and associated plumes also would have aesthetic impacts. Natural draft towers could be up to 168 m (550 ft) high (SERI 2003c), and mechanical draft towers could be up to 30 m (100 ft) high. The stacks would be visible from parks and other recreational areas in the vicinity of the plant. The power block units and associated stacks and cooling towers would also be visible at night because of outside lighting. The Federal Aviation Administration generally requires that all structures exceeding an overall height of 61 m (200 ft) above ground level have markings and/or lighting so as not to impair aviation safety (FAA 2000). A mitigating factor is that the Grand Gulf ESP site is currently an industrial site located in a rural, forested area. The visual impacts of a new coal-fired plant could be further mitigated by landscaping and color selection for buildings that is consistent with the environment. Visual impacts at night could be mitigated by reduced use of lighting, provided the lighting meets Federal Aviation Administration requirements, and appropriate use of shielding.

Coal-fired power generation would introduce mechanical sources of noise that would be audible offsite. Sources contributing to the noise produced by plant operation are classified as continuous or intermittent. Continuous sources include the mechanical equipment associated with normal plant operations and mechanical draft cooling towers. Intermittent sources include the equipment related to coal handling, solid-waste disposal, transportation related to coal and lime/ limestone delivery, use of outside loudspeakers, and the commuting of plant employees. Noise impacts associated with rail delivery of coal and lime/limestone would be most significant for residents living in the vicinity of the facility and along the rail route. Although noise from passing trains significantly increases noise levels near the rail corridor, the short duration of the noise reduces the impacts. Nevertheless, given the frequency of train transport and the fact that many people are likely to be within hearing distance of the railway, the impacts of noise on residents in the vicinity of the facility and of the rail line are considered significant. Noise associated with barge transportation of coal and lime/limestone would be minor. Noise and light from the plant would be detectable offsite.

For the purpose of its ESP application, SERI assumed that no new electric power transmission lines would be needed to serve a new generating facility located at the ESP site (SERI 2003c). Constructing and operating a coal-fired generation plant would be consistent with the industrial nature of the ESP site. Although best management practices would be expected to be implemented, the viewshed would be affected. Therefore, the staff concludes that the visual and aesthetic impacts of a coal-fired generation plant would be MODERATE.

The ESP site was disturbed during construction of the Grand Gulf Nuclear Station (GGNS). As a result, significant cultural and historic resource impacts would be unlikely and would be minimized by survey and recovery techniques. A cultural resources inventory would likely be needed for any onsite property that has not been previously surveyed. Other lands, if any, that are acquired to support the plant would also likely need an inventory of field cultural resources, identification and recording of existing historic and archaeological resources, and possible mitigation of the adverse effect from ground-disturbing actions. Before construction, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new power plant construction on cultural resources. The studies would likely be needed for all areas of potential disturbance at the plant site, any offsite affected areas, such as mining and waste disposal sites, and along associated corridors where new construction would occur (for example, roads, transmission line rights-of-way, rail lines, or other rights-of-way). The staff concludes that the historic and cultural resource impacts would be SMALL.

There is evidence of potential environmental justice issues at the ESP site. Some impacts on housing availability and prices during construction might occur, which could disproportionately affect minority and low-income populations. Therefore, the staff concludes that environmental justice impacts would be SMALL to MODERATE.

Other construction and operation impacts would be SMALL. In most cases, the impacts would be detectable, but they would not destabilize any important attribute of the resource involved. Due to the minor nature of these impacts, mitigation beyond that discussed would not be warranted.

The impacts of constructing coal-fired power generation at the ESP site are given in Table 8-1.

Table 8-1. Summary of Environmental Impacts of Coal-Fired Power Generation – 2000 MW(e)

Impact Category	Impact	Comment
Air Quality	MODERATE	SO_x – 12,100 MT (13,340 tons) per year NO_x – 11,600 MT (12,800 tons) per year CO – 1500 MT (1650 tons) per year PM – 350 MT (390 tons) per year Small amounts of hazardous air pollutants.
Waste Management	MODERATE	Total waste volume would be approximately 711,000 MT/yr (784,000 tons/yr) of ash and spent catalyst, and an additional 660,000 MT/yr (728,000 tons/yr) of scrubber sludge.
Human Health	SMALL	Regulatory controls and oversight would be protective of human health.
Land Use	MODERATE	Uses up to 1085 ha (2680 ac) for power block; coal handling, storage, and transportation facilities; infrastructure facilities; waste disposal; rail spur; and cooling-water facilities. Mining activities would have additional impacts offsite.
Ecology	MODERATE to LARGE	Uses the undeveloped upland area of the ESP site and probably some adjacent offsite undeveloped land. Potential upland hardwood forest loss and fragmentation, reduced productivity and biological diversity, and impacts to terrestrial ecology from cooling tower drift. Additional impacts associated with coal mining and construction of a rail spur.
Water Use and Quality	SMALL	Impacts would be comparable to the impacts for a new nuclear facility located at the ESP site.
Socioeconomics	SMALL (Adverse) to MODERATE (Beneficial)	Construction-related impacts would be noticeable. Impacts during operation would be minor. Local property tax base would benefit mainly during operations. Depending on where the workforce lives, the construction-related impacts would be noticeable or minor. Impacts during operation likely would be smaller than during construction.
Aesthetics	MODERATE	Best management practices can be used to mitigate visual impacts from exhaust stacks, cooling towers, and plumes. Some offsite noise impacts would occur.
Historic and Cultural Resources	SMALL	Any potential impacts could likely be effectively managed. Most of the facility and infrastructure would be built on previously disturbed ground.
Environmental Justice	SMALL to MODERATE	Some impacts on housing availability and prices during construction may occur.

8.2.2.2 Natural Gas-Fired Power Generation

SERI chose to evaluate natural gas-fired generation in its environmental report. For this alternative, the staff assumed construction and operation of a natural gas-fired plant with a closed-cycle cooling system and cooling towers located at the Grand Gulf ESP site. The staff assumed that the replacement natural gas-fired plant would use combined-cycle combustion turbines, which is consistent with the SERI ESP application (SERI 2003c). The staff also used the SERI assumption of four units with a net capacity of 508 MW(e) per unit (SERI 2003c).

Air Quality

Natural gas is a relatively clean-burning fuel. When compared with a coal-fired plant, a natural gas-fired plant would release similar types of emissions but in lower quantities.

A new natural gas-fired power generation plant would likely need a prevention of significant deterioration permit and an operating permit under the Clean Air Act. A new combined-cycle, natural gas-fired plant would also be subject to the new source performance standards specified in 40 CFR Part 60, Subparts Da and GG. These regulations establish emission limits for particulates, opacity, sulfur dioxide, and nitrogen oxides.

EPA has various regulatory requirements for visibility protection in 40 CFR Part 51, Subpart P, including a specific requirement for review of any new major stationary source in areas designated as attainment or unclassified under the Clean Air Act. The Grand Gulf ESP site is in an area designated as attainment or unclassified for criteria pollutants (40 CFR 81.325).

Section 169A of the Clean Air Act (42 USC 7491) establishes a national goal of preventing future impairment of visibility and remedying existing impairment in mandatory Class I Federal areas when impairment is from air pollution caused by human activities. In addition, EPA regulations provide, that for each mandatory Class I Federal area located within a State, State regulatory agencies must establish goals that provide for reasonable progress toward achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for the most impaired days over the period of the implementation plan and ensure no degradation in visibility for the least impaired days over the same period (40 CFR 51.308(d)(1)). If a new natural gas-fired power plant were located close to a mandatory Class I area, additional air pollution control requirements could be imposed. The State of Mississippi has no mandatory Class I Federal areas.

SERI estimates that a natural gas-fired plant equipped with appropriate pollution control technology would have approximately the following emissions (SERI 2003c):

- SO_x – 109 MT (120 tons) per year
- NO_x – 417 MT (460 tons) per year
- CO – 553 MT (610 tons) per year
- PM_{10} – 63 MT (70 tons) per year.

PM_{10} is particulate matter having an aerodynamic diameter less than or equal to 10 μm (40 CFR 50.6(c)). A natural gas-fired power plant would also have unregulated carbon dioxide emissions that could contribute to global warming.

The combustion turbine portion of the combined-cycle plant would be subject to EPA's National Emission Standards for Hazardous Air Pollutants for Stationary Combustion Turbines (40 CFR Part 63, Subpart YYYY) if the site is a major source of hazardous air pollutants. Major sources have the potential to emit 10 tons/yr or more of any single hazardous air pollutant or 25 tons/yr or more of any combination of hazardous air pollutants (40 CFR 63.6085(b)).

The fugitive dust emissions from construction activities would be mitigated using best management practices; such emissions would be temporary.

The impacts of emissions from a natural gas-fired power generation plant would be clearly noticeable, but would not be sufficient to destabilize air resources. Overall, the staff concludes that air quality impacts resulting from construction and operation from new natural gas-fired power generation at the ESP site would be SMALL to MODERATE.

Waste Management

In the GEIS, the staff concluded that waste generation from natural gas-fired technology would be minimal (NRC 1996). The only significant waste generated at a natural gas-fired power plant would be spent SCR catalyst, which is used to control NO_x emissions. The spent catalyst would be regenerated or disposed of offsite. Other than spent SCR catalyst, waste generation at an operating natural gas-fired plant would be largely limited to typical office waste. Construction-related debris would be generated during construction activities. Overall, the staff concludes that waste impacts from natural gas-fired power generation would be SMALL.

Human Health

In the GEIS, the staff identified cancer and emphysema as a potential health risk from natural gas-fired plants (NRC 1996). The risk may be attributable to NO_x emissions that contribute to ozone formation, which in turn contribute to health risk. Air emissions from a natural gas-fired power generation plant located at the Grand Gulf ESP site would be regulated by the MDEQ.

The human health effect is expected to be either undetectable or sufficiently minor. Overall, the staff concludes that the impacts on human health from natural gas-fired power generation would be SMALL.

Other Impacts

The natural gas-fired generating plant would require approximately 44 ha (110 ac) for the power block and support facilities and likely would be sited on land that was previously disturbed during the construction of GGNS Unit 1 (SERI 2003c). Assuming the natural gas plant uses a closed-cycle cooling system, an additional land area of up to 12 ha (30 ac) would be required for cooling towers and support systems. Construction of a natural gas pipeline from the Grand Gulf ESP site to the closest natural gas distribution line could require up to 34 ha (85 ac) (SERI 2003c). Thus, the total land use commitment would be approximately 90 ha (225 ac) (SERI 2003c). For any new natural gas-fired power plant, additional land would be required for natural gas wells and collection stations. In the GEIS, the staff estimated that approximately 1500 ha (3600 ac) would be needed for a 1000-MW(e) plant (NRC 1996). Information from the GEIS for license renewal is useful for this analysis as well. Overall, the staff concludes that land-use impacts from new natural gas-fired power generation would be SMALL.

Siting of the natural gas-fired plant would have ecological impacts that would be less than a new nuclear facility. Much of the impact would occur in areas that were previously disturbed during the construction of GGNS Unit 1. Constructing a new underground gas pipeline to the site would cause temporary ecological impacts. Ecological impacts to the plant site and utility easements would not affect threatened or endangered species, although some wildlife habitat loss and fragmentation, reduced productivity, and a local reduction in biological diversity would be likely. Withdrawal and discharge of makeup water for the cooling system could affect aquatic resources, and drift of condensation from the cooling towers could affect terrestrial ecology. Overall, the staff concludes that ecological impacts would be SMALL to MODERATE.

The impacts to water use and quality from constructing and operating a natural gas-fired plant at the Grand Gulf ESP site would be comparable to the impacts associated with constructing and operating a new nuclear facility. Closed-cycle cooling with cooling towers is assumed. The impacts to water quality from sedimentation during construction of a natural gas-fired plant were characterized in the GEIS as SMALL (NRC 1996). NRC also noted in the GEIS that the impacts to water quality from operations would be similar to, or less than, the impacts from other generating technologies. Information from the GEIS for license renewal is useful for this analysis as well. Overall, the staff concludes that impacts to water use and quality would be SMALL.

Socioeconomic impacts would result from the approximately 150 workers needed to operate the natural gas-fired facility, demands on housing and public services during construction, and the loss of jobs after construction. Overall, the staff concludes that these impacts would be SMALL because of the mitigating influence of the site's proximity to the surrounding population area and the relatively small number of workers needed to construct and operate the plant in comparison to nuclear and coal-fired generation alternatives. The plant would pay property taxes to Claiborne County. Considering the population and economic condition of the County, the staff concludes that the taxes would have a MODERATE to LARGE beneficial impact on the County.

The turbine buildings, four exhaust stacks (approximately 60 m [200 ft] tall) and associated emissions, cooling towers, condensation plumes from the cooling towers, and the gas pipeline compressors would be visible during daylight hours from offsite. Noise and light from the plant would be detectable offsite. For the purpose of its ESP application, SERI assumed that no new electric power transmission lines would be needed to serve a new generating facility located at the Grand Gulf site (SERI 2003c). A mitigating factor is that the Grand Gulf ESP site is currently an industrial site located in a rural, forested area. Overall, the staff concludes that the aesthetic impacts associated with new natural gas-fired power generation at the Grand Gulf ESP site would be SMALL to MODERATE.

The ESP site was disturbed during construction of the GGNS. As a result, significant cultural and historic resource impacts would be unlikely and would be minimized by survey and recovery techniques. A cultural resources inventory would likely be needed for any onsite property that has not been previously surveyed. Other lands, if any, that are acquired to support the plant would also likely need an inventory of field cultural resources, identification and recording of existing historic and archaeological resources, and possible mitigation of the adverse effects from ground-disturbing actions. Before construction, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new power plant construction on cultural resources. The studies would likely be needed for all areas of potential disturbance at the plant site, any offsite affected areas, and along associated corridors where new construction would occur (for example, roads, transmission line rights-of-way, rail lines, or other rights-of-way). The staff concludes that the historic and cultural resource impacts would be SMALL.

There is evidence of potential environmental justice issues at the ESP site. Some impacts on housing availability and prices during construction might occur, which could disproportionately affect minority and low-income populations. Therefore, the staff concludes that environmental justice impacts would be SMALL to MODERATE.

Other construction and operation impacts would be SMALL. In most cases, the impacts would be detectable, but they would not destabilize any important attribute of the resource involved. Due to the minor nature of these impacts, mitigation beyond that discussed would not be warranted.

The impacts of constructing natural gas-fired power generation at the ESP site are summarized in Table 8-2.

Table 8-2. Summary of Environmental Impacts of Natural Gas-Fired Power Generation – 2000 MW(e)

Impact Category	Impact	Comment
Air Quality	SMALL to MODERATE	SO_x – 109 MT (120 tons) per year NO_x – 417 MT (460 tons) per year CO – 553 MT (610 tons) per year PM_{10} – 63 MT (70 tons) per year Some hazardous air pollutants.
Waste Management	SMALL	The only significant waste would be from spent SCR catalyst used for control of NO_x emissions.
Human Health	SMALL	Regulatory controls and oversight would be protective of human health.
Land Use	SMALL	90 ha (225 ac) would be needed for power block, cooling towers and support systems, and connection to a natural gas pipeline. Additional land might be needed for infrastructure and other facilities.
Ecology	SMALL to MODERATE	Many of the impacts would occur in areas that were previously disturbed during the construction of GGNS Unit 1. Thus, potential habitat loss and fragmentation and reduced productivity and biological diversity would be negligible. Impacts to terrestrial ecology from cooling tower drift could occur.
Water Use and Quality	SMALL	Impacts would be comparable to the impacts for a new nuclear plant located at the ESP site.
Socioeconomics	SMALL (Adverse) to MODERATE (Beneficial)	Construction and operations workforces are both relatively small. Addition to property tax base, while smaller than for a nuclear or coal-fired plant, might still be quite noticeable. Construction-related impacts would be noticeable. Impacts during operation would be minor because of the small work force involved.
Aesthetics	SMALL to MODERATE	Best management practices can be used to mitigate visual impacts from the plant buildings, exhaust stacks, cooling towers, and condensation plumes from operation of the cooling towers.
Historic and Cultural Resources	SMALL	Any potential impacts could likely be effectively managed. Most of the facility and infrastructure would be built on previously disturbed ground.
Environmental Justice	SMALL to MODERATE	Some impacts on housing availability and prices during construction may occur.

8.2.3 Other Alternatives

This section discusses alternatives that SERI determined are not reasonable, the staff's conclusions about the overall environmental impacts of each alternative, and the staff's basis for the conclusions. New nuclear units at the ESP site would be a baseload generation plant. Any feasible alternative to the new units would need to generate baseload power. In performing its initial evaluation in the environmental report, SERI relied on the GEIS for license renewal (NRC 1996). The staff reviewed the information submitted by SERI and conducted its own independent review and finds that SERI's conclusion that these generation options are not reasonable alternatives to one or more new nuclear units is acceptable.

The staff has not assigned significance levels to the environmental impacts associated with the alternatives discussed in this section because, in general, the generation alternatives would have to be installed at a location other than the ESP site. Any attempt to assign significance levels would require staff speculation about the unknown site.

8.2.3.1 Oil-Fired Power Generation

The EIA projects that, because of higher fuel costs and lower efficiencies, oil-fired power plants will not provide new power generation capacity in the United States through the year 2025, except for limited industrial combined heat and power applications (DOE/EIA 2004). Oil-fired generation is more expensive than either the nuclear or coal-fired generation options. In addition, future increases in oil prices are expected to make oil-fired generation increasingly more expensive than coal-fired generation. The high cost of oil has resulted in a decline in its use for electricity generation. In Section 8.3.11 of the GEIS for license renewal, the staff estimated that construction of a 1000 MW(e) oil-fired plant would require about 49 ha (120 ac) of land (NRC 1996).

For the proceeding reasons, the staff concludes that an oil-fired powerplant at or in the vicinity of the Grand Gulf ESP site would not be an economical alternative to construction of a 2000 MW(e) nuclear power generation facility that would be operated as a baseload plant.

8.2.3.2 Wind Power

Mississippi and Louisiana are in a wind power Class 1 region (average wind speeds lower than 5.6 m/s) (DOE 2004a). Class 1 regions have the lowest potential for wind energy generation (DOE 2004a). Mississippi does not have sufficient wind resources to use large-scale wind turbines (DOE 2004b). Small wind turbines may have applications in some areas of the State (DOE 2004b). Wind turbines typically operate at a 25 to 35 percent capacity factor compared to 90 to 95 percent for a baseload plant such as a nuclear plant (NWPPC 2000).

For the preceding reasons, the staff concludes that a wind energy facility at or in the vicinity of the Grand Gulf ESP site would not be an economical alternative to construction of a 2000 MW(e) nuclear power generation facility that would be operated as a baseload plant.

8.2.3.3 Solar Power

Solar technologies use energy and light from the sun to provide heating and cooling, light, hot water, and electricity for consumers. Solar power technologies (both photovoltaic and thermal) cannot currently compete with conventional nuclear and fossil-fueled technologies in grid-connected applications because of solar power's higher capital cost per kilowatt of capacity. Energy storage requirements also limit the use of solar energy systems as baseload electricity supply. In the GEIS for license renewal, the staff determined that the average capacity factor of photovoltaic cells is about 25 percent, and the capacity factor for solar thermal systems is about 25 to 40 percent (NRC 1996).

Construction of solar generating facilities has substantial impacts on natural resources (such as wildlife habitat, land-use, and aesthetics). As stated in the GEIS, land requirements are high–142 km^2 (55 mi^2) per 1000 MW(e) for photovoltaic (NRC 1996) and approximately 57 km^2 (22 mi^2) per 1000 MW(e) for solar thermal systems (NRC 1996). Neither type of solar electric system would fit the land area footprint available at the Grand Gulf ESP site.

The Grand Gulf ESP site receives approximately 4500 to 5000 watt-hr/m^2/day that can be used for flat-plate solar systems, and approximately 4000 to 4500 watt-hr/m^2/day that can be used for solar concentrating systems (DOE 2004c). Areas in the southwest United States receive up to 7500 watt-hr/m^2/day (DOE 2004c). The solar resource in Mississippi can be used for water heating or photovoltaic systems but not for large concentrating solar thermal utility systems (DOE 2004c).

For the preceding reasons, the staff concludes that a solar energy facility at or in the vicinity of the Grand Gulf ESP site would not be an economical alternative to construction of a 2000 MW(e) nuclear power generation facility that would be operated as a baseload plant.

8.2.3.4 Hydropower

Mississippi has an estimated 92 MW of developable hydroelectric resources (INEEL 1997). As stated in Section 8.3.4 of the GEIS for license renewal (NRC 1996), the percentage of U.S. generating capacity supplied by hydropower is expected to decline because hydroelectric facilities have become difficult to site as a result of public concerns about flooding, destruction of natural habitat, and alteration of natural river courses. In the GEIS, the staff estimated that land requirements for hydroelectric power are approximately 400,000 ha (1 million ac) per

1000 MW(e) (NRC 1996). Because of the relatively low amount of undeveloped hydropower resource in Mississippi and the large land-use and related environmental and ecological resource impacts associated with siting hydroelectric facilities large enough to produce 2000 MW(e), the staff concludes that local hydropower is not a feasible alternative to construction of a new nuclear power generation facility operated as a baseload plant at the Grand Gulf ESP site.

8.2.3.5 Geothermal Energy

Geothermal energy has an average capacity factor of 90 percent and can be used for baseload power where available. However, geothermal technology is not widely used as baseload power generation because of the limited geographical availability of the resource and immature status of the technology (NRC 1996). Geothermal plants are most likely to be sited in the western continental United States, Alaska, and Hawaii, where hydrothermal reservoirs are prevalent. Mississippi has low- to moderate-geothermal resources that can be tapped for direct heat or for geothermal heat pumps. However, electricity generation is not possible with these resources (DOE 2004d). No feasible eastern location for geothermal capacity can serve as an alternative to a baseload nuclear power plant.

For the preceding reasons, the staff concludes that a geothermal energy facility at or in the vicinity of the Grand Gulf ESP site would not be an economical alternative to construction of a 2000 MW(e) nuclear power generation facility operated as a baseload plant.

8.2.3.6 Wood Waste

In the GEIS for license renewal, the staff determined that a wood-burning facility can provide baseload power and operate with an average annual capacity factor of around 70 to 80 percent and with 20 to 25 percent efficiency (NRC 1996). The fuels required are variable and site-specific. A significant impediment to the use of wood waste to generate electricity is the high cost of fuel delivery and high construction cost per megawatt of generating capacity. The larger wood-waste power plants are only 40 to 50 MW(e) in size. Estimates in the GEIS suggest that the overall level of construction impacts per megawatt of installed capacity would be approximately the same as that for a coal-fired plant, although facilities using wood waste for fuel would be built at smaller scales (NRC 1996). Similar to coal-fired plants, wood-waste plants require large areas for fuel storage and processing and involve the same type of combustion equipment.

Because of uncertainties associated with obtaining sufficient wood and wood waste to fuel a baseload powerplant, the ecological impacts of large-scale timber cutting (for example, soil erosion and loss of wildlife habitat), and high inefficiency, the staff has determined that wood waste is not a feasible alternative to a 2000 MW(e) nuclear power generation facility operated as a baseload plant.

8.2.3.7 Municipal Solid Waste

Municipal solid-waste combustors incinerate the waste and use the resultant heat to produce steam, hot water, or electricity. The combustion process can reduce the volume of waste by up to 90 percent and the weight of the waste by up to 75 percent (EPA 2004). Municipal waste combustors use three basic types of technologies: mass burn, modular, and refuse-derived fuel (DOE/EIA 2001). Mass burning technologies are most commonly used in the United States. This group of technologies processes raw municipal solid waste "as is," with little or no sizing, shredding, or separation before combustion. In the GEIS for license renewal, the staff determined that the initial capital cost for municipal solid-waste plants is greater than for comparable steam-turbine technology at wood-waste facilities because of the need for specialized waste-separation and waste-handling equipment for municipal solid waste (NRC 1996).

Municipal solid waste combustors generate an ash residue that is buried in landfills. The ash residue is composed of bottom ash and fly ash. Bottom ash refers to that portion of the unburned waste that falls to the bottom of the grate or furnace. Fly ash represents the small particles that rise from the furnace during the combustion process. Fly ash is generally removed from flue gases using fabric filters and/or scrubbers (DOE/EIA 2001).

Currently, approximately 89 waste-to-energy plants are operating in the United States. These plants generate approximately 2500 MW(e), or an average of approximately 28 MW(e) per plant (IWSA 2004). For the preceding reasons, the staff concludes that generating electricity from municipal solid waste would not be a feasible alternative to a 2000 MW(e) nuclear power generation facility operated as a baseload plant.

8.2.3.8 Other Biomass-Derived Fuels

In addition to wood and municipal solid waste fuel, several other biomass-derived fuels are available for fueling electric generators, including burning crops, converting crops to a liquid fuel such as ethanol, and gasifying crops (including wood waste). In the GEIS for license renewal, the staff determined 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 baseload plant (NRC 1996). For these reasons, the staff concludes that such fuels do not offer a feasible alternative to a 2000 MW(e) nuclear power generation facility operated as a baseload plant.

8.2.3.9 Fuel Cells

Fuel cells work without combustion and its associated environmental side effects. Power is produced electrochemically by passing a hydrogen-rich fuel over an anode, air over a cathode, and then separating the two by an electrolyte. The only by-products are heat, water, and carbon dioxide. Hydrogen fuel can come from a variety of hydrocarbon resources by subjecting them to steam under pressure. Natural gas is typically used as the source of hydrogen.

Phosphoric acid fuel cells are generally considered first-generation technology. Higher-temperature, second-generation fuel cells achieve higher fuel-to-electricity and thermal efficiencies. The higher temperatures contribute to improved efficiencies and give the second-generation fuel cells the capability to generate steam for cogeneration and combined-cycle operations.

During the past three decades, significant efforts have been made to develop more practical and affordable fuel cell designs for stationary power applications, but progress has been slow (DOE 2004e). Currently, the most widely marketed fuel cells cost about $4500 per kWh of installed capacity. By contrast, a diesel generator costs $800 to $1500 per kWh of installed capacity, and a natural gas turbine can be even less (DOE 2004e).

DOE initiated a program – the Solid State Energy Conversion Alliance – to bring about dramatic reductions in fuel cell cost. DOE's goal is to cut costs to as low as $400 per kWh of installed capacity by the end of this decade, which would make fuel cells competitive for virtually every type of power application (DOE 2004e).

The staff concludes that, at the present time, fuel cells are not economically or technologically competitive with other alternatives for baseload electricity generation. Future gains in cost competitiveness for fuels cells compared to other fuels are speculative.

For the preceding reasons, the staff concludes that a fuel cell energy facility located at or in the vicinity of the Grand Gulf ESP site would not be an economical alternative to construction of a 2000 MW(e) nuclear power generation facility operated as a baseload plant.

8.2.4 Combination of Alternatives

Individual alternatives to the construction of one or more new nuclear units at the Grand Gulf ESP site might not be sufficient on their own to generate SERI's target value of 2000 MW(e) because of the small size of the resource or lack of cost-effective opportunities. Nevertheless, it is conceivable that a combination of alternatives might be cost effective. There are many possible combinations of alternatives.

Section 8.2.2.2 assumes the construction of four 508 MW(e) natural gas combined-cycle generating units at the Grand Gulf ESP site using closed-cycle cooling with cooling towers. For a combined alternatives option, the staff assessed 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. A summary of the environmental impacts of this combination of alternatives in given in Table 8-3.

8.2.5 Summary Comparison of Alternatives

Table 8-4 contains a summary of environmental impact characterizations for constructing and operating new nuclear, coal-fired, and natural gas-fired, combined-cycle generating units at the Grand Gulf ESP site. The combination of alternatives shown in Table 8-4 assumes siting of natural gas-fired/combined-cycle units at the ESP site and siting of other generating units in the general vicinity (within 160 km/100 mi) of the site. Closed-cycle cooling with cooling towers is assumed for all thermal plants.

The staff reviewed the available information on the environmental impacts of power generation alternatives compared to the construction of new nuclear units at the Grand Gulf ESP site. Based on this review, the staff concludes that, from an environmental perspective, none of the viable energy alternatives are obviously superior to construction of a new baseload nuclear power generation plant. If significant changes in generation technology or environmental impacts associated with particular generation technologies should occur and an ESP holder seeks a construction permit or combined license to build a new nuclear generating plant at an ESP location, the staff would verify the analysis of energy alternatives conducted at the ESP stage.

8.3 Plant Design Alternatives

An important factor in assessing environmental impacts on the terrestrial and aquatic environments in the vicinity of a nuclear power plant site is the selection of heat dissipation and circulating water systems. In Sections 9.4.1 and 9.4.2 of its environmental report, SERI described the selection and evaluation process that resulted in 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 (SERI 2003c).

Table 8-3. Summary of Environmental Impacts of a Combination of Power Sources – 2000 MW(e)

Impact Category	Impact	Comment
Air Quality	SMALL to MODERATE	SO_x – 82 MT (90 tons) per year NO_x – 313 MT (345 tons) per year CO – 415 MT (458 tons) per year PM_{10} – 47 MT (53 tons) per year Some hazardous air pollutants.[a]
Waste Management	SMALL	The only significant waste would be from spent SCR catalyst used for control of NO_x emissions.[a]
Human Health	SMALL	Regulatory controls and oversight would be protective of human health.
Land Use	SMALL	Power block, cooling towers and support systems, and connection to a natural gas pipeline. Additional land might be needed for infrastructure and other facilities.
Ecology	SMALL to MODERATE	Many of the impacts would occur in areas that were previously disturbed during the construction of GGNS Unit 1. Thus, potential habitat loss and fragmentation and reduced productivity and biological diversity would be negligible. Impacts to terrestrial ecology from cooling tower drift could occur.
Water Use and Quality	SMALL	Impacts would be comparable to the impacts for a new nuclear plant located at the ESP site.
Socioeconomics	SMALL (Adverse) to MODERATE (Beneficial)	Construction and operations workforces are both relatively small. Addition to property tax base, while smaller than for a nuclear, coal-fired, or solely natural gas-fired plant, might still be quite noticeable. Construction-related impacts would be noticeable. Impacts during operation would be minor because of the small work force involved.
Aesthetics	SMALL to MODERATE	Best management practices can be used to mitigate visual impacts from the plant buildings, exhaust stacks, cooling towers, and condensation plumes from operation of the cooling towers.
Historic and Cultural Resources	SMALL	Any potential impacts could likely be effectively managed. Most of the facility and infrastructure would be built on previously disturbed ground.
Environmental Justice	SMALL to MODERATE	Some impacts on housing availability and prices during construction may occur.

(a) Impacts are principally from natural gas-fired power generation. Municipal solid waste or biomass facilities may generate some additional emissions.

(a) Impacts are principally from natural gas-fired power generation. Municipal solid waste or biomass facilities may generate some additional wastes.

Table 8-4. Summary of Environmental Impacts of Construction and Operation of New Nuclear, Coal-Fired, and Natural Gas-Fired Generating Units, and a Combination of Alternatives

Impact Category	Nuclear	Coal	Natural Gas	Combination of Alternatives
Air quality	SMALL	MODERATE	SMALL to MODERATE	MODERATE
Waste management	SMALL	MODERATE	SMALL	SMALL
Human health	SMALL	SMALL	SMALL	SMALL
Land use	SMALL	MODERATE	SMALL	SMALL
Ecology	SMALL to MODERATE	MODERATE to LARGE	SMALL to MODERATE	SMALL to MODERATE
Water use and quality	SMALL	SMALL	SMALL	SMALL
Socioeconomics	SMALL (Adverse) to MODERATE (Beneficial)	SMALL (Adverse) to MODERATE (Beneficial)	SMALL (Adverse) to MODERATE (Beneficial)	SMALL (Adverse) to MODERATE (Beneficial)
Aesthetics	SMALL to MODERATE	MODERATE	SMALL to MODERATE	SMALL to MODERATE
Historic and cultural resources	SMALL	SMALL	SMALL	SMALL
Environmental justice	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE

8.3.1 Heat Dissipation Systems

The purpose of the plant cooling system is to dissipate energy to the environment. The various cooling system options differ in how the energy transfer takes place, and therefore have different environmental impacts. SERI considered seven heat dissipation alternatives in its environmental report (SERI 2003c):

- once-through cooling

- wet mechanical draft cooling towers
- wet natural draft cooling towers
- wet-dry cooling towers
- dry cooling towers
- cooling pond
- spray canals.

Of these systems, SERI determined that the only alternatives suitable for the Grand Gulf ESP site were wet mechanical draft towers, wet natural draft towers, and wet-dry cooling towers. SERI only included wet natural draft and wet mechanical draft cooling towers within its PPE.

SERI eliminated dry cooling towers, cooling pond, and spray canals from consideration because it determined that the land requirements for these systems made them unsuitable for the site. SERI eliminated once-through cooling because of the aquatic impacts associated with the large volumes of water that would need to be withdrawn from the Mississippi River and subsequently returned to the river at an elevated temperature.

The GGNS site includes approximately 850 ha (2100 ac) in a rural setting along the Mississippi River. Lowlands below the bluffs make up about half of the site. The lowlands include Hamilton and Gin lakes and wetlands that are subject to frequent flooding from the river. Therefore, the staff determined that the lowlands would be less suitable for development than the upland area.

Approximately 60 ha (150 ac) of the uplands area is committed to the existing GGNS Unit 1 facility. Some additional wetlands, particularly along the Stream A and Stream B corridors, occur above the bluffs. The staff determined that the ESP site was unsuitable for cooling pond or spray canal heat dissipation designs based on the limited area of the site.

The staff also concluded that the Mississippi River is not a suitable source for a once-through cooling system. EPA regulations (40 CFR Part 125 Subpart I) issued in 2001 contain requirements applicable to cooling water intake structures for new facilities under Section 316(b) of the Clean Water Act that make it very difficult for large new generating plants to use once-through cooling. In addition, the staff determined that high sediment concentrations in the Mississippi River may require extensive large-scale water treatment, and that some adverse impacts would occur during the construction and maintenance activities associated with intake and discharge structures and buried piping.

Dry cooling tower systems use either a natural or a mechanical air draft to transfer heat from the condenser tubes to the air. Since dry cooling uses essentially no water, water use is bounded by the wet-tower designs. Although noise from the fans in a dry tower or a wet-dry tower would likely be greater than for a mechanical draft system, the staff believes that these impacts would be minimal in a rural environment such as the Grand Gulf ESP site. SERI determined that dry cooling for the ESP site would not be suitable because insufficient land would be available. However, even using SERI's high estimate of the land requirements for the dry cooling alternative, land requirements would only be approximately 65 ha (160 ac), which is considerably less than the available area. Nevertheless, the staff concludes that dry cooling tower systems would not be suitable for the ESP site for the reasons discussed by EPA in the preamble to EPA's final rule on NPDES regulations addressing cooling water intake structures for new facilities (66 FR 65256). EPA determined that dry cooling is not the best technology available for minimizing adverse environmental impacts in part because the technology of dry cooling carries costs that are sufficient to pose a barrier to entry to the marketplace for some projected new facilities, and dry cooling technology has some detrimental effects on electricity production by reducing the energy efficiency of steam turbines (66 FR 65282). Therefore, the staff concludes that dry cooling tower systems should only be considered if water supply is an issue. Water supply is not an issue at the Grand Gulf ESP site.

In conventional closed-cycle recirculating wet cooling towers, cooling water that has been used to cool the condensers is pumped to the top of a recirculating cooling tower; as the heated water falls, it cools through an evaporative process and warm, moist air rises out of the tower, often creating a vapor plume. The GEIS for license renewal has a summary of the impacts of wet cooling towers on terrestrial resources (NRC 1996). The impacts identified in the GEIS include visible plumes; noise; icing; deposition of salts, biocides, and microorganisms in the vicinity of towers; avian mortality from collisions of birds with towers; and the visual impacts of the towers themselves. Some of these impacts (for example, icing and deposition of salts) are associated with low, mechanical draft cooling towers, while others (such as avian mortality and visual impacts) are associated with natural draft towers.

Wet-dry cooling towers employ both a wet section and dry section and reduce or eliminate the visible plumes associated with wet cooling towers. Water use for the wet-dry cooling tower alternative is bounded by mechanical and natural draft wet cooling towers. Compared to wet cooling towers, less evaporation, makeup water, and blowdown are involved in the wet-dry cooling process, thus reducing water-related impacts. However, the disadvantages of dry cooling discussed in the EPA preamble to the final NPDES rule (66 FR 65256) apply to the dry cooling portion of the heat dissipation process. The dry cooling process is not as efficient as the wet cooling process because it requires the movement of a large amount of air through the heat exchanger to achieve the necessary cooling. This results in less net electrical power for distribution.

Water supply is not an issue at the Grand Gulf ESP site. Based on its independent review, the staff concludes that wet mechanical draft cooling towers and wet natural draft cooling towers are suitable for the site. The specific cooling system design for a new nuclear unit at the Grand Gulf ESP site has not been selected; therefore, system design alternatives would be discussed at the CP or COL stage if an application were submitted to build a new plant at the site.

8.3.2 Circulating Water Systems

In a once-through cooling process, water is withdrawn from a cooling water source, passed through the condenser once, and then returned to the receiving water body. In a closed-loop system, heat transferred from the condenser to the circulating water is dissipated through auxiliary cooling facilities, after which the cooled water is recirculated to the condenser. This recirculation step means that much less water needs to be withdrawn from the water source than for a once-through cooling system with the same heat rejection capacity. Alternative intake, discharge, water supply, and water treatment systems for a closed-loop design at the Grand Gulf ESP site are discussed below.

8.3.2.1 Intake Systems

GGNS Unit 1 uses multiple radial collector wells located next to the Mississippi River. The wells pump from the alluvial aquifer to provide makeup water for the natural and mechanical draft cooling system used for Unit 1. SERI states in its environmental report that a similar arrangement of collector wells drawing water from the alluvial aquifer for a new power plant located at the Grand Gulf ESP site could not be supported by the aquifer (SERI 2003c). Therefore, SERI states that, for a new plant, makeup water for the heat dissipation system and the circulating water system would be withdrawn directly from the Mississippi River through a shoreline embayment and intake constructed on the bank of the river (SERI 2003c).

Two alternative types of river intakes were considered by SERI in its environmental report. One alternative would involve a direct intake from the river with a structure located on the riverbed and a pipeline connecting it to the bank. The Mississippi River is very active with vast amounts of sediment moving along the riverbed making it difficult to maintain structures located on the riverbed. Additionally, the Mississippi River is a critical transportation corridor and any in-stream construction and maintenance activities must consider possible impacts on river traffic. The second alternative would involve a channel directing water to the intake structure on the shoreline. The staff found no basis to suggest that these two water intake alternatives would be environmentally preferable to SERI's proposed intake system.

8.3.2.2 Discharge Systems

GGNS Unit 1 uses a cooling tower/circulating water system. The blowdown from the cooling tower is discharged to the Mississippi River through the existing barge slip embayment. SERI states 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 (SERI 2003c).

The staff evaluated a shoreline diffuser outfall and a submerged single-point discharge. The shoreline diffuser would result in a larger plume, however its impact on the Mississippi River would be localized and small as discussed in Section 5.3.2. For a submerged port-diffuser located beneath the water surface, the buoyant jet would entrain ambient water as it rises to the surface, thus enhancing mixing. However, a submerged outfall could interfere with traffic on the river, would be more difficult to construct, and may require maintenance dredging. The shoreline discharge proposed by SERI would avoid dredging and in-stream construction. The staff found no basis to suggest that the two discharge alternatives would be environmentally preferable to SERI's proposed discharge system.

8.3.2.3 Water Supply

A source of makeup water at the ESP site would be needed to offset the continuous loss of water from evaporation, drift, and blowdown. The two sources of water on or near the Grand Gulf ESP site that could provide an adequate volume of makeup water are the Mississippi River and wells in the alluvial aquifer. Because of the hydraulic connection between the alluvial aquifer and the river, the wells would effectively withdraw water from the river. The staff also found that the Catahoula aquifer would not provide adequate water supply for any but the dry cooling heat dissipation system alternative. The staff did not identify any other environmentally preferable water supply.

8.3.2.4 Water Treatment

At this stage, the final design of the various water systems for a new nuclear plant located at the Grand Gulf ESP site has not been specified. The water treatment requirements and water system effluents are not known. However, all chemical and thermal discharges from the water treatment systems, regardless of the methods chosen, would be regulated by the MDEQ through the NPDES process.

8.4 Region of Interest, and Selection Process

NRC regulations require that the environmental report submitted in conjunction with an application for an ESP include an evaluation of alternative sites to determine whether any obviously superior alternative exists to the site proposed (10 CFR 52.17(a)(2)). This section includes a discussion of Entergy's region of interest for possible siting of a new nuclear power plant, Entergy's alternative site selection process for submission of an ESP application, and the environmental impact of constructing and operating new nuclear units at the three alternative sites.

SERI is the applicant for an ESP at the Grand Gulf site. SERI is a subsidiary of Entergy Corporation and has the exclusive rights to develop the proposed Grand Gulf ESP site property outside the existing power plant and support facilities (SERI 2003a). Entergy Nuclear, a division of Entergy Corporation, conducted the alternative site selection process for the proposed Grand Gulf ESP application.

8.4.1 Applicant's Region of Interest

Generally, the region of interest (ROI) is the geographic area considered in searching for candidate ESP sites (NRC 2000). More specifically, the region of interest is:

> The geographical area initially considered in the site selection process. This area may represent SERI's system, the power pool or area within which SERI's planning studies are based, or the regional reliability council or the appropriate subregion or area of the reliability council (NRC 1976).

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 (SERI 2003c) at the time of its application for an ESP. These seven sites are:

- Arkansas Nuclear One, located approximately 10 km (6 mi) west of Russellville, Arkansas
- Grand Gulf Nuclear Station, located approximately 40 km (25 mi) south of Vicksburg, Mississippi
- James A. FitzPatrick Nuclear Power Plant, located approximately 13 km (8 mi) northeast of Oswego, New York

- Indian Point Energy Center, located approximately 39 km (24 mi) north of New York City, New York

- Pilgrim Nuclear Station, located approximately 6 km (4 mi) southeast of Plymouth, Massachusetts

- River Bend Station, located approximately 39 km (24 mi) northwest of Baton Rouge, Louisiana

- Waterford-3, located approximately 32 km (20 mi) west of New Orleans, Louisiana.

Entergy Nuclear's ROI was limited to the preceding seven sites for the following reasons (SERI 2003c):

- NRC has approved the sites for nuclear plant construction and operation.

- Site infrastructures appropriate for nuclear plant operation are in place.

- Site characterization data have been collected and are available.

- Access to the sites is readily available.

- Programs, procedures, and arrangements have been established and are in place with State and local governmental agencies.

- Entergy liaisons with the local communities exist.

- Operational impact of the existing nuclear plants is documented.

- Site records document the presence of any radiological and non-radiological spills and contamination events on the sites.

- The sites and related facilities are controlled by Entergy.

Environmental review guidance promulgated by NRC for alternative nuclear plant sites recognizes there will be special cases for which the proposed site was not selected on the basis of a systematic site selection process (NRC 2000). One example cited in the guidance is when an existing nuclear power plant site is proposed for the siting of a new nuclear plant.

The staff concludes that the criteria used to identify the region of interest used in the ESP application were reasonable for consideration and analysis of potential ESP sites.

8.4.2 Applicant's Alternative Site Selection Process

Entergy Nuclear's process for selection of a preferred ESP site consisted of the following steps:

- A region of interest was established. Based on the region of interest, a set of potential sites was identified for consideration in the selection process.
- The initial set of sites was screened, using Entergy Nuclear's criteria, to further refine it to a listing of candidate sites warranting more detailed evaluation.
- Candidate sites were subjected to more detailed evaluation, using Entergy Nuclear's criteria, to arrive at a preferred site for an ESP application (SERI 2003c).

8.4.2.1 Screening of Seven Sites to Four

First, Entergy Nuclear eliminated the Indian Point Energy Center site from further review because the population density in the vicinity of the site exceeds 500 persons per square mile (SERI 2003c). Entergy Nuclear conducted an initial screening of the remaining six sites to reduce the potential ESP sites to a smaller subset of sites for detailed review. In conducting the initial screening, Entergy Nuclear (2001) used the screening criteria, the bases for screening criteria, and relative weighting factors for each criterion shown in Table 8-5.

The relative weighting factors were determined by Entergy Nuclear. Weights were assigned on a scale of 1 to 10 with 10 being most important and 1 least important. Each site was also qualitatively assigned a score by Entergy Nuclear for each criterion using a scale of 1 to 5 with 5 representing most favorable and 1 least favorable. After application of the scores and weighting factors, Entergy Nuclear ranked the six potential ESP sites in the following order of preference (Entergy Nuclear 2001):

(1) Grand Gulf Nuclear Station
(2) River Bend Station
(3) James A. FitzPatrick Nuclear Power Plant
(4) Waterford-3
(5) Arkansas Nuclear One
(6) Pilgrim Nuclear Station.

Table 8-5. Initial Screening Criteria for Selecting an Early Site Permit Site

Initial Screening Criteria	Basis for Screening Criteria	Relative Weighting Factor
Seismic Evaluation	Probability of ground acceleration greater than 0.3 g	7.2
Demographic Changes	Total population in nearby areas from the year 2000 census	6.1
Emergency Planning	Status of existing emergency plans	5.6
Exclusion Area	Available room for new nuclear generating units	6.1
Transmission Access	Potential for achieving required injection capacity and the cost of providing the capacity	8.2
Power Pricing	Expected price for power and ease of delivering power to the anticipated load center	9.1
Water Availability	Extent and ease to which water for plant use is available	7.1
Permitting/licensing Status	Relative ease to which required permits and licenses for a new nuclear plant can be obtained	6.4
Plans for Existing Units	Compatibility of Entergy plans for existing nuclear units with new nuclear units	3.0
Spent Fuel Storage	Availability of onsite spent fuel storage	2.6
Public Acceptance	Perceived level of public acceptance of a new nuclear plant at each site	6.6

Source: Entergy Nuclear 2001

At this stage, Entergy Nuclear eliminated the Waterford-3 and Arkansas Nuclear One sites from further consideration because it wished "to gain ESP experience in a variety of technical and public acceptance environments, as well as to capitalize on two separate power markets" (SERI 2004f). Further consideration of the Pilgrim site, even though it had the lowest weighted score of the six sites, was driven by Entergy Nuclear's interest in ensuring regional diversity.

Entergy Nuclear determined that both the Waterford-3 and Arkansas Nuclear One sites are viable for new nuclear plants, but the two sites are currently viewed by Entergy Nuclear as less suitable than Grand Gulf and River Bend (Entergy Nuclear 2001).

Given Entergy Nuclear's interest in ensuring regional diversity (i.e., sites in its two power markets), the staff concluded that the down-selection of the Waterford-3 and Arkansas Nuclear One sites is reasonable. The staff continued to review the Pilgrim alternative site because it permits an assessment of regional diversity. In the end, had there been concerns with the overall impacts of the preferred site, the staff would have reconsidered this step.

8.4.2.2 Screening of Four Sites to One

For the final screening of sites from four to one preferred site, Entergy Nuclear used a similar approach to the initial screening. Screening criteria and weighting factors were developed. Relative weights and scores for each criterion for each site were assigned by Entergy Nuclear (Entergy Nuclear 2001). In conducting the final screening, Entergy Nuclear used the screening criteria and relative weighting factors for each criterion shown in Table 8-6.

Table 8-6. Final Screening Criteria for Selecting an Early Site Permit Site

Final Screening Criteria	Elements of the Screening Criteria	Weighting Factor
Geology/Seismology	Vibratory ground motion, capable tectonic structures or sources, surface faulting and deformation, geologic hazards, and soil stability	3.77
Cooling System Requirements	Quantity of cooling water available and the ambient air temperature	3.27
Flooding	Flooding potential at the site	2.4
Nearby Hazardous Land Uses	NRC reactor site criteria in 10 CFR Part 100 and existing and projected hazards within 8 km (5 mi) of the site	3.35
Extreme Weather Conditions	Plant parameter envelope criteria regarding tornadoes, wind, and precipitation	2.36
Accident Effect-Related	NRC population criteria in 10 CFR 100.21, population density guidance in NRC Regulatory Guide 4.7 (NRC 1998), emergency planning characteristics, and short-term atmospheric dispersion characteristics	4.09

Table 8-6. (contd)

Final Screening Criteria	Elements of the Screening Criteria	Weighting Factor
Surface-Water Radionuclide Pathway	Potential liquid pathway dose consequences including dilution capacity, existing radionuclides in the stream, and proximity to downstream consumptive users	2.5
Groundwater Radionuclide Pathway	Vulnerability of shallow groundwater resources to potential contamination	2.55
Air Radionuclide Pathway	Radionuclide pathways as a function of topographic effects and atmospheric dispersion	2.5
Air-food Ingestion Pathway	Emission of radionuclides into the food chain via local crops and pastures	2.5
Surface-Water-Food Radionuclide Pathway	Use of irrigation water by downstream users as a potential pathway for exposure	2.41
Transportation Safety	Increase of highway traffic safety risk as a result of fogging and ice caused by cooling towers	2.14
Disruption of Important Aquatic and Marine Species or Habitats	Construction-related impacts on aquatic and marine ecology	2.64
Bottom Sediment Disruption Effects	Short-term impacts to aquatic and marine resources resulting from dredging activities during construction	2.14
Disruption of Important Plant And Animal Species	Construction-related impacts on important species, their habitats, and terrestrial ecology	3.18
Dewatering Effect on Adjacent Wetlands	Impacts of construction related dewatering activities on area wetlands	2.77
Thermal Discharge Effects	Impacts of thermal discharges on migratory species, other important species and habitat, and water quality	3.64
Entrainment and Impingement Effects	Entrainment and impingement effect on marine organisms resulting from cooling water withdrawal and screening	3.23
Dredging and Disposal Effects	Environmental impacts related to maintenance dredging at the cooling water intake structure	2.36

Table 8-6. (contd)

Final Screening Criteria	Elements of the Screening Criteria	Weighting Factor
Cooling Tower Drift Effects on Surrounding Areas	Impacts related to the emission and downwind deposition of cooling water salts	2.36
Socioeconomics	Socioeconomic impacts during construction of new nuclear power plants	2.0
Environmental Justice	Possible disproportionate adverse impacts on minority and low-income populations	1.95
Water Supply	Raw water consumption cost	3.7
Pumping Distance	Cost of construction associated with supplying a primary water source for the plant	3.05
Flood Mitigation	Cost of flood mitigation features and insurance	2.9
Vibratory Ground Motion	Incremental construction cost to account for vibratory ground motion	4.0
Soil Stability	Incremental construction cost to account for soil stability	3.4
Railroad Access	Cost of constructing railroad spur	2.6
Highway Access	Cost of constructing roads to from plant site to nearby highway	2.8
Barge Access	Cost of constructing barge terminal	2.85
Transmission	Cost of transmission line to connect site to grid and necessary system upgrades	4.8
Topography	Land preparation cost related to the topography	2.55
Land Rights	Cost of acquiring land area and relocating existing structures	2.75
Labor Rates	Relative cost of labor	3.3

Source: Entergy Nuclear 2001

After applying the scores and weighting factors, Entergy Nuclear ranked the four potential ESP sites in the following order of preference (Entergy Nuclear 2001):

(1) Grand Gulf Nuclear Station
(2) James A. FitzPatrick Nuclear Power Plant
(3) River Bend Station
(4) Pilgrim Nuclear Station.

Accordingly, SERI submitted the ESP application for the Grand Gulf site as the preferred site. The staff concluded that the overall site selection process involving alternative sites is reasonable and the identification of the Grand Gulf ESP site is consistent with SERI's approach.

8.5 Evaluation of Alternative Sites

The three alternative sites examined in detail are River Bend Station near Baton Rouge, Louisiana; Pilgrim Nuclear Station near Plymouth, Massachusetts; and James A. FitzPatrick Nuclear Power Plant near Oswego, New York. All three of the alternative sites have existing nuclear power plants that are owned and operated by Entergy Corporation. The staff visited each of the three alternative sites as well as the proposed Grand Gulf ESP site, and collected additional reconnaissance-level information about the sites.

8.5.1 Evaluation of the River Bend Station Site

This section covers the staff's evaluation of the potential environmental impact of siting new nuclear units within the scope of the SERI PPE at the River Bend Station (River Bend) site.

8.5.1.1 Land Use Including Site and Transmission Corridors

Site and Vicinity

The River Bend site is 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 area around the site and the vicinity remains largely agricultural with significant crop production and some industrial forestry. Similar in many respects to the Grand Gulf site, there is adequate land area available within the existing site boundary to house a generating facility based on the PPE. Because the potential site of the ESP facility would use a portion of the existing River Bend site, no land would be preempted for additional facilities built at this site (SERI 2003a). The types of impacts of new facility construction and operations (i.e., physical, ecological, social, and radiological impacts) are likely to be similar to those expected for the Grand Gulf ESP site. The River Bend site is not affected by the Coastal Zone Management Act of 1972, as amended.

Based on the information provided by SERI and the staff's independent review, the staff concludes that the land-use impacts on the site and vicinity of construction and operation are expected to be SMALL.

Transmission Corridors

Three transmission lines exit the site. One 500-kV line runs due east from the site crossing mostly agricultural and forested land for 43 km (27 mi) to a substation near the junction of State Highways 959 and 63 (McKnight Crossing). Another 500-kV line runs south-southwest from the site, crosses the Mississippi River, and then runs across agricultural and forested land 47.2 km (29.3 mi) to a substation near Rosedale, Louisiana. The third line (230 kV) runs south-southeast for 18.2 km (11.3 mi) paralleling the Mississippi River and U.S. Highway 61, and then across lowlands and swamps to a substation near Irene, Louisiana. None of these transmission line rights-of-way cross any known protected land designations or special land uses. Section 3.3 details the regulatory procedure required to link new large generation to the grid. The issues that could result in potential impacts from construction and operations in these transmission corridors (i.e., physical and ecological impacts) would be similar to those land-use impacts for construction and operations in the transmission corridors associated with the Grand Gulf ESP site. Therefore, the staff concludes that the land-use impacts of transmission system construction and continued operation would be SMALL.

8.5.1.2 Water Use and Quality

Water Use

The River Bend site is located adjacent to the Mississippi River downstream of the Grand Gulf ESP site where flows, rainfall, and floodplain characteristics are similar. Construction activities for a new nuclear unit or units at River Bend would have similar water usage impacts (i.e., physical and ecological impacts) as at the Grand Gulf ESP site. During operation, the consumptive use of water from the proposed mechanical draft cooling towers would be a very small fraction of the supply available in the river, even during record low flows. Therefore, the staff concludes that the impacts to water use and water supply at the River Bend site would be SMALL.

Water Quality

Construction activities of a new nuclear unit or units at the River Bend site would follow best management practices and have similar water-quality impacts at the Grand Gulf ESP site, and would be bounded by the operational impacts. The additional heat from blowdown water could be commingled with the discharge of existing River Bend Units 1 and 2. This would increase the size of the thermal plume that currently exists. Thermal and chemical discharges to the Mississippi River would be regulated by the Louisiana Department of Environmental Quality via an NPDES permit issued to protect the environment. Since the combined discharge represents a very small fraction of the flow in the Mississippi River, and the water quality of the receiving water (Mississippi River) is already degraded at that point, the staff concludes that the impacts to water quality at the River Bend site would be SMALL.

8.5.1.3 Terrestrial Resources Including Endangered Species

Construction Impacts

Three general vegetation types are onsite: upland forests, bottomland hardwoods, and meadows and pastures. Following construction of the existing River Bend plant, remaining land cover for the three vegetation types were upland forests (347 ha [858 ac]), bottomland hardwoods (282 ha [697 ac]), and meadows and pastures (105 ha [259 ac]) (AEC 1974a), totaling 734 ha (1814 ac).

Construction of a new generating facility would likely remove the three vegetation types listed above in similar proportions as did construction of the existing units at the River Bend site, which were upland hardwood forests, 63.3 percent; bottomland hardwoods, 3.0 percent; and meadows and pastures, 33.7 percent (AEC 1974a). Construction of a new generating facility would disturb a total of about 160 ha (395 ac), thus 101 ha (250 ac) of upland hardwood forest, 5 ha (12 ac) of bottomland hardwood forest, and 54 ha (133 ac) of meadows and pastures would be lost. These values account for 29, 2, and 51 percent of the hardwood forest, bottomland forest, and meadows and pastures remaining on the River Bend site. The combined loss of upland and bottomland hardwood forest would be about 106 ha (262 ac), or approximately 17 percent of the total available, constituting a modest loss of forest habitat.

The potential impacts from construction, such as erosion and dust generation, would be typical of large construction projects. These impacts could be mitigated using standard industrial procedures and best management practices. Standard practices, such as silt fences to control sedimentation and water sprays to limit dust generation, would protect wetlands and other ecological resources in the site vicinity.

Five transmission lines, extending over a total length of 139 km (87 mi) and covering 410 ha (1031 ac) (NRC 1996), currently serve the River Bend Station. Land cover along these lines consists of pasture (43 percent), forest (38 percent), crops (15 percent), residential (2 percent), and water (2 percent) (AEC 1974a). It is assumed that these transmission lines would not have the capacity to carry the power generated by a new facility and that a transmission system upgrade, including new transmission lines and an additional right-of-way, would be needed. It is assumed that any additional right-of-way would be an expansion, or a doubling, of the existing right-of-way (see Section 4.4.1). Consequently, a modest amount of forest habitat, about 156 ha (385 ac), would be lost due to the expansion.

The staff concludes the impacts to 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 corridors would be MODERATE.

Threatened and Endangered Species

The only Federally listed threatened or endangered terrestrial species that could occur in the River Bend area is the threatened Louisiana black bear (*Ursus americnus luteolus*) (FWS 2004a). The River Bend site is located adjacent to the range of the Atchaflaya River Basin breeding sub-population of Louisiana black bears (FWS 1995). The proposed Atchaflaya River Basin Floodway critical habitat unit is located at least 16 km (10 mi) to the west of the River Bend site. No occurrences of the bear are known within 16 km (10 mi) of the site (Table 8-7) (LNHP 2004a). Therefore, it appears unlikely the subspecies occurs on the River Bend site (SERI 2004d) and so would not be impacted by construction or operation of a new generating facility. None of the five River Bend transmission lines are located within 16 km (10 mi) of the Atchaflaya River Basin Floodway critical habitat unit. Consequently, critical habitat would not be impacted by expansion of the existing transmission corridors.

Table 8-7. Terrestrial Federally and State-Listed Species Occurring in the Vicinity of the River Bend Site

Scientific Name	Common Name	Status[a]	Distance from the River Bend Site[b]	Source
Mammals				
Mustela frenata	long-tailed weasel	S2-S4	beyond 3.2 km (2 mi) but within 16 km (10 mi)	LNHP 2004a
Sorex longirostris	southeastern shrew	S2-S3	beyond 3.2 km (2 mi) but within 16 km (10 mi)	LNHP 2004a
Spilogale putorius	eastern spotted skunk	S1	beyond 3.2 km (2 mi) but within 16 km (10 mi)	LNHP 2004a
Ursus americanus luteolus	Louisiana black bear	FT/S2	>10 mi (16 km)	FWS 2004a; LNHP 2004a
Plants				
Actaea pachypoda	white baneberry	S2	beyond 3.2 km (2 mi) but within 16 km (10 mi)	LNHP 2004a

Table 8-7. (contd)

Scientific Name	Common Name	Status(a)	Distance from the River Bend Site(b)	Source
Plants				
Antennaria solitaria	single-head pussytoes	S2	beyond 3.2 km (2 mi) but within 16 km (10 mi)	LNHP 2004a
Circaea lutetiana canadensis	intermediate enchanter's nightshade	S2	beyond 3.2 km (2 mi) but within 16 km (10 mi)	LNHP 2004a
Deparia acrostichoides	silvery glade fern	S2	<3.2 km (2 mi)	LNHP 2004a
Dichanthelium clandestinum	deer-tongue witchgrass	S2	<3.2 km (2 mi)	LNHP 2004a
Dryopteris ludoviciana	southern shield wood-fern	S1	beyond 3.2 km (2 mi) but within 16 km (10 mi)	LNHP 2004a
Eleocharis radicans	rooted spike-rush	S1?	beyond 3.2 km (2 mi) but within 16 km (10 mi)	LNHP 2004a
Magnolia pyramidata	pyramid magnolia	S2	beyond 3.2 km (2 mi) but within 16 km (10 mi)	LNHP 2004a
Mimulus ringens	square-stemmed monkey-flower	S2	beyond 3.2 km (2 mi) but within 16 km (10 mi)	LNHP 2004a
Pachysandra procumbens	Allegheny-spurge	S2	beyond 3.2 km (2 mi) but within 16 km (10 mi)	LNHP 2004a
Physalis carpenteri	carpenter's ground-cherry	S1	<3.2 km (2 mi)	LNHP 2004a
Stewartia malacodendron	silky camelia	S2-S3	beyond 3.2 km (2 mi) but within 16 km (10 mi)	LNHP 2004a
Triphora trianthophora	nodding pogonia	S2	beyond 3.2 km (2 mi) but within 16 km (10 mi)	LNHP 2004a

(a) Federal status rankings developed by the U.S. Fish and Wildlife Service under the Endangered Species Act, FT = Federal threatened (FWS 2004a). State status rankings developed by the Louisiana Natural Heritage Program, S1 = critically imperiled, S2 = imperiled, S3 = rare, S4 = secure (LNHP 2004a). Hyphenated State ranks indicate a range in the status of the species based on insufficient data to make a determination. A question mark indicates uncertainty in the indicated status of the species.

(b) Distances provided by LNHP (2004a).

Three State-listed imperiled or critically imperiled terrestrial animal species are known to occur beyond 3.2 km (2 mi) but within 16 km (10 mi) of the River Bend site: the long-tailed weasel (*Mustela frenata*), southeastern shrew (*Sorex longirostris*), and eastern spotted skunk (*Spilogale putorius*) (Table 8-7) (LNHP 2004a). The long-tailed weasel is found in a wide variety of habitats, including farmland, woodlands, and swamps, with areas near water being preferred (Linzey and Brecht 2002a). The southeastern shrew occurs in a variety of habitats from fields to forests (Linzey and Brecht 2002b), as does the eastern spotted skunk (Pennington 2002). These three species are habitat generalists and could occur on the River Bend site and along its transmission corridors. Therefore, they could potentially be affected by construction of a new generating facility at the River Bend site and possible expansion of the existing transmission corridors.

There are three State-listed imperiled or critically imperiled terrestrial plant species known to occur within 3.2 km (2 mi) of the River Bend site: silvery glade fern (*Deparia acrostichoides*), deer-tongue witchgrass (*Dichanthelium clandestinum*), and carpenter's ground-cherry (*Physalis carpenteri*) (Table 8-6) (LNHP 2004a). Silvery glade fern occurs in damp woods (FNA 2004b). Deer-tongue witchgrass occurs in moist soils of woodland edges and clearings (Ernst Conservation Seeds 2004). Carpenter's ground-cherry occurs in mixed hardwood-loblolly pine (*Pinus taeda*) woods, southern mesophytic woods, and hardwood slope forest (LNHP 2004b). These three species are habitat generalists that could occur on the River Bend site and along its transmission corridors. Consequently, they could be adversely affected by construction of a new generating facility on the River Bend site and by possible expansion of the existing transmission corridors.

Ten additional State-listed imperiled or critically imperiled terrestrial plant species are known to occur beyond 3.2 km (2 mi) but within 16 km (10 mi) of the River Bend site: white baneberry (*Actaea pachypoda*), single-head pussytoes (*Antennaria solitaria*), intermediate enchanter's nightshade (*Circaea lutetiana canadensis*), southern shield wood-fern (*Dryopteris ludoviciana*), rooted spike-rush (*Eleocharis radicans*), pyramid magnolia (*Magnolia pyramidata*), square-stemmed monkey-flower (*Mimulus ringens*), Allegheny-spurge (*Pachysandra procumbens*), silky camelia (*Stewartia malacodendron*), and nodding pogonia (*Triphora trianthophora*) (Table 8-6) (LNHP 2004a). White baneberry occurs in deciduous forests (FNA 2004a). Single-head pussytoes grows in woods and woodland clearings (Nearctica 2004). Intermediate enchanter's nightshade occurs in deciduous woodlands (Verburg 1998). Southern shield wood-fern occurs in swamps and wet woods (FNA 2004c). Rooted spike-rush occurs in stream alluvium and around lake margins, meadows, seeps, and bogs (FNA 2004d). Pyramid magnolia occurs in woods and on river bluffs (FNA 2004e). Square-stemmed monkey-flower occurs along stream banks, lake margins, and wet meadows (Missouriplants 2004). Allegheny-spurge occurs in riparian forest habitat (SERPIN 2004). Silky camelia inhabits the understory of wooded bluffs and ravine slopes and the open edges of transition zones (ecotones) between sand hills and creek swamps (GSRCORP 2004). Nodding pogonia occurs on rotten logs and in rich humus and leaf mold of low hammocks, hardwood and coniferous forests, woods along streams, edges of swamps, floodplain forests, and mountain slopes (LNHP 2004c). These ten species are habitat generalists that could occur on the River Bend site and along its transmission corridors. Consequently, they could be affected by construction of a new generating facility on the River Bend site and by possible expansion of the existing transmission corridors.

Based on these considerations, the staff concludes that the impacts to threatened and endangered species from construction of a new generating facility on the River Bend site and possible expansion of the existing power transmission corridors could range from SMALL to MODERATE.

Operation Impacts

Impacts to terrestrial resources that may result from operation of one or more new nuclear units at the River Bend site include those associated with cooling towers and transmission lines. The River Bend plant currently employs cooling towers, and more cooling towers would be added for one or more new nuclear units. The impacts of cooling tower drift and bird collisions for existing nuclear power plants were evaluated previously in the GEIS (NRC 1996) and were found to be small for all plants, including those with multiple cooling towers of various types. The staff is not aware of any information that would cause it to modify its earlier conclusion. On this basis, for the purposes of consideration of alternative sites, the impacts of cooling tower drift and bird collisions with cooling towers resulting from operation of one or more new nuclear units at the River Bend site would be negligible.

For both natural and mechanical draft cooling towers, the anticipated noise level from cooling tower operation is anticipated to be 55 decibels at 305 m (1000 ft) (SERI 2003c). The noise level for dry cooling towers is somewhat higher. However, these noise levels are all well below the 80- to 85-decibel threshold at which birds and small mammals are startled or frightened (Golden et al. 1980). Thus, noise from operating cooling towers at the River Bend site would not be likely to disturb wildlife beyond 305 m (1000 ft) from the source. Further, impacts within this distance, if any, would be considered negligible owing to the large expanses of open habitat available into which mobile wildlife species could move if disturbed. Consequently, the impacts of cooling tower noise on wildlife from operation of one or more new nuclear units at the River Bend site would be minimal.

The cooling towers from one or more new nuclear units at the River Bend site would withdraw a small quantity of water relative to Mississippi River flows, and would discharge water back into the river at a temperature greater than ambient conditions. The amount of water withdrawn from the Mississippi River would represent only about 0.2 percent of the total flow and would not detectably alter shoreline habitat.

The impacts usually associated with transmission line operation consist of bird collisions with transmission lines and electromagnetic field (EMF) effects on flora and fauna. The impacts usually associated with transmission line right-of-way maintenance (cutting and herbicide application) are erosion/siltation and disturbance of wildlife and wildlife habitat. Right-of-way maintenance would likely be conducted under best management procedures. Electromagnetic field effects would not change except that they would cover a wider area. Further, the addition of new transmission lines within the same corridor would likely present few new opportunities for bird collisions that would not be expected to cause a measurable reduction in local bird populations. These effects (i.e., bird collisions, with transmission lines, EMF effects on flora and fauna, and effects of cutting and herbicide application in rights-of-ways) were evaluated previously in the GEIS (NRC 1996) and were found to be small for all plants, including those with transmission corridors of various widths and with various numbers of transmission lines. The staff is not aware of any information that would cause it to modify its earlier conclusion. Based on the above rationale and the associated conclusions presented in GEIS (NRC 1996), the effects of transmission line operation and right-of-way maintenance from one or more new nuclear units at the River Bend site would be negligible.

Based on these considerations, the staff concludes that the impacts of operation of one or more nuclear units at the River Bend site would be SMALL.

8.5.1.4 Aquatic Resources Including Endangered Species

Construction and Operation Impacts

The aquatic resources at the River Bend site are associated with the Mississippi River and the watershed of Grants Bayou. The station is located on a terrace above the river's floodplain at approximately River Mile 262. Other water resources on the site within Grants Bayou watershed include Alexander Creek, West Creek, Alligator Bayou, and 19 small farm ponds, including Grassy Lake and a constructed wildlife management lake (AEC 1974a; NRC 1985).

The River Bend Station uses a closed-cycle cooling system that draws water from the Mississippi River and discharges it back into the river at a downstream location. The intake and discharge systems for River Bend Units 1 and 2 would be used for operation of a new facility, and minimal construction activities are anticipated in upgrading these facilities to handle discharges from the new unit(s). Any construction impacts, such as erosion and sedimentation into the water resources, could be mitigated using standard industrial procedures and best management practices.

Operation of the new unit(s) would have minimal impacts on the aquatic resources of the Mississippi River. Water withdrawn from the river for the cooling system would be a very small fraction of the supply available in the river, even during record low flows. Impacts from entrainment and impingement of aquatic resources would not increase greatly. The additional heat from blowdown water would be commingled with the discharge from the other units, resulting in a slightly greater thermal plume in the area of the discharge.

The other water resources at the River Bend site are not anticipated to be affected by construction and operation of a new unit or units. West Creek was rerouted when the current facility was built and is used for collection of runoff water. Additional facilities at the site would increase runoff into the creek; however, the aquatic resources in this concrete channel are of a poor quality and have adapted to the changes in water flow from precipitation events. Impacts to Alligator Bayou would not be anticipated because the river access road connecting a new generation facility to the Mississippi River would not be changed.

The staff concludes that the overall impacts on aquatic resources from construction and operation of new nuclear units and associated cooling towers at the River Bend site would be SMALL.

Threatened and Endangered Species

Table 8-8 lists the Federally and State-listed threatened and endangered aquatic species within 16 km (10 mi) of the River Bend site. The only Federally listed threatened or endangered aquatic species that could occur in the River Bend area is the endangered pallid sturgeon (*Scaphirhynchus albus*) (FWS 2004a). The River Bend site is adjacent to the shores of the Mississippi River within the known range of the pallid sturgeon. The species was designated as endangered throughout its entire range in 1990 (55 FR 36641; FWS 1993). Pallid sturgeon have not been caught in the vicinity of the River Bend site. The closest and most recent catches have been at River Miles 229 and 314 (LDOTD 2003).

There are two State-listed imperiled or rare species that are known to occur within 16 km (10 mi) of the River Bend site. The bluntface shiner (*Cyprinella camura*) is an imperiled or rare fish found within the tributaries of the Mississippi River. The Louisiana Department of Wildlife and Fisheries (LDWF) lists the bluntface shiner as known to occur within 3.2 km (2 mi) of the River Bend site (LNHP 2004a); however, past studies of the aquatic resources onsite have not reported the fish (AEC 1974a; NRC 1985). The rainbow darter (*Etheostoma caeruleum*) is an imperiled or rare fish found within 16 km (10 mi) of the River Bend site. The rainbow darter is found in moderately swift runs and riffles of shallow tributaries of the Mississippi River. Neither the bluntface shiner nor the rainbow darter have not been found on the River Bend site during past sampling programs (AEC 1974a; NRC 1985).

Table 8-8. Federally and State-Listed Threatened or Endangered Aquatic Species Reported within a 16-Kilometer (10-Mile) Radius of the River Bend Site

Scientific Name	Common Name	Status[(a)]	Distance from the River Bend Site[(b)]	Source
Fish				
Cyprinella camura	bluntface shiner	S2-S3	<3.2 km (2 mi)	LNHP 2004a
Etheostoma caeruleum	rainbow darter	S2-S3	beyond 3.2 km (2 mi) but within 16 km (10 mi)	LNHP 2004a
Scaphirhynchus albus	pallid sturgeon	FE; S1	<3.2 km (2 mi)	LNHP 2004a; FWS 2004a

(a) Federal status rankings developed by the U.S. Fish and Wildlife Service under the Endangered Species Act, FE = Federal endangered (FWS 2004a). State status rankings developed by the Louisiana Natural Heritage Program: S2 = imperiled, S3 = rare (LNHP 2004a). Hyphenated State ranks indicate a range in the status of the species based on insufficient data to make a determination.
(b) Distances provided by LNHP (2004a).

The staff concludes that the overall impacts on Federally and State-listed threatened and endangered aquatic species from new nuclear units and associated cooling towers at the River Bend site would be SMALL.

8.5.1.5 Socioeconomics

In evaluating the socioeconomic impacts of construction at the River Bend site, the staff and Entergy undertook a reconnaissance survey of the site using readily obtainable data from the Internet or published sources. The staff conducted some local interviews with knowledgeable local officials. No new data were collected. The socioeconomic subsections follow the organizational structure of the socioeconomic discussions in Sections 2.8, 4.5, and 5.5. Impacts from both construction and station operation are discussed.

Physical Impacts

Construction activities can cause temporary and localized physical impacts such as noise, odor, vehicle exhaust, vibration, shock from blasting, and dust emissions. The use of public roadways, railways, and waterways would be necessary to transport construction materials and equipment. However, extensive work is planned on the existing roads, and new routes are being built to reduce existing bottlenecks in the regional highway system, so no physical impact on the existing road net is expected. It is expected that all construction activities would occur within the existing River Bend site. Offsite areas that would support construction activities (for example, borrow pits, quarries, and disposal sites) are expected to be already permitted and operational. Impacts on those facilities from construction of the new units would be small incremental impacts associated with their normal operation.

Potential impacts from station operation includes noise, odors, exhausts, thermal emissions, and visual intrusions. New units would produce noise from the operation of pumps, dry cooling tower fans, transformers, turbines, generators, and switchyard equipment, and traffic at the site would also be a source of noise. SERI states in its environmental report that any noise coming from the proposed Grand Gulf ESP site would be controlled in accordance with applicable local county regulations. By inference, this is also expected to apply to the River Bend site. Commuter traffic would be controlled by speed limits. Good road conditions and appropriate speed limits would minimize the noise level generated by the workforce commuting to River Bend site (SERI 2003c).

New units would have standby diesel generators and auxiliary power systems. Permits obtained for these generators would ensure that air emissions comply with regulations. In addition, the generators would be operated on a limited, short-term basis. During normal plant operation, new units would not use a significant quantity of chemicals that could generate odors that exceed odor threshold values. Good access roads and appropriate speed limits would minimize the dust generated by the commuting workforce (SERI 2003c).

Construction activities would be temporary and would occur mainly within the boundaries of the River Bend site. Offsite impacts would represent small incremental changes to offsite services supporting the construction activities. During station operations, noise levels would be managed to local ordinances. Air quality permits would be required for the diesel generators, and chemical use would be limited, which should limit odors. Based on the information provided by SERI and its own independent review, the staff concludes that the physical impacts of construction and operation would be SMALL.

Demography

The population base is considered to be the population of significant population centers within a 80-km (50-mi) radius of the River Bend site. The combined population of West Feliciana Parish, East Feliciana Parish and the East Baton Rouge Parish, West Baton Rouge Parish, and Pointe Coupee Parish was 494,000 (USCB 2004) and, in 1997, was projected to grow by approximately 15 percent to about 570,000 by 2020 (LPDC 1997). The estimated population within an 80-km (50-mi) radius of the River Bend site is 907,000 (NRC 2004). Most (approximately 70 percent) of the construction workforce are expected to come from within the region, and those who might relocate to the region would represent a small percentage of the larger population base (Entergy Nuclear 2001). While part of the station operation workforce is also expected to relocate into the region, their numbers are small (about 2000 total new operating employees and family members during construction, and a smaller, unspecified number during operations) when compared to the total base population, and their locations of residence would probably be scattered throughout the region. Based on the information in its environmental report (SERI 2003c) and the Early Site Permit Selection Committee Notebook (Entergy Nuclear 2001) prepared by Entergy and its own independent review, the staff concludes that any increase in the population from construction and operation within an 80-km (50-mi) radius of the region would be SMALL.

Social and Economic Impacts

Economy

The River Bend site is located in one of the stronger economic areas in Louisiana. The Baton Rouge area is the primary economic driving force in the area within an 80-km (50-mi) radius of the River Bend site. In recent years, the regional economy has become more diversified, with major chemicals, papermills, and refining businesses; financial and health care components; and a growing high-tech business sector. The local economic development leaders consider additional unit or units at the River Bend site to be highly compatible with the current economy and their economic plans for the parish. Regionally, the service sector now offers the most employment opportunities. Construction and operation of up to two new nuclear units at the River Bend site would be expected to add to the economic prosperity of the region, especially in West Feliciana Parish.

Based on the information provided by SERI and its own independently obtained information, the staff reviewed the impacts of construction and operation on the economy of the region and concludes that the impacts would be minor everywhere in the region except West Feliciana Parish, where the impact could be positive and significant. Although the economic impacts would be diffused over several local jurisdictions, employment in West Feliciana Parish would increase by 50 percent during the peak of construction. Much of the economic impacts likely would be felt in the larger economic bases of East Baton Rouge Parish and the City of Baton Rouge.

Entergy estimates that it would take 3150 construction workers more than 5 years to build two new nuclear units at the River Bend site (Entergy Nuclear 2001). Entergy is expected to be able to attract the necessary workforce for construction activities at the River Bend site because of its proximity to the major population center of Baton Rouge. The availability of construction workers for regular construction projects of longer duration is reported to be good. The number of construction workers employed within the five parishes nearest the River Bend site was estimated to be approximately 27,000 in 2002 (Louisiana Department of Labor 2003).

The addition of new units would require an increase in the operations workforce of 1160 employees. Approximately 454 permanent employees currently work at the River Bend site (SERI 2004a). In its site comparison study, Entergy Nuclear (2001) stated that it expected 30 percent of the construction labor force for the new units would relocate from outside the region. Some nuclear defense sites are reducing their workforces as they change missions, and workers from these sites could be potential pools of labor for the operating workforce at River Bend.

Based on the information provided by Entergy and its own independent review, the staff concludes that construction labor would be readily available from within the region, and there would be little problem recruiting the required labor skills to enable the construction of new nuclear units at the River Bend site. Much of the operations workforce would already be in the region.

Taxes

Construction and operations workers would pay income, sales, and use taxes to Louisiana and to the local governments in the region where sales take place and property taxes to the counties in which they own a residence. Sales and use taxes would be paid from the sales of construction materials and supplies purchased for the project and on expenditures of both the construction and operations workforce for goods and services. SERI has made no estimate of the day-to-day expenditures that would occur in the region during construction. Corporate income taxes on profits would also be paid by those companies engaged in construction at the site.

There are two types of property taxes in Louisiana: tangible personal property taxes and real property taxes. Tangible personal property taxes would be paid by contractors during construction of the additional units. This tax is based on the value of property owned by the contractors that acquire taxable status in West Feliciana Parish during the construction period. Real property taxes are levied for the incremental increase in value to the entire site from the operation of the additional units. It is expected that West Feliciana Parish would be the only beneficiary of the these taxes. Property owned by Entergy currently accounts for 90 percent of the local tax base. Its tax rate is the lowest in the state (70 mills); elsewhere in the state, tax rates generally range from 100 to 130 mills. In a few jurisdictions, tax rates as high as 200 mills are levied. For schools, the state reduces its funding allocation for education as the local jurisdictions provide more. In West Feliciana Parish, the state provides nothing, but the local district spends much more per student than the state average. Entergy has a significant impact on the economic well being of West Feliciana Parish, with Entergy paying well over 90 percent of the property taxes between 1996 and 2000 (Scott 2004).

Based on the information provided by SERI, Entergy, and its own independent review, the staff concludes that the overall impacts from construction and operation on taxes collected through the income, sales and use, and property taxes would be barely noticeable, with the exception of West Feliciana Parish. The taxes paid, while substantial, are nevertheless a small sum when compared to the total amount of taxes collected by Louisiana and local governments in the region. Depending on the outcome of tax negotiations between Entergy and the state of Louisiana on the amount of property taxes, the staff considers that the overall impacts of the property taxes collected in West Feliciana Parish would be significant and beneficial relative to the total amount of taxes the county currently collects through property taxes.

<u>Summary of Social and Economic Impacts</u>

Based on the information provided by SERI, Entergy, and its own independent review, the staff concludes that the overall impacts of construction and operation of new unit(s) at the River Bend site would be SMALL adverse to MODERATE beneficial.

Infractructure and Community Services

<u>Transportation</u>

The general area around the River Bend site is served by several major highways, including Interstate 10, Interstate 12, U.S. Highways 61 and 190, and State Route (SR) 10. Baton Rouge is about a 20-minute drive from the River Bend site on four-lane roads. Site access from the west side of the Mississippi River is currently limited, but a new bridge is expected to replace existing ferry service at St. Francisville. The principal road access to the River Bend site is via the River Bend Access Road and via Louisiana SR 965, which is a two-lane paved road.

The construction of a new power facility would require additions to the workforce. In addition, construction materials, wastes, and excavated materials would be transported both to and from the site. These activities would result in increases in operation of personal-use vehicles by commuting construction workers, in commercial truck traffic, and in traffic associated with daily operations. However, five of the seven reactor types referred to in the SERI environmental report are generally smaller and modular in nature. Consequently, transportation of plant equipment could be less challenging and workforce requirements are expected to be less than those for the conventional nuclear plants.

The level-of-service designation on River Bend Access Road and Louisiana SR 965 would likely be degraded during the peak construction period for a new nuclear plant at the River Bend site. Louisiana SR 965 intersects U.S. Highway 61 approximately 2.6 km (1.6 mi) from the plant and

River Bend Access Road intersects U.S. Highway 61 approximately 2.2 km (1.4 mi) from the plant. Because it is the principal route from the direction of Baton Rouge, portions of U.S. Highway 61 would receive significantly more traffic during plant construction.

Direct rail access and a barge slip (which would have to be dredged) are available to the River Bend site, so large equipment would not have to be offloaded and transported by road. The Baton Rouge Metropolitan Airport and New Orleans International Airport serve the area. The airports in Baton Rouge and New Orleans provide regular freight and passenger jet services and are of sufficient size to accommodate the relatively small air shipments normally associated with a construction project.

The impacts of station operation employees on the transportation system would be less than that incurred during construction. There would be increases in operation of personal-use vehicles by commuting operators of both the existing and new units and in traffic associated with daily operations. Portions of U.S. Highway 61 may be affected by commuters to the plant site, particularly during shift changes. During new plant operation, the level-of-service designation on the access roads and U.S. Highway 61 may degrade to stable flow instead of the free flow indicated under a level-of-service "A" designation. This change in designation would indicate that the freedom to select speed is unaffected, but the freedom to maneuver is slightly diminished.

Based on a review of information provided by SERI, Entergy, and its own reconnaissance level review, the staff concludes 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). Some of the local roads could have their level of service degraded during construction to the point where operations of individual drivers could be significantly affected by interactions with the rest of the traffic. This would be at level-of-service "C" or lower. Also, it is possible that, given the heavy loads carried by vehicles transporting construction materials to the River Bend site, some of the roads may need improvement to carry the additional load.

Based on a review of information provided by SERI, Entergy, and its own independent review, the staff concludes that the impacts of an operations workforce and related transportation impacts would be much less noticeable than during construction. There may be some minor congestion at shift changes and level of service may degrade.

Recreation

The River Bend site is an industrial site not used for recreation. Its current structures are not visually obtrusive from any vantage point because of the large size and wooded nature of the site. The existing units are well isolated from the river and from other vantage points. Any new units would not use a once-through cooling system, so cooling towers would be necessary. However, the River Bend site already has cooling towers, so additional cooling towers for the new reactors would not significantly change the existing appearance of the site that would affect any nearby recreation experience. Traditionally, visible plumes resulting from operation of cooling towers could cause a negative aesthetic effect. However, with the installation of modern drift eliminators, use of cooling towers would not create extensive, elevated visible plumes (Dominion and Bechtel 2002), so the aesthetic effect could be reduced. Based on the information provided by SERI, Entergy, and its own independent review, the staff concludes that no noticeable impacts on recreation in the vicinity of the River Bend site would result from construction and operation of a new generating facility at the site.

Housing

A 18.7 percent vacancy rate out of a total of 4485 housing units currently exists in West Feliciana Parish. However, given the proximity of the River Bend site to the Baton Rouge metropolitan area, which has 12,000 vacant housing units in East Baton Rouge Parish alone, housing for construction workers, most of whom will be coming from within the region, and the subsequent operations workforce is expected to be available. Sufficient housing is available in West Feliciana Parish and the Baton Rouge area to support the additional workforce that would be needed to operate a new generating facility at the River Bend site (Scott 2004).

Based on the information provided by SERI, Entergy, and its own independent review, the staff concludes that the impact of a construction and operations workforce on the demand for housing could be easily handled. This conclusion is based on the availability of approximately 840 vacant housing units in West Feliciana Parish, existing construction plans, and the proximity of the River Bend site to the larger Baton Rouge metropolitan area.

Public Services

Water Supply and Waste Treatment. West Feliciana Parish would have to upgrade some of their water distribution lines from 6 in. to 8 in. to accommodate growth, but plans for that upgrade already are in place. The Parish has a plentiful groundwater supply and a complete Parish-wide water distribution system. The Parish government regulates sewage treatment, but there are individual sewage districts (Scott 2004).

Most of the construction workforce would come from within the region, so their demands on the water treatment and distribution systems are already accounted for. The station operating workforce, while probably relocating into the region, would probably reside throughout the region; therefore, their presence would not particularly affect any one community or jurisdiction. Based on its independent review, the staff concludes that the impact of construction and operation on the water treatment and distribution systems would not be noticeable.

Police, Fire, and Medical Facilities. In the larger metropolitan area of West Feliciana Parish, East Feliciana Parish, East Baton Rouge Parish, and Baton Rouge, and in nearby St. Francisville, police, fire, and medical facilities would not be materially affected by an increase in the construction workforce. It is anticipated that many of the workers who would be involved in construction at the River Bend site already live in the region and would commute to the site from their permanent residences. These workers already are being served by existing police, fire, and medical services and facilities.

Thirty percent of the operations workforce of 1160 (approximately 350 workers) is anticipated to come from outside the region (Entergy Nuclear 2001). Because these workers would probably reside throughout the region, their presence would not particularly affect any one community or jurisdiction and is not expected to place inordinate demands placed on police, fire, and medical services and facilities.

Based on its independent review, the staff concludes that the impact of construction and operations workforce on police, fire, and medical services facilities would not be noticeable. Most construction workers already live within the region. New operations workforce employee would live throughout the region, so there should be minimal new demands placed on these services and facilities by either construction or operations workers.

Social Services. A variety of emergency assistance, counseling, child and family services, and other social services are provided in each parish by the Louisiana Department of Social Services. During the construction phase at the River Bend site, there may be an increased demand for some social services.

Generally, construction and operation of a new generation facility at the River Bend site would be viewed as beneficial economically to the disadvantaged population segments served by the Louisiana Department of Social Services. The workforce associated with construction at the River Bend site would be relatively higher paid than other employment categories in the region. Construction and operation of the new units, through the multiplier effect (see Section 4.5.3.1), may enable the disadvantaged population to improve their social and economic position by moving up to higher paying jobs. At a minimum, the expenditures of the construction and operations workforce in the counties for food, services, etc., could, through the multiplier effect, increase the number of jobs available to the disadvantaged population.

Based on its independent review, the staff concludes that the demand for social and related services as a result of construction and operation of a new generation facility at the River Bend site likely would be insignificant. Construction and operation would have a beneficial economic impact to the economically disadvantaged population of the region, which should decrease the demand for social services. There could be an initial increase in demand for social services at the beginning of the construction period, but this is considered manageable and limited.

Education

The West Feliciana Parish school system has just over 2000 students (NCES 2004b). There currently is no overcrowding in the system, and the system enjoys some of the lowest student teacher ratios in Louisiana, high standardized test performance, and excellent facilities (Scott 2004). The extensive regional parochial school system is also considered to be strong. In the other counties and cities of the region, it is anticipated that the construction and operations workforce would minimally affect school infrastructures because many construction workers already live within the region. Entergy estimates that it would take 3150 construction workers more than 5 years to build two new nuclear units at the River Bend site (Entergy Nuclear 2001); some of the workforce would reside in the region already. Entergy estimates that the population increase in the region during peak construction would be 2459 of whom 759 are likely to be children (Entergy Nuclear 2001). The operations workforce, while coming from outside and relocating into the region, would probably be distributed throughout the region, thereby placing little demand on school infrastructure.

It is anticipated that most of the construction workforce would come from within the area and would not relocate their families. Those construction and operations workers potentially relocating to the region would most likely reside throughout the region and, as a result, would not be in sufficient concentrated pockets to place an undue burden on the existing infrastructure. Based on its independent review, the staff concludes that the impact of the construction and operations workforce on education facilities in West Feliciana Parish and the area would be easily accommodated by the existing school systems and facilities.

Summary of Infrastructure and Community Services

Based on the information provided by SERI, Entergy, and the staff's own independent review, the staff concludes that impacts on infrastructure and community services from construction and operation of new nuclear units at the River Bend site would be SMALL to MODERATE adverse.

Summary of Socioeconomics

In summary, on the basis of information provided by SERI, Entergy, and its own independent review, the staff concludes that the impacts of the construction and operations at the River Bend site on socioeconomics would be SMALL, with the exceptions that the transportation impacts during construction likely would be adverse and MODERATE and that the impacts on the West Feliciana Parish economy and tax base likely would be beneficial and MODERATE. Some of the increase in taxes may have to be used to improve local transportation infrastructure.

8.5.1.6 Historic and Cultural Resources

The footprint for a new generating facility at the River Bend site does not appear to have any historic properties located within areas likely to be affected by new construction and operations (AEC 1974a). In 1972, Gulf States Utilities Company commissioned an archaeological survey of portions of the planned River Bend Station. No archaeological deposits were encountered during that survey (Neuman 1972). In 1978, Gulf States Utilities commissioned two transmission line surveys. Prehistoric sites were identified within the right-of-way, but not within the plant boundaries (Neuman 1978a; 1978b). In 1982, personnel from Gulf States Utilities informed the Louisiana State Archaeologist's Office of the remains of a 19th century sugar mill within the plant boundaries. Testing and evaluation of the mill remains conducted in 1983 determined that the site was not eligible for listing on the National Register of Historic Places (Shuman and Orser 1984). Miscellaneous archaeological surveys conducted over the years in the area indicate that while sites may exist on the premises, either the sites are not eligible for listing on the National Register of Historic Places or are located away from areas where new construction would likely occur. Protective measures would be implemented if historic and/or cultural resources were discovered during construction or during operations. In the event that an unanticipated discovery is made, site personnel would be instructed to notify the State Historic Preservation Officer and would consult with him or her in assessing the discovery to determine if additional evaluation of the discovery is needed.

There are no significant differences between the Grand Gulf ESP site and the River Bend site that would make any material difference in the potential for historic properties or other important cultural sites to be adversely affected. Based on information provided by SERI, Entergy, and its own independent review, the staff concludes that the impacts on historic and cultural resources at the River Bend site would be SMALL.

8.5.1.7 Environmental Justice

As part of the evaluation of the potential environmental justice impacts related to the River Bend site, the staff used information from interviews with community leaders, U.S. Census Bureau, Housing Assistance Council, and local Internet websites. Sightly over half of the population of West Feliciana Parish is African-American. About 20 percent of the population live below the Federal poverty level (Housing Assistance Council 2002). The pathways through which the environmental impacts associated with the construction of new units at the River Bend site could affect human populations were ascertained. The staff then evaluated whether minority and low-income populations could be disproportionately affected by these impacts. The staff found no unusual resource dependencies or practices, such as subsistence agriculture, hunting, or fishing, through which the populations could be disproportionately affected. In addition, the staff did not identify any location-dependent disproportionate impacts affecting these minority and low-income populations.

Based on the information provided by Entergy, SERI, and its own independent review, the staff concludes that the offsite impacts of construction and operation of new units at the River Bend site to minority and low-income populations would be SMALL. No adverse nor disproportionately high impacts were identified.

8.5.2 Evaluation of the Pilgrim Nuclear Power Station Site

This section covers the staff's evaluation of the potential environmental impact of siting new nuclear units within the scope of the SERI PPE at the Pilgrim Nuclear Station (Pilgrim) site.

8.5.2.1 Land Use Including Site and Transmission Corridors

Site and Vicinity

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 town of Plymouth, Massachusetts. The area around the site and the vicinity has become increasingly urbanized since the existing facility was built, but the area also features coastal forest, cranberry farms, and access to Cape Cod recreational areas. The new facility would be situated on a bluff above and to the west-northwest of the existing Pilgrim units. Because the site of the ESP facility would use a portion of the existing Pilgrim site, no land would be preempted for additional facilities built at this site (SERI 2003c).

The types of impacts of new facility construction and operations (i.e., physical, ecological, social, and radiological impacts) are likely to be similar to those expected for the Grand Gulf ESP site. The Pilgrim site is unique from Grand Gulf in that it is located within the costal zone of Cape Cod and is subject to the Coastal Zone Management Act of 1972, as amended. Congress enacted the Coastal Zone Management Act (CZMA) to address the increasing pressures of over-development upon the nation's coastal resources. At the Federal level, the National Oceanic and Atmospheric Administration administers the Act. The CZMA encourages States to preserve, protect, develop, and, where possible, restore or enhance valuable natural coastal resources such as wetlands, floodplains, estuaries, beaches, dunes, barrier islands, and coral reefs, as well as the fish and wildlife using those habitats. Participation by States is voluntary; however, Commonwealth of Massachusetts has an approved coastal zone management program. The staff assumed that SERI would comply with all provisions of the CZMA as implemented in the Cape Cod region. Based on the information provided by SERI and its own independent review, the staff concludes that the land-use impacts on the site and vicinity of construction and operations would be SMALL.

Transmission Corridors

One 345-kV line runs south-southeast from the Pilgrim site, crossing Commonwealth Highway 3, then turning west and continuing another 0.8 km (0.5 mi) to a substation near Long Pond Road. This transmission line right-of-way traverses rural coastal forested lands. The existing right-of-way does not cross any land known to be protected or designated for special uses. From this substation, rights-of-way exit to the north and to the south. Section 3.3 discusses the regulatory procedure required to link new large generation to the grid. The issues that could result in potential impacts of construction and operation in these transmission corridors (i.e., physical and ecological impacts) would be similar to those land-use impacts of construction and operation in the transmission corridors and offsite areas associated with the Grand Gulf ESP site. Therefore, the staff concludes that the land-use impacts of transmission system construction and continued operations would be SMALL.

8.5.2.2 Water Use and Quality

Water Use

The Pilgrim site is located adjacent to Cape Cod Bay. Construction activities for new nuclear units at Pilgrim would have similar water use impacts (i.e., physical and ecological impacts) to Grand Gulf and would be bounded by the operational impacts. During operation, the consumptive use of water from the cooling towers would be very small compared to the supply available in the ocean; however, there are concerns with Pilgrim's existing level of entrainment, which could increase. Cooling towers using salt water require fewer cycles of concentration than would be required with a similar cooling tower using fresh water. Therefore, the intake flow rate of makeup water and discharge flowrate of blowdown water are expected to be higher than at Grand Gulf. The staff concludes that the impacts to surface-water use and water supply at the Pilgrim site would be SMALL given the water supply available.

Water Quality

Construction activities for new nuclear units sited at Pilgrim would follow best management practices and have similar water-quality impacts as the construction at Grand Gulf, which would be bounded by the operational impacts. The additional heat from the relatively small amount of blowdown water would be commingled with the discharge of the existing Pilgrim Station. This addition would increase the size of the current thermal plume. Thermal and chemical discharges to Cape Cod Bay would be regulated by the Massachusetts Department of Environmental Protection via an NPDES permit issued to protect the environment. Since the combined discharge represents a very small fraction of the water volume, the staff concludes that the impacts to water quality at the Pilgrim site would be SMALL.

8.5.2.3 Terrestrial Resources Including Endangered Species

Construction Impacts

The western portion of the Pilgrim site is largely undeveloped, consisting primarily of forest that has been harvested multiple times and was burned in 1957. The most extensive plant community on the Pilgrim site and in the surrounding region is an oak-pine forest, which covers most of the western portion of the site. Small tracts of permanently moist soil support plant species not associated with oak and pine forest, such as stands of red maple (*Acer rubrum*). Small tracts of other forest communities are also found onsite, such as black locust (*Robinia pseudoacacia*). Only very small ponds and artificially created wetlands occur on the Pilgrim site (south of the plant), in contrast to bogs and lakes that are a common feature of the surrounding landscape (AEC 1974b).

It is assumed that a new generating facility would be located on the western portion of the Pilgrim site and would thus primarily affect the oak and pine forest habitat, and that the small ponds and artificial wetlands would not be affected. Consequently, the impacts to habitat from construction of a new generating facility on the Pilgrim site are expected to be noticeable, but not destabilizing.

Potential construction impacts, such as erosion and dust generation, would be typical of large construction projects. These impacts could be mitigated using standard industrial procedures and best management practices. Standard practices, such as silt fences to control sedimentation and water sprays to limit dust generation, should be adequate to protect wetlands and other ecological resources on and in the vicinity of the site.

One transmission line right-of-way, extending a total length of 8 km (5 mi) (AEC 1974b) and covering 70 ha (173 ac) (NRC 1996), currently serves the Pilgrim site. It traverses rural coastal forest and does not cross any land known to be designated for special uses or as protected. It is assumed this transmission line would not have the capacity to carry the power that would be generated by a new generating facility, and that a transmission system upgrade including new transmission lines and an additional right-of-way would be needed. It is assumed that any additional right-of-way would involve expanding the existing right-of-way. Although land cover details are unknown for the transmission corridor, the terrestrial ecological impacts associated with the expansion are expected to be small, given the relatively short length of the corridor.

Based on information provided by SERI, Entergy, and its own independent review, the staff concludes that impacts to terrestrial ecological resources from construction of a new generating facility at the Pilgrim site and construction associated with possible expansion of the existing Pilgrim transmission corridor could range from SMALL to MODERATE

Threatened and Endangered Species

The Federally listed threatened or endangered terrestrial species that could occur in the vicinity of the Pilgrim site include one turtle, the Plymouth population of the redbelly turtle (*Chrysemys rubriventris bangsi*), and three birds: the roseate tern (*Sterna dougallii dougallii*), the Atlantic coast breeding population of the piping plover (*Charadrius melodus*), and the bald eagle (*Haliaeetus leucocephalus*) (Table 8-9) (FWS 2004b).

The redbelly turtle, a large, freshwater basking turtle of deep, coastal plain ponds, is restricted to approximately 17 ponds of varying sizes and one river site in Plymouth County, Massachusetts (FWS 1994; MNHESP 1995a). The current known range of the turtle overlaps the Pilgrim site (FWS 1994), and the species is known to occur within 3.2 km (2 mi) (Table 8-9) (MDFW 2004). Designated critical habitat for the species is located approximately 4.8 km (3 mi) to the southwest (FWS 1994). Therefore, the turtle could potentially occur on the Pilgrim site. Consequently, if construction of a new generating facility on the Pilgrim site were to affect the small ponds and wetlands and/or adjacent upland areas, which are typically important for egg laying and movement away from the ponds, it could potentially affect the species, if in fact the species is present.

Approximately 1.6 km (1 mi) of a Pilgrim transmission corridor crosses critical habitat for the redbelly turtle (AEC 1974b; 45 FR 21828; FWS 1994). Within the critical habitat, the transmission line passes adjacent to a cranberry bog and otherwise crosses upland areas (FWS 1994). Expansion of the existing Pilgrim transmission corridor could affect critical habitat via disturbance of vegetation and soils. Indirectly, this could adversely affect the species via destruction of basking, nesting, and overwintering areas around ponds and alteration of water quality resulting from erosion/siltation.

The roseate tern is a colonial species that in Massachusetts prefers to nest along islands, coastal beaches, and inshore waters (MNHESP 1988a). The tern is known to occur beyond 3.2 km (2 mi) but within 16 km (10 mi) of the Pilgrim site (Table 8-9) (MDFW 2004) on Plymouth Bay (MNHESP 1988a). Because of this distance, it is not anticipated that construction of a new generating facility at the Pilgrim site would affect the tern. The Pilgrim transmission corridor is located greater than 3.2 km (2 mi) from this tern colony. Thus, it is not anticipated that expansion of the corridor would affect the tern. There is no proposed or designated critical habitat for the tern (52 FR 42064).

Two State-listed threatened birds are known to occur beyond 3.2 km (2 mi) but within 16 km (10 mi) of the Pilgrim site: the grasshopper sparrow (*Ammodramus savannarum*) and the vesper sparrow (*Pooecetes gramineus*) (Table 8-9) (MDFW 2004). The grasshopper sparrow (MNHESP 1986a) and vesper sparrow (NJDFW 2004c) are species of open fields. The only habitat on the Pilgrim site similar to open fields is grass meadow. However, because this habitat type appears to comprise less than 3 percent of the site (AEC 1974b), it is unlikely that the grasshopper or vesper sparrow exist onsite. It is also unlikely that these species exist along the Pilgrim transmission corridor because it crosses coastal forest habitat (AEC 1974b). Thus, it is not anticipated that construction of a new generating facility at the Pilgrim site or expansion of the Pilgrim transmission corridor would affect these two sparrow species.

One threatened turtle is known to occur beyond 3.2 km (2 mi) but within 16 km (10 mi) of the Pilgrim site: Blanding's turtle (*Emydoidea blandingii*) (Table 8-9) (MDFW 2004). Blanding's turtle is primarily aquatic, preferring densely vegetated shallow ponds, marshes, or small streams (MNHESP 1987). Because small ponds (but no marshes and small streams) are found on the Pilgrim site (AEC 1974b), Blanding's turtle could occur there and, thus, could be affected by construction of a new generating facility. The Pilgrim transmission corridor crosses coastal forest habitat (AEC 1974b). However, it is unclear if the corridor also crosses ponds, marshes, or small streams that could support Blanding's turtle.

Five State-listed threatened or endangered moths and butterflies are known to occur beyond 3.2 km (2 mi) but within 16 km (10 mi) of the Pilgrim site: barrens daggermoth (*Acronicta albarufa*), Melsheimer's sack bearer (*Cicinnus melsheimeri*), Persius duskywing (*Erynnis persius persius*), Buchholz's gray (*Hypomecis buchholzaria*), and pine barrens zanclognatha (*Zanclognatha martha*) (Table 8-9) (MDFW 2004). All five species occur in open pitch pine (*Pinus rigida*)/scrub oak (*Quercus ilicifolia*) barrens (Wagner et al. 2003). Barrens daggermoth and Melsheimer's sack bearer also occur in scrub oak thickets (Wagner et al. 2003). Persius

Table 8-9. Terrestrial Federally Listed and State-Listed Species Occurring in the Vicinity of the Pilgrim Site

Scientific Name	Common Name	Status[a]	Distance from the Pilgrim Site[b]	Source
Birds				
Ammodramus savannarum	grasshopper sparrow	ST	beyond 3.2 km (2 mi) but within 16 km (10 mi)	MDFW 2004
Charadrius melodus	piping plover (Atlantic coast population)	FT/ST	beyond 3.2 km (2 mi) but within 16 km (10 mi)	MDFW 2004; FWS 2004b
Haliaeetus leucocephalus	bald eagle	FT/SE	beyond 3.2 km (2 mi) but within 16 km (10 mi)	MDFW 2004; FWS 2004b
Pooecetes gramineus	vesper sparrow	ST	beyond 3.2 km (2 mi) but within 16 km (10 mi)	MDFW 2004
Sterna dougallii	roseate tern	FE/SE	beyond 3.2 km (2 mi) but within 16 km (10 mi)	MDFW 2004; FWS 2004b
Reptiles				
Emydoidea blandingii	Blanding's turtle	ST	beyond 3.2 km (2 mi) but within 16 km (10 mi)	MDFW 2004
Pseudemys rubriventris bangsi	Plymouth redbelly turtle	FE/SE	<3.2 km (2 mi)	MDFW 2004; FWS 2004b
Moths and Butterflies				
Acronicta albarufa	barrens daggermoth	ST	beyond 3.2 km (2 mi) but within 16 km (10 mi)	MDFW 2004
Cicinnus melsheimeri	Melsheimer's sack bearer	ST	beyond 3.2 km (2 mi) but within 16 km (10 mi)	MDFW 2004
Erynnis persius persius	persius duskywing	SE	beyond 3.2 km (2 mi) but within 16 km (10 mi)	MDFW 2004
Hypomecis buchholzaria	Buchholz's gray	SE	beyond 3.2 km (2 mi) but within 16 km (10 mi)	MDFW 2004
Zanclognatha martha	pine barrens zanclognatha	ST	beyond 3.2 km (2 mi) but within 16 km (10 mi)	MDFW 2004
Damselflies				
Enallagma recurvatum	pine barrens bluet	ST	beyond 3.2 km (2 mi) but within 16 km (10 mi)	MDFW 2004
Plants				
Calamagrostis pickeringii	reed bentgrass	SE	beyond 3.2 km (2 mi) but within 16 km (10 mi)	MDFW 2004

Table 8-9. (contd)

Scientific Name	Common Name	Status[a]	Distance from the Pilgrim Site[b]	Source
Carex striata brevis	Walter's sedge	SE	beyond 3.2 km (2 mi) but within 16 km (10 mi)	MDFW 2004
Eupatorium leucolepis novae-angliae	New England boneset	SE	beyond 3.2 km (2 mi) but within 16 km (10 mi)	MDFW 2004
Isoetes acadiensis	acadian quillwort	SE	beyond 3.2 km (2 mi) but within 16 km (10 mi)	MDFW 2004
Lipocarpha micrantha	dwarf bulrush	ST	beyond 3.2 km (2 mi) but within 16 km (10 mi)	MDFW 2004
Ophioglossum pusillum	adder's-tongue fern	ST	<3.2 km (2 mi)	MDFW 2004
Rhynchospora inundata	inundated horn-sedge	ST	beyond 3.2 km (2 mi) but within 16 km (10 mi)	MDFW 2004
Rhynchospora nitens	short-beaked bald-sedge	ST	beyond 3.2 km (2 mi) but within 16 km (10 mi)	MDFW 2004
Rhynchospora torreyana	Torrey's beak-sedge	SE	beyond 3.2 km (2 mi) but within 16 km (10 mi)	MDFW 2004
Sphenopholis pensylvanica	swamp oats	ST	beyond 3.2 km (2 mi) but within 16 km (10 mi)	MDFW 2004

(a) Federal status rankings developed by the U.S. Fish and Wildlife Service (FWS) under the Endangered Species Act, FE = Federal endangered, FT = Federal threatened (FWS 2004b). State status rankings developed by the Massachusetts Division of Fisheries and Wildlife (MDFW), SE = State endangered, ST = State threatened (MDFW 2004).
(b) Distances provided by MDFW (2004).

duskywing, Buchholz's gray, and pine barrens zanclognatha likely do not occur on the Pilgrim site, because pitch pine/scrub oak barrens are not known to occur there (AEC 1974b). However, barrens daggermoth and Melsheimer's sack bearer could potentially occur on the Pilgrim site, because oak forest and mixed saplings and pole-sized oak stands occur there (AEC 1974b). Thus, these two species could be directly affected by construction of a new generating facility on the Pilgrim site if present in the impact area or indirectly via destruction of host plants. Insufficient detail is available about plant communities to determine whether these five moths and butterflies could occur along the coastal forest-dominated Pilgrim power transmission corridor (AEC 1974b).

One State-threatened damselfly is known to occur beyond 3.2 km (2 mi) but within 16 km (10 mi) of the Pilgrim site: pine barrens bluet (*Enallagma recurvatum*) (Table 8-9) (MDFW 2004). Pine barrens bluet appears to be restricted to ponds on the coastal plains

(MNHESP 2003). Because small ponds are found on the Pilgrim site (AEC 1974b), pine barrens bluet could occur there and, thus, could be affected by construction of a new generating facility. The Pilgrim transmission corridor crosses coastal forest habitat (AEC 1974b). However, it is unclear if it also crosses ponds on the coastal plains, marshes, or small streams that could support pine barrens bluet.

Only one State-listed threatened or endangered terrestrial plant species is known to occur within 3.2 km (2 mi) of the Pilgrim site: adder's tongue fern (*Ophioglossum pusillum*) (Table 8-9) (MDFW 2004). Adder's tongue fern in Massachusetts is found in ecologically diverse sites (boggy meadows, acidic fens [sphagnous areas with seeping groundwater], borders of marshes, wet fields, and moist woodland clearings) (MNHESP 1990b). Because small ponds and developed wetlands occur on the Pilgrim site, adder's tongue fern could occur there and, thus, could be affected by construction of a new generating facility. However, it is unclear whether the transmission corridor also crosses wet habitats that could support adder's tongue fern.

Nine other State-listed threatened or endangered terrestrial plant species are known to occur beyond 3.2 km (2 mi) but within 16 km (10 mi) of the site: reed bentgrass (*Calamagrostis pickeringii*), Walter's sedge (*Carex striata brevis*), New England boneset (*Eupatorium leucolepis novae-angliae*), acadian quillwort (*Isoetes acadiensis*), dwarf bulrush (*Lipocarpha micrantha*), inundated horn-sedge (*Rhynchospora inundata*), short-beaked bald-sedge (*Rhynchospora nitens*), Torrey's beak-sedge (*Rhynchospora torreyana*), and swamp oats (*Sphenopholis pensylvanica*) (Table 8-9) (MDWF 2004). Seven of these species – Walter's sedge, New England boneset, acadian quillwort, dwarf bulrush, inundated horn-sedge, short-beaked bald-sedge, and Torrey's beak-sedge – occur along the shorelines of or within freshwater ponds (MDCNAP 2004a and 2004b; MNHESP 1986b, 1988b, 1988c, 1990c, and 1993). Reed bentgrass occurs along the shorelines of coastal, nontidal, nonforested wetlands (MDCNAP 2004c). Swamp oats occur in a variety of wet places, including swamps (ODNR 2004). Because small ponds and developed wetlands occur on the Pilgrim site, these nine species could occur onsite and, thus, could be affected by construction of a new generating facility. The Pilgrim transmission corridor crosses coastal forest habitat (AEC 1974b). However, it is unclear whether it also crosses wet habitats that could support these species.

Based on potential impacts to the Federally listed redbelly turtle and the potential impacts to many of the State-listed species, the staff concludes the impacts to threatened and endangered species from construction of a new generating facility on the Pilgrim site and possible expansion of the existing transmission corridor would be MODERATE to LARGE.

Operational Impacts

Impacts to terrestrial resources that may result from operation of one or more new nuclear units at the Pilgrim site include those associated with cooling towers and transmission lines. The Pilgrim plant currently employs a once-through cooling system, but cooling towers would be employed for a new nuclear unit(s). Uncertainty exists regarding the potential impacts of salt drift deposition on crops and ornamental vegetation and native plants from cooling towers that draw salt water. The impacts of salt drift from cooling towers using fresh water were evaluated in the GEIS (NRC 1996) and were found to be of small significance for all plants. The EPA also concluded that impacts on crops and ornamental vegetation from salt drift from plants using estuarine/tidal makeup water would be minimal (EPA 2001). However, because of the uncertainty surrounding cooling towers that use salt water, it should be conservatively concluded that there could be damage to offsite vegetation resulting from salt drift from operation of cooling towers for the new nuclear unit(s) at the Pilgrim site.

The impacts associated with bird collisions with cooling towers for existing power plants were evaluated previously in the GEIS (NRC 1996) and were found to be small for all plants, including those with multiple cooling towers of various types. The staff is not aware of any new information that would cause it to modify its earlier conclusion. On these bases, for the purposes of consideration of alternative sites, the impacts of bird collisions with cooling towers resulting from operation of one or more new nuclear units at the Pilgrim site would be negligible.

For both natural and mechanical draft cooling towers, the anticipated noise level from cooling tower operation is anticipated to be 55 decibels at 305 m (1000 ft) (SERI 2003c). The noise level for dry cooling towers is somewhat higher. However, these noise levels are all well below the 80- to 85-decibel threshold at which birds and small mammals are startled or frightened (Golden et al. 1980). Thus, noise from operating cooling towers at the Pilgrim site would not be likely to disturb wildlife beyond 305 m (1000 ft) from the source. Further, impacts within this distance, if any, would be considered negligible owing to the large expanses of open habitat into which mobile wildlife species could move if disturbed. Consequently, the impacts of cooling tower noise on wildlife from operation of one or more new nuclear units at the Pilgrim site would be minimal.

The impacts usually associated with transmission line operation consist of bird collisions with transmission lines and electromagnetic field (EMF) effects on flora and fauna. It is reasonable to assume that the expansion of the transmission system for one or more new nuclear units at the Pilgrim site would present few new opportunities for bird collisions, and that no measurable reduction in local bird populations would result. The issue of bird collisions with transmission lines was evaluated previously in the GEIS (NRC 1996) and was found to be small for all facilities, including those with multiple transmission corridors with various numbers of transmission lines. Based on the above rationale and the associated conclusions presented in GEIS (NRC 1996), the effects on bird collisions of transmission line operation for one or more new nuclear units at the Pilgrim site would be negligible.

Regarding EMF effects on flora and fauna, it is reasonable to assume that the intensity of EMF effects would not change with the addition of new transmission lines to existing corridors, except that they would occur in a wider area. As discussed in the GEIS (NRC 1996), a careful review of the biological and physical studies of EMFs has not revealed consistent evidence linking harmful effects with field exposures. Therefore, potential EMF impacts to wildlife, including the Federally endangered redbelly turtle, that would be posed by addition of new transmission lines to existing corridors for one or more new nuclear units at the Pilgrim site would be minimal.

The impacts usually associated with transmission right-of-way maintenance (cutting and herbicide application) consist of erosion/siltation and disturbance of wildlife and wildlife habitat, and similar impacts where rights-of-ways cross floodplains and wetlands. It is reasonable to assume that right-of-way maintenance would be conducted how it currently is, only over a wider area. The effects of right-of-way maintenance were evaluated previously in the GEIS (NRC 1996) and were found to be small for all plants, including those with transmission corridors of various widths. The staff is not aware of any new information that would cause it to modify its earlier conclusion. Therefore, general wildlife and wildlife habitat would be expected to be minimally affected by right-of-way maintenance in the expanded transmission corridor. However, it is unknown to what extent the redbelly turtle would be affected by increasing the area of right-of-way maintenance over the approximately 1.6-km (1-mi) segment of Pilgrim transmission corridor that crosses critical habitat for the species. Nonetheless, it is likely that potential impacts to the redbelly turtle (e.g., mortality, destruction of basking, nesting, and overwintering areas around ponds) and its critical habitat (e.g., alteration of water quality resulting from erosion/siltation) from right-of-way maintenance would be less acute, although more long-term, than the construction impacts resulting from right-of-way widening. Therefore, potential impacts to the species from right-of-way maintenance in the expanded corridor could be modest.

The staff reviewed the operation of one or more nuclear units at the Pilgrim site, including the associated heat dissipation system and transmission line operation and right-of-way maintenance. Because of the potential for salt damage to vegetation from cooling tower drift and potential impacts to the Federally endangered redbelly turtle from transmission right-of-way maintenance, the staff concludes that the impacts of operation of one or more nuclear units at the Pilgrim site on terrestrial resources and threatened and endangered species could range from SMALL to MODERATE.

8.5.2.4 Aquatic Resources Including Endangered Species

Construction and Operation Impacts

The staff does not expect that the aquatic resources near the Pilgrim site would be affected by the construction and operation of new nuclear units and associated cooling towers. The existing intake structure in Cape Cod Bay would be sufficient to withdraw water necessary for the ESP units, for water use with cooling towers. Discharges to Cape Cod Bay would not increase substantially. Thus, issues with impingement, entrainment, and heat shock from the current system are not expected to increase substantially for the operation of the new nuclear unit. Current dredging activities for operation of the existing intake system would have to continue.

Since 1974, the Pilgrim Nuclear Station has identified approximately 68 species through programs on impingement and entrainment. Of these species, approximately 26 are of commercial or recreational value (EPA 2002). Winter flounder (*Pleuronectes americanus*) is one of the species that is important to the commercial and recreational industry in the vicinity of the Pilgrim Nuclear Station. In response to concerns from entrainment of winter flounder larvae, the Pilgrim Nuclear Station and the Massachusetts Division of Marine Fisheries have been raising flounder in a hatchery and releasing them into Cape Cod Bay (Galya et al. 2003; Lawton 2000; NEI 2002). Operation of new nuclear units at the Pilgrim site would result in increased use of cooling water from Cape Cod Bay by approximately 20 percent over current Pilgrim Nuclear Station rates. This would increase entrainment of winter flounder larvae approximately proportional to the amount of water withdrawal. Increased production of hatchery flounder could be used to mitigate the anticipated increased in larval mortality resulting from the operation of new units.

Based on information provided by SERI, Entergy, and its own independent review, the staff concludes that the overall impacts on aquatic ecological resources from construction of a new nuclear unit(s) and associated cooling towers at the Pilgrim ESP site would be SMALL. However, the overall impacts on aquatic ecological resources from operation of a new nuclear unit(s) and associated cooling towers at the Pilgrim ESP site, considering the potential for increased entrainment of winter flounder larval would be SMALL to MODERATE.

Threatened and Endangered Species

Federally listed threatened and endangered species are found within the vicinity of Cape Cod Bay (Table 8-10); however, construction and operation of new nuclear units are not expected to affect the species. National Oceanic and Atmospheric Administration (NOAA) Fisheries identified three species of sea turtles and two species of whales that are known to be seasonally located in waters off Massachusetts and may be present in the vicinity of the site (NMFS 2004). The sea turtles include loggerhead turtle (*Caretta caretta*), Kemp's ridley turtle (*Lepidochelys kempii*), and leatherback turtle (*Dermochelys coriacea*). The whales include North Atlantic right whale (*Eubalaena glacialis*) and humpback whale (*Megaptera novaeangliae*). No federally threatened or endangered species were identified at the Pilgrim site by the U.S. Fish and Wildlife Service (FWS 2004b).

Only one State-listed threatened species has been identified within the vicinity of the Pilgrim site (Table 8-10). The American brook lamprey (*Lampetra appendix*) are primitive jawless, eel-like fish and are a non-parasitic species of lamprey. They may grow as large as 0.2 m (8 inches). Their larvae live for 4 to 6 years in fine sediment of backwaters or freshwater streams. When they metamorphose into an adult, they stop feeding, spawn and die. While the American brook lamprey is found in the vicinity of the Pilgrim site, it is not found on the site. Operations and future construction are not likely to affect the streams within 16 km (10 mi) where the lamprey may be found.

Table 8-10. Aquatic Federally and State-Listed Species Occurring in the Vicinity of the Pilgrim Site

Scientific Name	Common Name	Status[a]	Distance from the Pilgrim Site[b]	Source[b]
Fish				
Lampetra appendix	American brook lamprey	ST	<3.2 km (2 mi)	MDFW 2004
Mammals				
Eubalaena glacialis	North Atlantic right whale	FE	16 km (10 mi)	NMFS 2004
Megaptera novaeangliae	humpback whale	FE	16 km (10 mi)	NMFS 2004
Reptiles				
Caretta caretta	loggerhead turtle	FT	16 km (10 mi)	NMFS 2004
Dermochelys coriacea	leatherback turtle	FE	16 km (10 mi)	NMFS 2004
Lepidochelys kempii	Kemp's ridley turtle	FE	16 km (10 mi)	NMFS 2004

(a) Federal status rankings developed by the U.S. Fish and Wildlife Service (FWS) under the Endangered Species Act, FE = Federal endangered, FT = Federal threatened. State status rankings developed by the Massachusetts Division of Fisheries and Wildlife (MDFW), ST = State threatened (MDFW 2004).
(b) Distances provided by MDFW (2004) and National Oceanic and Atmospheric Administration (NOAA) Fisheries (NMFS 2004).

The staff is unaware of any incidents involving threatened and endangered species and the operation of Pilgrim Nuclear Station. No sea turtles or whales have been impinged or entrained at the Pilgrim Nuclear Station, nor have any of these species been observed in the vicinity of the station since biological monitoring began in 1973 (Entergy Services 2005). Based on information provided by SERI and the staff's own independent review, the staff concludes that the overall impacts on threatened and endangered aquatic species from construction and operation of new nuclear unit(s) and associated cooling towers at the Pilgrim site would be SMALL.

8.5.2.5 Socioeconomics

In evaluating the socioeconomic impacts of construction at the Pilgrim site, Entergy undertook a "reconnaissance" survey of the site using readily obtainable data from the Internet or published sources. The staff conducted some local interviews with knowledgeable local officials. No new data were collected. The socioeconomic subsections follow the organizational structure of the socioeconomic discussions in Sections 2.8, 4.5, and 5.5. The impacts expected from both construction and station operation are discussed.

Physical Impacts

Construction activities can cause temporary and localized physical impact such as noise, odor, vehicle exhaust, vibration, shock from blasting, and dust emissions. The use of public roadways, railways, and waterways would be necessary to transport construction materials and equipment. Some of these roadways, such as the Pilgrim access road and Massachusetts Route 3A with which it connects, could require some minor repairs or upgrading (such as patching and filling potholes) to allow safe transport of these materials and equipment. However, no extensive work is planned for the existing roads. It is expected that all construction activities would occur within the existing Pilgrim site. Offsite areas that would support construction activities (for example borrow pits, quarries, and disposal sites) are expected to be already permitted and operational. Impact to those facilities from construction of the new units would be small and incremental and associated with their normal operation.

Potential impacts from station operation would include noise, odors, exhausts, thermal emissions, and visual intrusions. The new units would produce noise from the operation of pumps, dry cooling tower fans, transformers, turbines, generators, and switchyard equipment, and traffic associated with construction and operation of the new unit would also produce noise. SERI states that any noise coming from the proposed Grand Gulf ESP site would be controlled in accordance with applicable local county regulations (SERI 2003c). By inference, this is also expected to apply to the Pilgrim site. Regulations concerning noise limits can be found in 310 CMR 7.10: Noise, the Commonwealth of Massachusetts Air Pollution Control Regulations.

Commuter traffic would be controlled by speed limits. Good road conditions and appropriate speed limits would minimize the noise level generated by the workforce commuting to and from the Pilgrim site (SERI 2003c).

The new units would have standby diesel generators and auxiliary power systems. Permits obtained for these generators would ensure that air emissions comply with regulations. In addition, the generators would be operated on a limited short-term basis. During normal plant operation, the new units would not use a significant quantity of chemicals that could generate odors exceeding odor threshold values. Appropriate speed limits would minimize the dust generated by the commuting workforce (SERI 2003c).

Construction activities would be temporary and would occur mainly within the boundaries of the Pilgrim site. Offsite impacts would represent small incremental changes to offsite services supporting the construction activities. During station operations, noise levels would be managed by complying with local ordinances. Air quality permits would be required for the diesel generators, and chemical use would be limited, which should help minimize production of odors. Based on the information provided by SERI and its own independent review, the staff concludes that the physical impacts of construction and operation would be SMALL.

Demography

The population base is considered to be the population of significant population centers within a 80-km (50-mi) radius of the Pilgrim site. The combined population of the Boston Metropolitan Statistical Area is over six million people (USCB 2004). The 2000 Census reported the population within the five counties nearest the Pilgrim site (Plymouth, Barnstable, Suffolk, Norfolk, and Middlesex Counties) to be about 3.5 million, and the Massachusetts Institute for Social and Economic Research middle population projection series projected the counties to grow by approximately 6 percent to 3.7 million by 2020 (MISER 2004).

Most of the construction workforce of 3150 is expected to already live in the region, and those who might relocate to the region would represent a small percentage of the larger population base. While the station operation workforce would be expected to relocate into the region; the 390 workers (25 percent of new operating employees and their families) are a small percentage of the total base population, and they would probably reside throughout the region. Based on the information in its environmental report (SERI 2003c), the Early Site Permit Selection Committee Notebook (Entergy Nuclear 2001), and its own independent review, the staff concludes that any noticeable increase in the population within an 80-km (50-mi) radius of the region resulting from construction and operation would be unlikely and the impacts would be SMALL.

Social and Economic Impacts

Economy

The Pilgrim site is located in Plymouth County, which is much smaller than the Boston metropolitan area, approximately 64 km (40 mi) to the north. This part of Massachusetts is growing quickly, in part because of the suburbanization of Boston and the fact that the Cape Cod Commission acts as a strong constraint on growth on nearby Cape Cod. Tourism is a primary economic driving force in the Plymouth County area, with about 10,000 to 15,000 people in summer rental housing. About 3500 people are employed in the tourism industry out of 13,300 employed in the county. Other effects of tourism include $80 million in payroll, State tax payment of about $17 million, and local tax payments of about $15 million (TIA 2003). In recent years, the regional economy has become more diversified and includes major businesses, financial and health care components, and a growing "high-tech" sector. Local industrial parks are reportedly fully occupied (Scott 2004). The local economic development leaders consider construction and operation of additional units at the Pilgrim site to be incompatible with the current tourism-based economy and their economic plans for the county (Scott 2004). Regionally, the service sector now offers the most employment opportunities. Construction and operation of new reactors at the Pilgrim site would decrease the availability of housing in Plymouth County, where new housing and growth control are already issues.

Based on the information provided by SERI, Entergy, and its own independent review, the staff reviewed the impact of station construction and operation on the regional economy and concludes that the impact would not be noticeable in most of the region except for Plymouth County, where the impact could be either beneficial or adverse and significant, depending on how other economic sectors (most noticeably tourism) are affected. The magnitude of the economic impact would be diffused in the larger economy in the Boston metropolitan area. With the smaller economic bases of Plymouth County, the economic impact would be more noticeable.

SERI estimates that it would take 3150 construction workers more than 5 years to build two new nuclear units at the Pilgrim site (SERI 2004a). SERI is expected to be able to attract the necessary workforce for construction activities at the Pilgrim site because of its proximity to the major population center of Boston. In 2003, the construction industry employed over 10,500 workers in Plymouth County and over 85,000 in the Boston Labor Market Area (Massachusetts Division of Career Centers and Division of Unemployment Insurance 2004).

The addition of the proposed new units would require an increase in the operations workforce of 1160 employees. A total of 569 permanent employees currently work at the Pilgrim site (SERI 2004b), plus numerous additional contractor employees during outages. In its site comparison study, Entergy stated that it expected 25 percent of the construction labor force for the new units would relocate from outside the region (Entergy Nuclear 2001). Some nuclear sites are reducing their workforces as they change missions, and workers from these sites could be potential pools of labor for the operating workforce at Pilgrim.

Based on the information provided by SERI, Entergy, and its own independent review, the staff concludes that there would be little impact on the availability of construction and operating workers. Construction labor would be available from within the region, and there would be little problem recruiting the required labor skills to enable the construction of the nuclear units at the Pilgrim site. Much of the operations workforce likely would relocate to the region.

Taxes

Construction and operations workers would pay income, sales, and use taxes to Massachusetts and the local governments in the region where sales take place and property taxes to the counties in which they own a residence. Sales and use taxes would be paid from the sales of construction materials and supplies purchased for the project and on expenditures of both the construction and operations workforce for goods and services. SERI has made no estimate of the day-to-day expenditures that would occur in the region during construction. Corporate income taxes on profits would also be paid by those companies engaged in construction.

There are two types of property taxes in Massachusetts. The first is the tangible personal property taxes paid by contractors during construction of the additional units. This tax is based on the value of property owned by the contractors that acquire taxable status in Plymouth County during the construction period. The second is the real property taxes levied for the incremental increase in value to the entire site from the operation of the additional units. It is expected that Plymouth County would be the only beneficiary of the these taxes. Entergy currently has a significant but declining impact on the economic well-being of Plymouth County. Entergy is reportedly the second largest taxpayer to the County with the existing Pilgrim plant having a negotiated value of $125 million under a payment-in-lieu-of-taxes agreement that declines after 2008 (SERI 2004c). The current value of property owned by Entergy is about one third the assessed value for the industrial property and 1.7 percent of the $7.3 billion local assessed value in the municipality of Plymouth (Commonwealth of Massachusetts Department of Revenue 2004). While the value of new units would be subject to negotiations of a payment-in-lieu-of-taxes agreement, the assessed value of a new plant would be in the vicinity of $1 billion, thus increasing the municipal total assessed values by about 14 percent. At the 2004 commercial rate of 11.81 mills (Massachusetts Municipal Association 2003), the estimated tax bill for the property would be $11.8 million. Local officials believe that the value of other property, especially that related to tourism, might decline in value if a new plant were built (Scott 2004), thereby offsetting at least some of this increase. The level of taxes paid would depend on the outcome of tax negotiations between Entergy and the local officials on the amount of property taxes, but could noticeably increase the property taxes collected in Plymouth County.

Summary of Social and Economic Impacts

Based on information provided by SERI, Entergy, and the staff's own independent review, the staff concludes that impacts to social and economic resources from construction and operation of new nuclear units at the Pilgrim Site would be MODERATE adverse resulting from the physical and social demands, for example, to MODERATE beneficial resulting from economy and tax base, for example.

Infrastructure and Community Services

Transportation

The general area around the Pilgrim site is served by several major highways, but site access from the south side of Plymouth is crowded (Scott 2004). The principal road access to the Pilgrim site is via Power House Road from Massachusetts Highway 3A, both of which are winding, low-speed, two-lane paved roads that pass through wooded areas.

The construction of new power units would require significant additions to the workforce. In addition, construction materials, wastes, and excavated materials would be transported both to and from the site. These activities would result in increases in operation of personal-use vehicles by commuting construction workers, in commercial truck traffic, and in traffic associated with daily operations. In addition, the level of service would significantly degrade. There are no current plans to upgrade either road. No direct rail access is available to the Pilgrim site, so large equipment would have to be offloaded and transported by road and/or barge. Pilgrim has an onsite barge slip that can be used for the transport of large loads, thereby reducing some of the burden on road access.

The Providence Regional Airport in Providence, Rhode Island, and Logan International Airport in Boston serve the area. These airports provide regular freight and passenger jet services and are of sufficient size to accommodate the relatively small air shipments normally associated with a construction project.

The impact of station operation employees on the transportation system would be less than that incurred during construction. There would be increases in operation of personal-use vehicles by commuting operators of both the existing and new units and in traffic associated with daily operations. Portions of Massachusetts Highway 3A may be affected by commuters to the plant site, particularly during shift changes. During new plant operation, the level of service on

Massachusetts Highway 3A and Power House Road would degrade, but not as significantly as during construction.

Based on a review of information provided by SERI, Entergy, and its own reconnaissance-level review, the staff concludes that the impacts of a construction workforce and related transportation of construction supplies and materials on transportation infrastructure would significantly degrade their level of service during construction. Also, it is possible that, given the heavy loads carried by vehicles transporting construction materials to the Pilgrim site, some of the roads may need repair to carry the additional load.

<u>Recreation</u>

The Pilgrim site is clearly an industrial site. However, while its current structures are not visually obtrusive from any vantage point, the Pilgrim site is quite visible to recreational boaters and from the residential neighborhoods on highlands along the shoreline to the south of the existing facilities. Any new facilities would not be able to take advantage of once-through cooling, so cooling towers would be necessary and would be visually obvious. Traditionally, visible plumes generated by the operation of cooling towers could cause a negative aesthetic effect. However, with the installation of modern drift eliminators, use of cooling towers would not create extensive, elevated visible plumes (Dominion and Bechtel 2002), so the aesthetic effect could be reduced.

<u>Housing</u>

The 2000 Census reported that over 13,100 housing units out of about 181,500 in existence in April 2000 were vacant; this amounts to a 7.3 percent vacancy rate (USCB 2004). However, over 8900 units, or 4.7 percent of the total number of units, were considered seasonal or vacation property (mostly summer residences, and most of which likely would be vacant in early April), meaning that the "true" number of vacant houses was considerably lower in Plymouth County. Low vacancy rates are currently a challenge during plant outages at the existing Pilgrim plant (Scott 2004). Given the proximity of the Pilgrim site to the Boston metropolitan area, housing for construction workers, most of whom will be coming from within the region, and the operations workforce is expected to be available, although not in Plymouth itself. The ability of the Plymouth area to supply additional housing for construction workers is limited (Scott 2004).

<u>Public Services</u>

<u>Water Supply and Waste Treatment</u>. Plymouth County has a municipal water supply system that serves the town of Plymouth and a 269-km^2 (104-mi^2) area. Permitted groundwater wells

supply this system. Water supply needs in the intermediate term can be met, but there is little excess capacity (Scott 2004).

Most of the construction workforce would come from within the region, so they already are accounted for in the demand placed on the regional water systems. The station operating workforce, while relocating to the region, would probably reside throughout the area, so they would not affect any one community or jurisdiction. Based on its independent review, the staff concludes that the impact of construction and operation on water supply treatment facilities would not be noticeable.

Police, Fire, and Medical Facilities. In the larger metropolitan area of Boston and in Plymouth itself, police, fire, and medical facilities would not be materially affected by an increase in the construction workforce. It is anticipated that many of the construction workers will already live in the region and would commute to the Pilgrim site. As a result, these workers already are being served by existing services and facilities.

It is anticipated that an unknown percentage of the operations workforce and their families will come from outside the region. Most likely they would reside throughout the region (although possibly not in Plymouth because of its limited availability of housing) and would not concentrate in any one place or jurisdiction. Should this occur, there should not be inordinate demands placed on police, fire, and medical services and facilities.

Based on its independent review, the staff concludes that the impacts of construction and operations workforce on police, fire, and medical services and facilities would be easily handled by existing capabilities. Most construction workers already live within the region. New operations workforce employees would reside throughout the region. As a result, there should be minimal new demands placed on these services and facilities by either construction or operations workers.

Social Services. Social services in the state of Massachusetts are provided in each county by the Massachusetts Department of Social Services, and a variety of other public and private social service agencies. During the construction phase at the Pilgrim site, there may be an increased demand for social services.

Generally, construction and operation of new nuclear units at the Pilgrim site would be viewed as beneficial economically to the disadvantaged population segments served by Massachusetts Department of Social Services. The construction workforce associated with the Pilgrim site would be relatively higher paid than other employment categories in the region. Construction and operation of the new units through the multiplier effect (see Section 4.5.3.1), projected by Entergy at 1260 jobs during the construction period (Entergy Nuclear 2001), may enable the disadvantaged population to improve their social and economic position by advancing to higher paying jobs. At a minimum, the expenditures of the construction and operations workforce in the counties for food, services, etc., could, through the multiplier effect, increase the number of jobs that could be filled by members of the disadvantaged population. This would have a beneficial economic impact to the economically disadvantaged population of the region, which should decrease the demand for social services. There could be an initial increase in demand for social services at the beginning of the construction period, but this is considered manageable and limited in extent.

Education

The Plymouth school system has just over 8750 students (Massachusetts Department of Education 2004a). There currently is significant overcrowding in the system (Scott 2004), and the system is ranked slightly below the median (i.e., 188 out of 320) of Massachusetts school districts in spending (Massachusetts Department of Education 2004b). In the other counties and cities of the region, it is anticipated that the construction and operations workforce would affect school infrastructure minimally. The reasons are that many construction workers already live within the region. Entergy estimates that the number of persons added to the region during construction would be 2000, 610 of whom are likely to be children (Entergy Nuclear 2001), and most of whom would not be attending Plymouth schools. The operations workforce, while coming from outside and relocating into the region, would probably reside throughout the region, thus placing little demand on school infrastructure as a result.

Summary of Infrastructure and Community Services

Based on the information provided by SERI, Entergy, and the staff's own independent review, the staff concludes that impacts on infrastructure and community services from construction and operation of new nuclear units at the Pilgrim Site would be MODERATE.

Summary of Socioeconomics

In summary, based on the information provided by SERI, Entergy, and its independent review, the staff concludes that the socioeconomic impacts of construction and operation of new reactors on the region surrounding the Pilgrim site would be SMALL, except in Plymouth County. In Plymouth County, the exceptions are as follows: the impacts on the tax base of Plymouth county during operations would be beneficial and MODERATE; the impacts on the economy of Plymouth County may be either beneficial or adverse, depending on how other sectors of the economy react, and up to MODERATE in extent; local transportation and housing availability are likely to be adversely affected and the effect is likely to be MODERATE.

8.5.2.6 Historic and Cultural Resources

The area at the Pilgrim site where new reactors would be built and operated does not appear to be the location of any historic properties (AEC 1974b). Previous archaeological surveys indicate that while sites may exist on the premises, either the sites are not eligible for listing on the National Register of Historic Places or they are located away from likely areas of new construction. Protective measures would be put in place in the event that historic or archaeological materials are discovered during construction or during operations. In the event that an unanticipated discovery is made, site personnel would be instructed to notify the State Historic Preservation Officer and would conduct an assessment of the discovery to determine if additional work is needed.

No significant differences exist between the Grand Gulf ESP site and the Pilgrim site that would make any material difference in the potential for historic properties or other important cultural sites to be adversely affected. Based on information provided by SERI, Entergy, and the staff's own independent review, the staff concludes that the impacts on historic and cultural resources at the Pilgrim Site would be SMALL.

8.5.2.7 Environmental Justice

As part of the evaluation of the potential environmental justice impacts related to the Pilgrim site, the staff used information from the U.S. Census Bureau and local interviews. There is a very limited minority population in Plymouth County. This population is concentrated in the vicinity of Brockton (NRC 2004) and makes up only about 12 percent of the total population (USCB 2004). The pathways through which the environmental impacts associated with the construction of two additional new nuclear units at the Pilgrim site could affect human populations were ascertained. The staff then evaluated whether minority and low-income populations could be disproportionately affected by these impacts. The staff found no unusual resource dependencies or practices, such as subsistence agriculture, hunting, or fishing, through which the populations could be disproportionately affected. In addition, the staff did not identify any location-dependent disproportionate impacts affecting these minority and low-income populations.

Based on the information provided by Entergy, SERI, and its own independent review, the staff concludes that the offsite impact of construction and operation of the new units at the Pilgrim site to minority and low-income populations would be not be evident. At the 2000 Census, Plymouth County had a lower percentage of low-income persons (6.6 percent) than did Massachusetts (9.9 percent), which in turn had a lower percentage than the nation (12.4 percent). However, there are a few low income block groups concentrated in Brockton and also one centered on the East Wareham-Onset area (USCB 2005). No adverse nor disproportionately high impacts were identified. Impacts in the region would be SMALL.

8.5.3 Evaluation of the FitzPatrick Nuclear Power Plant Site

This section covers the staff's evaluation of the potential environmental impacts of siting new nuclear units within the scope of the SERI PPE at the James A. FitzPatrick Nuclear Plant site (FitzPatrick).

8.5.3.1 Land Use Including Site and Transmission Corridors

Site and Vicinity

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. The area around the site and the vicinity is known as Nine Mile Point and is shared with the Nine Mile Point Nuclear Station. In the past, the land in the vicinity of the existing FitzPatrick plant was farmed, but it has been fallow since initial construction of the plant and is now second-growth forest and brush. The new ESP facility would be situated next to or just east of the existing plant. Because the site of the ESP facility would use a portion of the existing FitzPatrick site, no land would be preempted for additional facilities (SERI 2003c).

The types of impacts of new facility construction and operations (i.e., physical, ecological, social, and radiological impacts) are likely to be similar to those expected for the Grand Gulf ESP site. The FitzPatrick site is unique from Grand Gulf in that it is located within the costal zone of Lake Ontario and is subject to the Coastal Zone Management Act of 1972. Congress enacted the CZMA to address the increasing pressures of over-development upon the nation's coastal resources. At the Federal level, the National Oceanic and Atmospheric Administration administers the Act. The CZMA encourages States to preserve, protect, develop, and, where possible, restore or enhance valuable natural coastal resources such as wetlands, floodplains, estuaries, beaches, dunes, barrier islands, and coral reefs, as well as the fish and wildlife using those habitats. Participation by States is voluntary, however, the State of New York has an approved coastal zone management program. The staff assumed that SERI would comply with all provisions of the CZMA as implemented in the Lake Ontario region. Based on the information provided by SERI and the staff's independent review, the staff concludes that the land-use impacts on the site and vicinity of construction and operations would be SMALL.

Transmission Corridors

One 345-kV transmission line right-of-way runs east-southeast from the site, crossing rural forested and agricultural lands for approximately 113 km (70 mi), to a substation just north of Utica, New York. The existing transmission line right-of-way does not cross any land known to be protected or designated for special uses. Section 3.3 discusses the regulatory procedure required to link new large electrical generation facilities to the grid. The issues that could result in potential impacts of construction and operation in this transmission corridor (i.e., physical and ecological impacts) would be similar to those land-use impacts of construction and operation in the transmission corridors associated with the Grand Gulf ESP site. Therefore, the staff concludes that land-use impacts of transmission system construction and operations would be SMALL.

8.5.3.2 Water Use and Quality

Water Use

The FitzPatrick site is located adjacent to Lake Ontario. Construction activities for new nuclear units at the FitzPatrick site would have similar water usage impacts (i.e., physical and ecological impacts) as the construction at Grand Gulf and would be bounded by the operational impacts. During operation, the consumptive use of water from the cooling towers would be very small compared to the supply available in the lake. Therefore, the staff concludes that the impacts to water use and water supply at the FitzPatrick site would be SMALL.

Water Quality

Construction of new nuclear units at the site would follow best management practices and have similar water-quality impacts as the construction at Grand Gulf, and would be bounded by the operational impacts. The additional heat from the relatively small amount of blowdown water would be commingled with the discharge of the existing FitzPatrick Station. This would increase the size of the current thermal plume. Thermal and chemical discharges to Lake Ontario would be regulated by the New York State Department of Environmental Conservation via a State Pollutant Discharge Elimination System permit issued to protect the environment. Since the combined discharge represents a very small fraction of the water volume, the staff concludes that the impacts to water quality at the FitzPatrick site would be SMALL.

8.5.3.3 Terrestrial Resources Including Endangered Species

Construction Impacts

The FitzPatrick site's coastal zone is a transitional area between northern boreal forest and northeastern hardwood forest. The two ecosystems present in this coastal zone are wetlands and upland areas. The climax community is a deciduous forest with an extensive herbaceous ground cover. Much of the original mature forest land was cleared in the past for farming, and a great deal of farm land has since been abandoned. Consequently, the uplands are mostly second-growth communities in a variety of successional stages. Wetlands are attributable to relatively impermeable glacial till soils where perched groundwater lies at or near ground surface at least seasonally or during particularly wet years. Wetlands are, therefore, generally transitional and include shallow ponds, shrub swamps, wood swamps, and intermittently wet bottomland-like forests (NMPC 1983).

The FitzPatrick facility occupies the majority of the northwest quarter of the site. The northeast quarter and southern half of the site consist of forest, old fields, and remnant orchard trees. These sections of the site also contain numerous freshwater forested/shrub wetlands, fresh-water emergent wetlands, and freshwater ponds (Cowardin et al. 1979), totaling from about 24 ha (60 ac) to 32 ha (80 ac), representing an estimated 8 to 12 percent of the site. These wetlands range in size from 0.4 ha (1 ac) to 10 (24 ac), are widely scattered across the northeast quarter and the southern half of the site, and are part of the U.S. Fish and Wildlife Service (FWS) National Wetlands Inventory Database (FWS 2004c).

It is assumed that a new generating facility would be located in the northeast quarter or southern half of the site. In either of these areas, forests and old fields would be affected. Wetlands would also likely be affected because of their relatively homogenous distribution across the northeast quarter and southern half of the site. Consequently, habitat impacts from construction of a new generating facility on the site would be expected to be substantial.

The potential impacts from construction, such as erosion and dust generation, would be typical of large construction projects. These impacts could be mitigated using standard industrial procedures and best management practices. Standard practices such as silt fences to control sedimentation and water sprays to limit dust generation would protect wetlands and other ecological resources in the vicinity.

One transmission corridor, extending for a distance of approximately 113 km (70 mi) (NRC 1996) and covering 400 ha (988 ac) (NRC 1996), currently serves the FitzPatrick plant. Land cover along the transmission corridor consists of forest (63 percent); cropland and pasture (29 percent); wetlands (8 percent); and recreational areas, residential areas, and highways.

(less than one percent) (AEC 1973). It is assumed this transmission corridor would not have the capacity to carry the power generated by a new facility and that a transmission system upgrade, including new transmission lines and an additional right-of-way, would be needed. Consequently, a substantial amount of forest habitat, about 252 ha (623 ac), could be lost because of the expansion, and a substantial amount of wetland habitat could be affected.

Based on information provided by SERI, Entergy, and the staff's own independent review, the staff concludes that the impacts to terrestrial ecological resources from construction of a new generating facility at the FitzPatrick site and associated expansion of the transmission corridor would be MODERATE to LARGE.

Threatened and Endangered Species

No terrestrial animal or plant species that are Federally listed as threatened, endangered, or proposed for listing, and no associated designated or proposed critical habitat are known to occur in the vicinity of the FitzPatrick site (NYDFWMR 2004; FWS 2004d). No State-listed threatened or endangered terrestrial animal or plant species are known to occur within 3.2 km (2 mi) of the FitzPatrick site (NYDFWMR 2004).

Six State-listed threatened or endangered bird species are known to occur beyond 3.2 km (2 mi) but less than 16 km (10 mi) from the FitzPatrick site: Henslow's sparrow (*Ammodramus henslowii*), black tern (*Chlidonias niger*), northern harrier (*Circus cyaneus*), sedge wren (*Cistothorus platensis*), least bittern (*Ixobrychus exilis*), and pied-billed grebe (*Podilymbus podiceps*) (Table 8-11) (NYDFWMR 2004). Henslow's sparrow breeds and migrates in open fallow and grassy fields, sedge meadows, and pastures (NJDFW 2004a). The black tern breeds in inland marshes and sloughs with fairly dense marsh vegetation and pockets of open water (University of Michigan 2004). Northern harriers nest and feed in wet meadows, grasslands, abandoned fields, and coastal and inland marshes (MNHESP 1990e). The sedge wren inhabits wet meadows, freshwater marshes, bogs, and the drier portions of salt or brackish coastal marshes throughout the year (NJDFW 2004b). The least bittern inhabits freshwater marshes (MNHESP no date). The pied-billed grebe nests in marshes, lakes, large ponds, and other wetlands that have an abundance of marsh vegetation. They winter in open lakes and rivers, estuaries, and tidal creeks (MNHESP 1990d). Because forested wetlands are prevalent on the FitzPatrick site and along its transmission line right-of-way, the black tern, northern harrier, sedge wren, least bittern, and pied-billed grebe could occur there and could thus be affected by construction of a new generating facility and expansion of the existing right-of-way. Because old fields occur on the FitzPatrick site and cropland and pasture occur along the transmission line right-of-way, Henslow's sparrow could also occur there and could thus be affected by construction of a new facility and expansion of the right-of-way.

Table 8-11. Terrestrial State-Listed Species Occurring Greater than 3.2 Kilometers (2 Miles) but less than 16 Kilometers (10 Miles) from the FitzPatrick Site

Scientific Name	Common Name	Status[a]
Birds		
Ammodramus henslowii	Henslow's sparrow	ST
Chlidonias niger	black tern	SE
Circus cyaneus	northern harrier	ST
Cistothorus platensis	sedge wren	ST
Ixobrychus exilis	least bittern	ST
Podilymbus podiceps	pied-billed grebe	ST
Plants		
Carex chordorrhiza	creeping sedge	ST
Cypripedium arietinum	giant pine-drops	SE
Desmodium ciliare	little-leaf tick-trefoil	ST
Polygonum setaceum interjectum	swamp smartweed	SE

(a) Status rankings developed by the New York State Division of Fish, Wildlife, and Marine Resources, SE = State endangered, ST = State threatened (NYDFWMR 2004).

All the above avian species, except for the black tern, have been recognized in studies at the neighboring Nine Mile Point (NMP) Nuclear Station, its transmission corridor, and the Heritage Station site (located on Lake Ontario about 3.2 km (2 mi) southwest of NMP, which exhibits comparable wetland types and edaphic conditions) as potentially occurring in the general area. However, it is unlikely that any of these species nest on the NMP site, based on available habitat (Constellation Energy 2004). Further, these species do not appear in the results of a 1979 field survey of the Nine Mile Point Unit 2 environs that included the FitzPatrick site (NMPC 1983). It, therefore, appears unlikely these species would use the FitzPatrick site for nesting.

Four State-listed threatened or endangered terrestrial plant species are known to occur beyond 3.2 km (2 mi) but less than 16 km (10 mi) from the FitzPatrick site: creeping sedge (*Carex chordorrhiza*), giant pine-drops (*Cypripedium arietinum*), little-leaf tick-trefoil (*Desmodium ciliare*), and swamp smartweed (*Polygonum setaceum interjectum*) (Table 8-11) (NYDFWMR

2004). Creeping sedge is a wetland obligate in the northeastern United States and is known to occur in wet sphagnum bogs (USGS 2004). Giant pine-drops occurs in damp or mossy woods or bogs, in conifer, hardwood, and mixed forests, and in forested wetlands (MDCNAP 2004d). Little-leaf tick-trefoil occurs in shrub succession areas with disturbed sands (NearActica 2005). Swamp smartweed occurs on the open shores of natural lakes and less frequently in swamp forests (ODNR 1998). Because forests and forested wetlands are prevalent on the FitzPatrick site and along its transmission line right-of-way, creeping sedge, giant pine-drops, and swamp smartweed could occur there and could thus be affected by construction of a new generating facility and expansion of the existing right-of-way. It appears unlikely that little-leaf tick-trefoil would occur on the FitzPatrick site or along its transmission line right-of-way because shrub succession areas are not known from there.

Surveys conducted in 1991 and 1999 for State-listed threatened and endangered plant species at the Heritage Station site and none were found. Constellation Energy (2004) considers the results of these surveys to indicate that these plant species are unlikely to occur on the Nine Mile Point site because the habitat types present are essentially the same. It is assumed the results of the Heritage site surveys would also apply to the neighboring FitzPatrick site.

Based on information provided by SERI, Entergy, and the staff's own independent review, the staff concludes that the impacts to threatened and endangered species from construction of a new generating facility on the FitzPatrick site and possible expansion of the existing transmission corridor would be SMALL.

Operation Impacts

Impacts to terrestrial resources that may result from operation of one or more new nuclear units at the FitzPatrick site include those associated with cooling towers and transmission lines. The FitzPatrick plant currently employs a once-through cooling system, but cooling towers would be employed for a new nuclear unit(s). The impacts of cooling tower drift and bird collisions for existing power plants were evaluated previously in the GEIS (NRC 1996) and were found to be small for all plants, including those with multiple cooling towers of various types. The staff is not aware of any new information that would cause it to modify its earlier conclusions. On these bases, for the purposes of consideration of alternative sites, the impacts of cooling tower drift and bird collisions with cooling towers resulting from operation of one or more new nuclear units at the FitzPatrick site likely would be negligible.

For both natural and mechanical draft cooling towers, the anticipated noise level from cooling tower operation is anticipated to be 55 decibels at 305 m (1000 ft) (SERI 2003c). The noise level for dry cooling towers is somewhat higher. However, these noise levels are all well below the 80- to 85-decibels threshold at which birds and small mammals are startled or frightened (Golden et al. 1980). Thus, noise from operating cooling towers at the FitzPatrick site would not be likely to disturb wildlife beyond 305 m (1000 ft) from the source. Further, impacts within this distance, if any, would be considered negligible owing to the large expanses of open habitat into which mobile wildlife species could move if disturbed. Consequently, the impacts of cooling tower noise on wildlife from operation of one or more new nuclear units at the FitzPatrick site would be minimal.

The impacts usually associated with transmission line operation consist of bird collisions with transmission lines and EMF effects on flora and fauna. The impacts usually associated with transmission line right-of-way maintenance (cutting and herbicide application) are erosion/ siltation and disturbance of wildlife habitat. It is reasonable to assume that right-of-way maintenance would be conducted where and how it currently is, only in a wider right-of-way, and that electromagnetic field effects would not change except that they would occur a wider area. Further, the addition of new transmission lines within the same corridor would likely present few new opportunities for bird collisions which would not cause a measurable reduction in local bird populations. These effects (i.e., bird collisions with transmission lines, EMF effects on flora and fauna, and effects of cutting and herbicide application in rights-of-ways) were evaluated previously in the GEIS (NRC 1996) and were found to be small for all plants, including those with transmission corridors of various widths and numbers of transmission lines. The staff is not aware of any new information that would cause it to modify its earlier conclusions. Based on the above rationale and the associated conclusions presented in GEIS (NRC 1996), the effects of transmission line operation and right-of-way maintenance from one or more new nuclear units at the FitzPatrick site would be negligible.

The staff reviewed the operation of one or more nuclear units at the FitzPatrick site, including the associated heat dissipation system and transmission line operation and right-of-way maintenance. Based on information provided by SERI, Entergy, and its own independent review, the staff concludes 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.

8.5.3.4 Aquatic Resources Including Endangered Species

Construction and Operation Impacts

The aquatic resources near the FitzPatrick ESP site would not be expected to be affected by the construction and operation of a new nuclear facility and associated cooling towers. The existing intake structure in Lake Ontario would be sufficient for additional water withdrawals for proposed cooling towers. This system includes an acoustic deterrent system on the intake structure to discourage fish from approaching the inflow region, an approach that is considered best available technology for discouraging impingement of aquatic organisms. Discharges to Lake Ontario would not increase substantially because of operation of the new facility and would use closed-cycle cooling. Impingement, entrainment and heat shock from the current system are not expected to increase substantially for the operation of the new nuclear unit. Based on information provided by SERI, Entergy, and its own independent review, the staff concludes that the overall impacts on aquatic ecological resources from construction and operation of one or more new nuclear units and associated cooling towers at the FitzPatrick ESP site would be SMALL.

Threatened and Endangered Species

No federally listed or proposed threatened and endangered species are found within the vicinity of the FitzPatrick site. The FWS and NOAA Fisheries did not identify any Federally listed threatened or endangered species, except for the occasional transient individual, in the vicinity of the FitzPatrick site (FWS 2004d; NMFS 2004).

The New York State Division of Fish, Wildlife, and Marine Resources (2004) has listed three species of fish that are listed as endangered that might be in the region of the FitzPatrick site: lake sturgeon (*Acipenser fulvescens*), deepwater sculpin (*Myoxocephalus thompsoni*), and round whitefish (*Prosopium cylindraceum*) (Table 8-12). Mature adult lake sturgeon average between 0.9-1.5 m (3-5 feet) in length and 4.5-30 kg (10-80 pounds) in weight. They have a torpedo-shaped body and a sharp, cone-shaped snout. The top and side bony plates (called scutes) are the same color as the dull grey body. Lake sturgeon spawn in the spring from May-June in areas of clean, large rubble such as along windswept rocky shores of islands and in rapids in streams. Lake sturgeon are bottom feeders, eating leeches, snails, clams, other invertebrates, small fish, and even algae. The cause for the decline of lake sturgeon in Lake Ontario is uncertain. New York Department of Environmental Conservation has been trying to reestablish populations of lake sturgeon in selected tributaries of Lake Ontario (NYDEC 2003b).

The deepwater sculpin ranges from 0.05-0.12 m (2 to 4.7 in.) in length, and is New York's largest sculpin species. The fish has a long, tapered body, a blunt snout and a flat head. The deepwater sculpin spawns year round and is usually found in cold water. The fish is found in deep, cool waters. It was abundant in Lake Ontario until 1980, and was considered extirpated from this lake until it was collected in the late 1990s. The cause of the sculpins' population decline is unknown but may be related to competition and predation with alewives (*Alosa pseudoharengus*) and rainbow smelt (*Osmerus mordax*) (NYDEC 2003a).

Round whitefish are a medium-sized fish, averaging 0.2-0.3 m (8-12 in.) in length. The shape of the fish is long and tubular with a nearly round midsection (hence its name). Round whitefish

Table 8-12. State-Listed Threatened or Endangered Aquatic Species Reported Within a 16-Kilometer (10-Mile) Radius of the FitzPatrick Site

Scientific Name	Common Name	Status[(a)]	Distance from the River Bend Site[(b)]	Source
Fish				
Acipenser fulvescens	lake sturgeon	SE	16 km (10 mi)	NYDFWMR 2004
Myoxocephalus thompsoni	deepwater sculpin	SE	16 km (10 mi)	NYDFWMR 2004
Prosopium cylindraceum	round whitefish	SE	16 km (10 mi)	NYDFWMR 2004

(a) Status rankings developed by the New York State Division of Fish, Wildlife, and Marine Resources, SE = State endangered, ST = State threatened (NYDFWMR 2004).

are bottom feeders, and they eat a variety of invertebrates, small fish, and fish eggs. Round whitefish spawn in the fall (November-December) over gravel shoals of lakes or at river mouths (NYDEC 2003c).

None of these State-listed endangered fish species have been reported in the extensive lake sampling and impingement monitoring efforts at FitzPatrick, nor at the nearby Nine Mile Point Nuclear Station and Oswego Steam Station. The lake sampling efforts were conducted through the 1970s until 1981. The impingement and entrainment studies have been conducted through 1997 (NMPNS 2004a).

Based on the information provided by SERI, Entergy, and the staff's independent review, the staff concludes that the overall impact on threatened and endangered aquatic species from construction and operation of one or more new nuclear units and associated cooling towers at the FitzPatrick ESP site would be SMALL.

8.5.3.5 Socioeconomics

In evaluating the socioeconomic impacts of construction at the FitzPatrick site, Entergy undertook a "reconnaissance" survey of the site using readily obtainable data from the Internet or published sources. The staff conducted some local interviews with knowledgeable local officials. No new data were collected. The socioeconomic subsections follow the organizational structure of the socioeconomic discussions in Sections 2.8, 4.5, and 5.5. The impacts expected from both construction and station operation are discussed.

Physical Impacts

Construction activities can cause temporary and localized physical impacts such as noise, odor, vehicle exhaust, vibration, shock from blasting, and dust emissions. The use of public roadways, railways, and waterways would be necessary to transport construction materials and equipment. However, extensive work is planned to the existing roads or railways, and new routes are being built to reduce existing bottlenecks in the regional highway system, so no physical impacts on the existing road net are expected. It is expected that all construction activities would occur within the existing FitzPatrick site. Offsite areas that would support construction activities (borrow pits, quarries, and disposal sites, for example) are expected to be already permitted and operational. Impacts on those facilities from construction of the new units would be a small incremental impact associated with their normal operation.

Potential impacts from station operation include noise, odors, exhausts, thermal emissions, and visual intrusions. The new units would produce noise from the operation of pumps, dry tower fans, transformers, turbines, generators, and switchyard equipment, and noise from traffic. New York regulations or guidelines regarding noise limits were revised February 2, 2001 (NYDEC 2001). SERI states in its environmental report (SERI 2003c) that any noise coming from the Grand Gulf site would be controlled in accordance with applicable local county regulations. By inference, this is also expected to apply to the FitzPatrick site. Commuter traffic would be controlled by speed limits. Good road conditions and appropriate speed limits would minimize the noise level generated by the workforce commuting to the ESP site (SERI 2003c).

The new units would have standby diesel generators and auxiliary power systems. Permits obtained for these generators would ensure that air emissions are in compliance with regulations. In addition, the generators would be operated on a limited, short-term basis. During normal plant operation, the new units would not use significant quantities of chemicals that could generate odors that exceed olefactory threshold values. Good access roads and appropriate speed limits would minimize the dust generated by the commuting workforce (SERI 2003c).

Construction activities would be temporary and would occur mainly within the boundaries of the FitzPatrick site. Offsite impacts would represent small incremental changes to offsite services that support the construction activities. During station operations, noise levels would be managed to local ordinances. Air quality permits would be required for operation of the diesel generators, and chemical use would be limited, which should limit odors. Based on the information provided by SERI and its own independent review, the staff concludes that the physical impacts of construction and operation would be SMALL.

Demography

The population base potentially affected is considered to be the population of significant population centers within 80 km (50 mi) of the FitzPatrick site. The population of Oswego County is about 122,000 (USCB 2004). The estimated population within 80 km (50 mi) of the FitzPatrick site is slightly over 943,000 (NRC 2004). The populations of the 10 counties within 80 km of the James A. FitzPatrick site are projected to decline by approximately 6 percent by the year 2030 (NYSIS 2002).

Most (70 percent) of the estimated construction workforce of 3150 is expected to come from within the region, and those who might relocate to the region would represent a small percentage of the larger population base. While the station operation workforce is expected to relocate into the region, their numbers are small (1160 new operating employees and their families) when compared to the total base population, and their locations of residence would probably be distributed throughout the region. Based on the information in SERI's environmental report (SERI 2003c), the Early Site Permit Selection Committee Notebook (Entergy Nuclear 2001) prepared by Entergy, and its own independent review, the staff concludes that any increase in the population within an 80-km (50-mi) radius of the region because of construction and operation would not be noticeable, and the impacts would be SMALL.

Social and Economic Impacts

<u>Economy</u>

The FitzPatrick site is located in an economic area of New York that is in the process of reinvention and renewal that is organized around clusters of businesses in energy, health care, manufacturing, and outdoor recreation. The Syracuse labor market area (Oswego, Onodaga, Cayuga, and Cortland Counties) has an unemployment rate of 5.3 percent in August 2004, while the unemployment rate in Oswego County is somewhat higher at 7.7 percent (NYDL 2004). The economy within the an 80-km (50-mi) radius of the FitzPatrick site is diverse and mature, with major manufacturing employment in paper and primary metals and service companies in many sectors. The Oswego area has lost several major manufacturing plants over the past few years (for example, Néstle in 2003), and community leaders are now working hard to replace these jobs and further diversify the local economy. The local economic development leaders consider additional nuclear units at the FitzPatrick site to be highly compatible with the current economy and their economic plans for the county (Scott 2004). Regionally, the service sector now offers the most employment opportunities. The construction and operation of two new nuclear units at the FitzPatrick site would be expected to add to the prosperity of the region, especially Oswego County.

Based on the information provided by SERI, Entergy, and its own independent review, the staff reviewed the impacts of station construction and operation on the economy of the region and concludes that the impacts would only be significant in Oswego County where the impacts could be positive and noticeable. Much of the economic impacts would be diffused in the larger economic bases of the central New York region. With the smaller economic base of Oswego County, the economic impacts would be more noticeable.

SERI estimates it would take 3150 construction workers more than 5 years to build two new nuclear units at the FitzPatrick site (SERI 2004a). Entergy is expected to be able to attract the necessary workforce for construction activities at the site because of its proximity to the major population center of Syracuse, with additional workers available in the Watertown, Utica-Rome, and Rochester areas. The availability of craft workers for regular construction projects of longer duration is reported to be good. In the year 2002, about 12,500 construction workers were employed in the Syracuse labor market area, with several thousand more located within an 80-km (50-mi) radius of the FitzPatrick ESP site (NYDL 2004).

The addition of new units would require an increase in the operations workforce of approximately 1160 employees. Currently, approximately 700 permanent employees work at the FitzPatrick site (SERI 2004d). In its site comparison study, Entergy did not state what percentage of the operations labor force for the new units would relocate from outside the region (Entergy Nuclear 2001). Some nuclear sites are reducing their workforces as they change missions, and workers from these sites could be potential pools of labor for the operating workforce at the new FitzPatrick reactors.

Construction labor would be readily available from within the region, and there should be little problem recruiting the required labor skills to enable construction of the nuclear units at the FitzPatrick site. Much of the operations workforce likely would already be in the region.

Taxes

Construction and operations workers would pay income, sales, and use taxes to New York and the local governments in the region where sales take place, and property taxes to the counties and school districts in which they own a residence. Sales and use taxes would be applied to the sales of construction materials and supplies purchased for the project and to purchases made by the construction and operations workforce for goods and services. SERI has made no estimate of the day-to-day expenditures that would be made in the region during construction. During operations, the current plant generates about $150,000 per year in sales and use taxes (Oswego County Business Magazine 2001). Corporate income taxes on profits would also be paid by companies engaged in construction at the site.

New York has no personal property tax (Empire State Development 2002), so no tax would be paid by companies on the value of equipment used during construction of any new nuclear units at the site. The local property tax impact is the real property taxes levied for the incremental increase in value to the entire site from the operation of the additional units. The increase in value would depend on how the eventual agreements on assessed value are reached. It is expected that Oswego County, the town of Scriba, and the Mexico School District would be the only beneficiaries of the these taxes. Entergy currently has a significant impact on the tax base of Oswego County, paying $436,000 to the town of Scriba (out of a budget of roughly $4.2 million), $2.9 million to Oswego County (out of $50 million total property taxes and payments in lieu of taxes and $150 million total revenues raised), and $3.9 million to the Mexico School District (out of $9.1 million from local sources and $31.7 million total from 2001 to 2002) (SERI 2004e; NMPNS 2004b; Oswego County 2004; NYSED 2004).

Based on the information provided by SERI, Entergy, and its own independent review, the staff concludes that the overall impacts from construction and operation of taxes collected through the income, sales and use, and property taxes would be noticeable in Oswego County, Mexico School District, and town of Scriba, but not noticeable elsewhere. The taxes paid, while substantial, are nevertheless a small sum when compared to the total amount of taxes collected by New York and local governments in the 80-km region surrounding the site. Depending on the outcome of tax negotiations between Entergy and the State of New York on the amount of property taxes, the staff considers the overall impacts of the property taxes collected in Oswego County would be significant and beneficial relative to the total amount of taxes the county collects through property taxes.

<u>Summary of Social and Economic Impacts</u>

Based on information provided by SERI, Entergy, and the staff's own independent review, the staff concludes that impacts to social and economic resources from construction and operation of new nuclear units at the FitzPatrick site would be SMALL adverse to MODERATE beneficial.

Infrastructure and Community Services

<u>Transportation</u>

The general area around the FitzPatrick site is served by several major highways, including Interstate 90, Interstate 81, and State Highway 481. Oswego is about a 10-minute drive from the site on good, straight, two-lane roads. The principal road access to the FitzPatrick site is via County Roads 1 and 1A (Lake Road), which is a two-lane paved road.

The construction of new reactors would require additions to the workforce. In addition, construction material, waste, and excavated material would be transported both to and from the site. These activities would result in increases in operation of personal-use vehicles by commuting construction workers, in commercial truck traffic, and in traffic associated with daily operations.

Although neither State nor local governments have level-of-service information for county roads in the State of New York, a capacity analysis of area intersections was performed as part of the application for Certification of a Major Generating Facility Under Article X of the New York State Public Service Law for the proposed Heritage Station, approximately two miles west of the neighboring Nine Mile Point nuclear site. In the study, the average count for the segment of County Road 1A from County Road 1 to Lakeview Road was 4900 in 1995. Level-of-service ratings of the approaches for the two intersections closest to the Nine Mile Point site along County Road 1A for peak use hours ranged from "A" to "C," with one approach having an "F" rating; however, the majority of approaches carried an "A" or "B" rating (NMPNS 2004c). The level-of-service designation on nearby county roads would likely be degraded (as individual users are significantly affected by interactions with the traffic stream) during the peak construction period for new nuclear reactors at the FitzPatrick site.

Direct rail access is available from CSX Corporation to the FitzPatrick site, so large equipment and bulk deliveries could be sent via that mode of transportation. There is also a barge slip at the site that also could be used for large equipment

The Oswego County Airport and the Syracuse-Hancock International Airport serve the area. The airport in Syracuse provides regular freight and passenger jet services and is of sufficient size to accommodate the relatively small air shipments normally associated with a construction project.

The impacts of station operation employees on the transportation system would be less than that incurred during construction. There would be increases in operation of personal-use vehicles by commuting operators of both the existing and new units and in traffic associated with daily operations. Portions of County Road 1, County Road 1a, and New York State Route 104 may be affected by commuters to the plant site, particularly during shift changes. No level-of-service or traffic count information appear to be readily available for these roads in the vicinity of the FitzPatrick site. County Road 1 was recently upgraded. Route 104 to New Haven and the town of Mexico is due to be upgraded in 2007 to remove current congestion (Scott 2004). A degraded level of service indicates that the freedom to select speed or freedom to maneuver is diminished.

Based on a review of information provided by SERI, Entergy, and its own reconnaissance-level review, the staff concludes that the impacts of a construction workforce and related transportation of construction supplies and materials on the transportation infrastructure at the FitzPatrick site would be noticeable but temporary. Some of the local roads could have their level of service degraded during construction. Much of the Oswego County road network has been improved for heavy trucks; however, if heavy loads are carried by vehicles transporting construction materials to the FitzPatrick site, some of the roads may need additional repair. The impacts of the operations workforce and related transportation impact likely would be less. There may be some minor congestion at shift changes.

Recreation

The FitzPatrick site is clearly an industrial site with nearby lake and state park recreation. The Nine Mile Point reactor site (nearby) already has cooling towers, so new towers would not create much of a change. Traditionally, visible plumes generated by the operation of cooling towers could cause a negative aesthetic effect on recreation. However, with the installation of modern drift eliminators, use of cooling towers would not create extended, elevated visible plumes (Dominion and Bechtel 2002), so the aesthetic effect could be reduced. Based on the information provided by SERI, Entergy, and its own independent review, the staff concludes that the impact of construction and operation on aesthetics in the vicinity of the FitzPatrick site would not be significant.

Housing

Of the 3150 construction workers needed to build two new nuclear units at the FitzPatrick site, SERI expects that virtually all would be available from the major nearby population centers of Syracuse, Watertown, Utica-Rome, and Rochester (SERI 2004a). A 13.8 percent vacancy rate out of a total 52,800 housing units existed in Oswego County at the 2000 Census (USCB 2004). The housing market in the Oswego area has been "soft" since about 1993 (Scott 2004). Given the proximity of the FitzPatrick site to the Oswego metropolitan area, housing for any additional construction workers, most of whom will be coming from within the region, and the operations workforce is expected to be available. During operations, Oswego County and the Oswego area could easily support additional housing (Scott 2004).

Based on the information provided by SERI, Entergy, and its own independent review, the staff concludes that the impacts of a construction and operations workforce on the demand for housing and housing availability would be modest positive development in what is currently a soft housing market. The conclusion is based on approximately 7300 vacant housing units in Oswego County, existing construction plans, and the proximity of the FitzPatrick site to the larger Syracuse metropolitan area.

Public Services

Water Supply and Waste Treatment. There are 29 public water districts in Oswego County. These districts cover the cities of Fulton and Oswego and the towns of Central Square, Cleveland, Mexico, Phoenix, Pulaski, Sandy Creek, and Lacona, as well as portions of the surrounding towns. The total population served is over 50,870, which is over 40 percent of the total population of the county (the remainder use private wells). These districts obtain their water from a variety of sources, including directly from Lake Ontario, local wells, and water purchased from the Onondaga County Water Authority. The main water sources for the public water districts are Lake Ontario and a variety of groundwater aquifers and associated springs (Oswego County Department of Planning and Community Development 2000). While there are districts close to their capacity, in general the decline of manufacturing in the county and several additions to capacity over the years mean that substantial excess capacity is available.

Most of the construction workforce would come from within the region, so they are already accounted for in the demands being placed on the local water systems. The station operating workforce, while relocating to the region, would probably reside throughout the region, so they would not particularly affect any one community or jurisdiction. Based on its independent review, the staff concludes there would be no noticeable impact of construction and operation on water supply treatment facilities.

Police, Fire, and Medical Facilities. In the larger metropolitan area of Oswego County, and the towns of Texas, Mexico, Syracuse, and in nearby Oswego itself, police, fire, and medical facilities would not be affected materially by an increase in the construction workforce. Many of the construction workers are anticipated to live in the region already and would commute to the FitzPatrick site. As a result, these workers are being served by existing police, fire, and medical services and facilities already.

An unknown percentage of the approximately 1160 operations workers and their families is anticipated to come from outside the region. Most likely they would reside throughout the region and would not concentrate as a group in any one place or jurisdiction. As such, should this occur, there should not be any significant additional demands placed on these services and facilities.

Social Services. A variety of social services in New York are provided in each county by the New York Department of Family Assistance, Office of Mental Health, Office for the Prevention of Domestic Violence and others (New York State Citizen Guide 2005). During construction at the FitzPatrick site, there may be an increased demand for some social services.

Generally, construction and operation of new nuclear units at the FitzPatrick site would be viewed as beneficial economically to the disadvantaged population segments served by the New York Department of Social Services. The new workforce that would be associated with the FitzPatrick site would be relatively higher paid than workers in other employment categories in the region. Construction and operation of the new units, through the multiplier effect (see Section 4.5.3.1), may enable the disadvantaged population to improve their social and economic position by moving up to higher paying jobs. At a minimum, the expenditures of the construction and operations workforce in the counties for goods and services could, through the multiplier effect, increase the number of jobs that could be filled by members of the disadvantaged population. Noticeable new demand for social and related services as a result of construction and operation of the new facility is unlikely. Construction and operation would have a beneficial impact to the economically disadvantaged population of the region, which should lessen the demand for social services. There could be an initial increase in demand for social services at the beginning of the construction period, but this increased demand is considered manageable and limited.

Education

The 10 Oswego County school systems have just over 25,300 students, and private schools enroll another 460 students (NCES 2004a). The school districts for the city of Oswego and the town of Mexico in particular have taken advantage of recently conferred payments in lieu of taxes on the existing FitzPatrick and Nine Mile Point nuclear plants to upgrade facilities. There currently is no overcrowding in the systems, and the Oswego and Mexico school systems enjoy some of the lowest teacher-to-student ratios in the State of New York, high standardized test performance (top 10 in New York State), and excellent facilities (Scott 2004). In the other counties and cities of the region, it is anticipated that the construction and operations workforce would minimally impact school infrastructure. The reasons are that many construction workers already live within the region. Entergy estimates that new population in the region during construction would be 2360 (Entergy Nuclear 2001), of whom 661 are likely to be children. The operations workforce, while moving from outside and relocating into the region, would probably be distributed throughout the region, thus placing little demand on school infrastructure as a result.

It is anticipated that most of the construction workforce would come from within the area and would not relocate their families. Those construction and operations workers potentially relocating to the region would most likely reside throughout the region and, as a result, would not be in sufficiently concentrated groups to place an undue burden on the existing infrastructure.

<u>Summary of Infrastructure and Community Services</u>

Based on information provided by SERI, Entergy, and the staff's own independent review, the staff concludes that impacts on infrastructure and community services from construction and operation of new nuclear units at the FitzPatrick site would be SMALL to MODERATE.

Summary of Socioeconomics

In summary, based on the information provided by SERI, Entergy, and its independent review, the staff concludes that the socioeconomic impacts of the construction and operations on the region surrounding the FitzPatrick ESP site would be SMALL with the following exceptions. The impacts on the economy of Oswego County would be MODERATE beneficial, and the impacts on the tax bases of the three nearest taxing jurisdictions would be SMALL beneficial to MODERATE beneficial during construction and MODERATE beneficial during operations. The impacts on transportation near the plant during construction would likely be MODERATE adverse during construction. Some additional transportation upgrades may be necessary.

8.5.3.6 Historic and Cultural Resources

The footprint for proposed new reactors at the FitzPatrick site does not appear to have any historic properties located within areas that are likely to be affected by new construction and operation. Previous investigation indicate that no historic properties exist on the site (AEC 1973). Protective measures would be implemented in the event that historic or archaeological materials are discovered during construction or during operations. In the event that an unanticipated discovery is made, site personnel would be instructed to notify the State Historic Preservation Officer and would consult with him or her in conducting an assessment of the discovery to determine if additional work is needed.

There are no significant differences between the Grand Gulf ESP site and the FitzPatrick site that would make any material difference in the potential for historic properties or other important cultural sites to be adversely affected. Based on information provided by SERI, Entergy, and its own independent review, the staff concludes that the impacts would be SMALL.

8.5.3.7 Environmental Justice

As part of the evaluation of the potential environmental justice impacts related to the James A. FitzPatrick site, the staff used information from U.S. Census Bureau (USCB 2004), SERI (2003b), Entergy Nuclear (2001), interviews with local officials (Scott 2004), and its own independent review of local conditions. The Oswego County area has relatively few minority residents (3.5 percent of the population), and no concentrations of minority residents. Concentrations of minority residents within 80 km are mostly found at some distance from the FitzPatrick site, in the Syracuse and Rome-Utica areas. There are two (non-minority) low-income census block groups within the city of Oswego, but no others in the county. The pathways through which the environmental impacts associated with the construction of two additional new nuclear units at the FitzPatrick site could affect human populations were ascertained. The staff then evaluated whether minority and low-income populations could be disproportionately affected by these impacts. The staff found no unusual resource dependencies or practices, such as subsistence agriculture, hunting, or fishing, through which the populations could be disproportionately affected. In addition, the staff did not identify any location-dependent disproportionate impacts affecting these minority and low-income populations.

Based on the information provided by Entergy, SERI, interviews, and its own independent review, the staff concludes that the offsite impacts of construction and operation of the new units at the FitzPatrick site to minority and low-income populations would be SMALL. No adverse nor disproportionately high impacts were identified.

8.5.4 Generic Impacts Consistent Among Alternative Sites

In evaluating the alternative sites, the staff found certain impact categories would not vary among sites, and, as a result, would not affect the evaluation of whether an alternative site is environmentally preferable to the proposed site. These areas include air quality; nonradiological and radiological effects on members of the public, workforce, and biota; and postulated accidents. As a result, the impacts of these four areas are not evaluated as part of the site-specific alternatives analysis. Instead they are discussed generically in the following subsections.

8.5.4.1 Air Quality Impacts

Some minor impacts to air quality are likely to occur during construction at the Grand Gulf ESP site or any of the alternative ESP sites. The impacts will result from fugitive dust emissions from general construction activities. Elevated ambient air quality levels might also result from the automotive emissions of workforce traffic and emissions from construction equipment. These impacts, which are discussed in Section 2.3.2, are not likely to vary significantly among the Grand Gulf ESP site and the three alternative sites. In its environmental report, SERI (SERI 2003c) stated with respect to construction at the proposed ESP site that "... controls would be initiated to keep air emissions within applicable government standards during construction." Although the environmental report does not address the impacts of construction at the alternative sites on air quality, the staff would expect SERI to make a similar commitment for construction at any site. Controls discussed include dust emission controls, burning controls, and engine emission controls.

Air quality at the Grand Gulf ESP site, the FitzPatrick Nuclear Power Plant, and the River Bend Station alternative sites is good. None of these sites is in an area that is designated as in nonattainment of National Ambient Air Quality Standards for any of the criteria air pollutants (40 CFR Part 81). The staff concludes that the impacts of construction activities on air quality at these sites would be SMALL because of the limited duration of the construction activities and the use of best management practices to limit dust and emissions.

The area around the Pilgrim Nuclear Station alternative site is designated nonattainment for both the 1-hour and 8-hour ozone standards. Ozone is associated with emissions from vehicles. Federal agencies are required by 40 CFR Part 93 to prepare a written conformity analysis where the total of direct and indirect emissions caused by a proposed Federal action would exceed established threshold emission levels in a nonattainment area. Estimation of direct and indirect emissions is beyond the scope of reconnaissance-level information. For the purpose of evaluating alternative sites, the staff assumes that the construction work force for the Pilgrim Nuclear Station alternative site would come from the local area because of the relatively large population of the area. Consequently, construction of the ESP facility at the Pilgrim Nuclear Station site would not result in a large increase in vehicle emissions in the area. On this basis, the staff concludes that the impacts of construction at the Pilgrim Nuclear Station site would also be SMALL.

The air quality impacts from operating the ESP facility at the proposed site or at any of the alternative sites would be limited to those resulting from operation of wet cooling towers and pollutant emissions from periodic operation of auxiliary boilers and generators. The impacts, which are discussed in Section 5.2 of this report, would be similar at the four sites. SERI would require approval under the existing Federal, State, or local air quality laws and regulations.

8.5.4.2 Nonradiological Health Impacts

Nonradiological health impacts from construction of the proposed unit(s) on the construction workers at all the alternative sites would be similar to those evaluated in Section 4.8. The impacts would include noise, odor, vehicle exhaust, and dust emissions. Plant construction would be in compliance with all applicable State regulations regarding fugitive dust emissions and air pollution control. Two out of three of the alternative sites (River Bend Station and FitzPatrick Nuclear Power Plant) are in rural areas, and construction impacts would be minimal on the surrounding population. For the third site, Pilgrim Nuclear Station, mitigative actions can be taken to minimize the impacts of construction on the population. The staff concludes that health impacts to construction workers and the public resulting from the construction of the new unit(s) at any of the alternative sites would be SMALL.

Occupational health impacts to operational employees would be the same for all the alternative sites. Thermophilic microorganisms would not be a concern at alternative sites for any facilities using either type of cooling towers. Health impacts to workers from noise and electromagnetic fields would be similar among the sites. Noise and electromagnetic fields would be monitored and controlled in accordance with applicable U.S. Occupational Safety and Health Administration regulations. The staff concludes that the occupational health impacts to construction or operations employees of proposed units at any of the alternative sites are expected to be SMALL.

With respect to transmission systems, the potential exists for impacts to members of the public from operation of the transmission system in terms of electrical shock, electromagnetic field exposure, noise, and aesthetics. The impacts at the alternative sites would be similar to that evaluated in Section 5.8. All transmission lines, either constructed or used as part of an existing nuclear site, must meet standards established by the most current version of the National Electrical Safety Code (NESC) (IEEE 2001). The standard is applicable to the systems and equipment operated by utilities. The areas of particular interest are the potential to create an electric shock that could disrupt the operation of pacemakers and health-assistance devices, and the potential for chronic exposure to electromagnetic fields associated with the transport of electric current through large conductors, such as high-voltage transmission lines.

Acute Effects of Electromagnetic Fields

Currently, NESC requires the design of transmission lines be such that electrostatic effects from operation do not create a steady-state current that exceeds 5 mA root mean square to limit the potential for electric shock. For the alternative sites considered, NESC requirements for preventing electric shock from induced current would be met, and the impacts to the public would be insignificant. However, this would need to be verified upon selection of an alternative site, reactor type, and condition and capacity of the transmission system.

Chronic Effects of Electromagnetic Fields

There is considerable scientific debate regarding the potential impacts from exposure to 60-Hz electromagnetic fields resulting from energized transmission lines. The potential for chronic effects from these fields continues to be studied and consensus results are still outstanding. The National Institute of Environmental Health Sciences (NIEHS) directs related research through the DOE. A recent report (NIEHS 1999) contains the following conclusion:

> The NIEHS concludes that ELF-EMF (extremely low frequency-electromagnetic field) exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In our opinion, this finding is insufficient to warrant aggressive regulatory concern. However, because virtually everyone in the United States uses electricity and is exposed to ELF-EMF, passive regulatory action is warranted such as a continued emphasis on educating both the public and the regulated community on means aimed at reducing exposure. The NIEHS does not believe that other cancers or non-cancer health outcomes provide sufficient evidence of a risk to currently warranted concern.

This statement is not sufficient to cause the staff to consider the potential impact as significant to the public, but the staff will continue to follow developments on this issue.

8.5.4.3 Radiological Health Impacts

Exposure pathways for gaseous and liquid effluents from the proposed new unit(s) at the Grand Gulf ESP site would be similar for the alternative locations. Gaseous effluent pathways would include external exposure to the airborne plume, external exposure to contaminated soil, inhalation of airborne activity, and ingestion of contaminated agricultural products. Liquid effluent pathways would include ingestion of aquatic foods, ingestion of drinking water, external exposure to shoreline sediments, and external exposure to water through boating and swimming.

Radiation Doses and Health Impacts to Members of the Public

Section 5.9 provides an estimate of doses to the maximally exposed individual and the general population for the Grand Gulf ESP site during routine operations for both the liquid effluent and gaseous effluent pathways. The same bounding liquid and gaseous effluent releases would be used to evaluate doses to the maximally exposed individual and the population at each alternative site. However, there would be differences in the estimated doses at each of the sites. The differences would be caused by the use of site-specific atmospheric and water dispersion data, different exposure pathways, and site-specific population data used in the dose calculations.

Section 4.9 shows that the estimated dose to the maximally exposed individual (occupational workers during construction) at the Grand Gulf ESP site would be well within the design objectives of 10 CFR Part 50, Appendix I. Considering the differences in pathways analyzed, atmospheric and water dispersion factors, and population size, doses estimated to the maximally exposed individual for the alternative sites would also be expected to be well within the design objectives in Appendix I of 10 CFR Part 50. Population doses within 80 km (50 mi) of those alternative sites that are closer to major population centers (such as Pilgrim Nuclear

Station) would be higher than for the Grand Gulf ESP site; however, the dose would still be small compared to the population dose from natural background radiation.

Based on the evaluation submitted by SERI (2003a) and its own independent evaluation, the staff concludes that annual doses to the public from the proposed system would be well within regulatory limits, and there would be no observable health impacts to the public from construction and normal operation of new nuclear units at the Grand Gulf ESP site or at any of the alternative sites. Therefore, the staff concludes that radiation doses and resultant health impacts from operation of the proposed new reactors at the alternative sites is expected to be SMALL.

Occupational Doses to Workers

Occupational doses would be approximately the same for workers at nuclear facilities at any of the alternative sites. The same (accumulated) annual occupational dose estimates of 150 person-Sv (150 person-rem) would be expected for all the proposed units regardless of the site location. The advanced reactor design proposed for construction and operation at the ESP site would result in less annual occupational exposure than that received by workers at currently operating reactors. The staff concludes that the occupational radiation doses from operation of the proposed ESP facility at the alternative sites would be SMALL.

Impacts to Biota

Table 5-9 provides the annual whole body dose estimates to surrogate biota species for the proposed new unit(s) at the Grand Gulf ESP site. The limits specified in 40 CFR Part 190 apply to members of the public in unrestricted areas, not specifically to biota. The Grand Gulf dose estimates are conservative because they do not consider any dilution or decay of liquid effluents during transit. Actual doses to biota are likely to be much less. The staff reviewed the available information relative to the radiological impact on biota, other than man, and performed an independent estimate of dose to the biota. The staff concludes 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. The staff also concludes that impacts to biota of radiation doses from the operation of new reactors at the alternative sites would be SMALL.

8.5.4.4 Postulated Accidents

A suite of design-basis accidents (DBAs) has been considered for new nuclear units at the Grand Gulf ESP site. The evaluation involved calculation of doses for specified periods at the exclusion area and low population zone boundaries, and comparison of those doses with doses based on regulatory limits and guidelines. Similar analyses have not been conducted for the alternative sites. Had such evaluations been conducted, the differences in the results would only have resulted from meteorological conditions and the distances to the site boundaries. The release characteristics would have been the same at all sites.

For the Grand Gulf ESP site, the doses for each accident sequence considered were well below the corresponding regulatory limits and guidelines. The Grand Gulf ESP site and the three alternative sites have similar climatological settings (mid-latitude, non-tropical, gently rolling terrain) and are sufficiently similar that it is highly unlikely that differences in local meteorological conditions would be sufficient to cause doses from DBAs for new nuclear units at any of the alternative sites to exceed regulatory limits or guidelines. Similarly, because each of the alternative sites is located at a nuclear reactor site, it is unlikely that differences in distances to the exclusion area and low population boundaries would be sufficient to cause doses from DBAs for new nuclear units at any of the alternative sites to exceed regulatory limits or guidelines. Therefore, the staff concludes that for the purposes of consideration of alternative sites, the impacts of DBAs at each of the alternative sites are SMALL.

A detailed analysis of the potential consequences of severe accidents for the postulated plants has been conducted for the Grand Gulf ESP site. Similar analyses have not been conducted for the alternative sites. Had such evaluations been conducted, subtle differences in the results would result from site-specific factors such as meteorological conditions, population distribution, and land-use distribution. The release characteristics would have been the same at all sites.

The probability-weighted consequences estimated for severe accidents for a new nuclear unit at the Grand Gulf ESP site are well below the consequences estimated for severe accidents at current generation reactors (see Section 5.10). For the purposes of license renewal, the staff has determined the probability-weighted consequences of severe accidents is SMALL for all existing plants (10 CFR 51, Subpart B, Table B-1). On this basis, the staff concludes that, for the purposes of consideration of alternative sites, the impacts of severe accidents at each of the alternative sites would be SMALL.

8.5.4.5 Hydrological Alterations

Construction of any major industrial facility would alter the local patterns of surface water runoff and groundwater recharge. Detailed designs are not available for an ESP facility at the alternative sites. However, because of hydrologic changes associated with the currently operating facilities and best management practices at these sites, the staff concludes that the incremental impacts to local hydrology would be small.

Facilities at the three alternative sites would use major water bodies as the source of makeup water and the sink for blowdown water. As at the Grand Gulf ESP site, a new nuclear facility at the River Bend site would rely on the Mississippi River for cooling water. New nuclear facilities at the Pilgrim or FitzPatrick sites would rely on the Atlantic Ocean and Lake Ontario, respectively, for cooling water needs. These water bodies are so vast compared to the water fluxes associated with a nuclear plant that any changes to the flow patterns of the water bodies would be small and localized. Therefore, the staff concludes that the hydrological alterations to surface water of these alternative sites would be small.

Consumptive water use of groundwater for facility water needs other than cooling (e.g., potable, demineralized) could affect the water table at the site. The staff concludes that if the potential impacts on groundwater were significant, these groundwater needs could be eliminated by treating water from the surface water sources instead of using groundwater.

Based on the above discussion, the staff concludes that the impacts of hydrological alterations, from construction and operation of a new nuclear facility at one of the alternative sites is generic and would be SMALL.

8.6 Summary of Alternative Site Impacts

Entergy Nuclear selected three sites where Entergy Corporation currently owns and operates nuclear power plants as alternative sites to the proposed Grand Gulf ESP site. The three sites selected for detailed review are:

- River Bend Station, located approximately 39 km (24 mi) northwest of Baton Rouge, Louisiana.
- Pilgrim Nuclear Station, located approximately 6 km (4 mi) southeast of Plymouth, Massachusetts
- James A. FitzPatrick Nuclear Power Plant, located approximately 13 km (8 mi) northeast of Oswego, New York.

8.6.1 Summary of Alternative Site Construction Impacts

The staff's characterization of the environmental impacts of constructing new nuclear generating plants within the scope of the SERI PPE at the three alternatives sites is shown in Table 8-13.

Table 8-13. Characterization of Construction Impacts at the Alternative Early Site Permit Sites

Impact Category	River Bend	Pilgrim	FitzPatrick
Land use			
Site and vicinity	SMALL	SMALL	SMALL
Power transmission corridors and offsite areas	SMALL	SMALL	SMALL
Air quality	SMALL	SMALL	SMALL
Water-related			
Water use	SMALL	SMALL	SMALL
Water quality	SMALL	SMALL	SMALL
Ecological			
Terrestrial ecosystems	MODERATE	SMALL to MODERATE	MODERATE to LARGE
Aquatic ecosystems	SMALL	SMALL	SMALL
Threatened and endangered species	SMALL to MODERATE	MODERATE to LARGE	SMALL
Socioeconomic			
Physical	SMALL	SMALL	SMALL
Demography	SMALL	SMALL	SMALL
Social and economic	SMALL (Adverse) to MODERATE (Beneficial)	MODERATE (Adverse) to MODERATE (Beneficial)	SMALL (Adverse) to MODERATE (Beneficial)
Infrastructure and community services	MODERATE[a]	MODERATE[b]	MODERATE[c]
Historic and cultural resources	SMALL	SMALL	SMALL
Environmental justice	SMALL	SMALL	SMALL
Nonradiological health impacts	SMALL	SMALL	SMALL
Radiological health impacts	SMALL	SMALL	SMALL

(a) Most of the adverse impact would be related to effects on transportation.
(b) Most of the adverse impact would be related to effects on transportation and housing.
(c) Most of the adverse impact would be related to effects on transportation near the plant.

8.6.2 Summary of Alternative Site Operation Impacts

The staff's characterization of the environmental impacts of operating new nuclear generating plants within the scope of the SERI PPE at the three alternatives sites is shown in Table 8-14.

Table 8-14. Characterization of Operational Impacts at the Alternative Early Site Permit Sites

Impact Category	River Bend	Pilgrim	FitzPatrick
Land use			
Site and vicinity	SMALL	SMALL	SMALL
Power transmission corridors and offsite areas	SMALL	SMALL	SMALL
Air quality	SMALL	SMALL	SMALL
Water-related			
Water use	SMALL	SMALL	SMALL
Water quality	SMALL	SMALL	SMALL
Ecological			
Terrestrial ecosystems	SMALL	SMALL to MODERATE	SMALL
Aquatic ecosystems	SMALL	SMALL to MODERATE	SMALL
Threatened and endangered species	SMALL	SMALL to MODERATE	SMALL
Socioeconomic			
Physical	SMALL	SMALL	SMALL
Demographics	SMALL	SMALL	SMALL
Social and economic	SMALL (Adverse) to MODERATE (Beneficial)	MODERATE (Adverse) to MODERATE (Beneficial)	SMALL (Adverse) to MODERATE (Beneficial)
Infrastructure and community services	SMALL	MODERATE[(a)]	SMALL
Historic and cultural resources	SMALL	SMALL	SMALL
Environmental justice	SMALL	SMALL	SMALL
Nonradiological health impacts	SMALL	SMALL	SMALL
Radiological health impacts	SMALL	SMALL	SMALL
Impacts of postulated accidents	SMALL	SMALL	SMALL

(a) Most of the adverse impact would be related to effects on transportation.

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9.0 Comparison of the Impacts of the Proposed and Alternative Sites

The need to compare the proposed Grand Gulf early site permit (ESP) site with alternative sites arises from the requirement in Section 102(2)(c)(iii) of the National Environmental Policy Act of 1969 (NEPA) (42 USC 4332(c)(iii)) that environmental impact statements include an analysis of alternatives to the proposed action. The test to be employed in assessing whether a proposed ESP site is to be rejected in favor of an alternative site is based on whether the alternative site is "obviously superior" to the site proposed by the applicant. An alternative site is "obviously superior" to the proposed site if it is "clearly and substantially" superior to the proposed site (Rochester Gas & Electric Corp. 1978).

The standard of obvious superiority "is designed to guarantee that a proposed site will not be rejected in favor of an alternate unless, on the basis of appropriate study, the Commission can be confident that such action is called for" (New England Coalition on Nuclear Pollution 1978). The "obviously superior" test is appropriate for two reasons. First, the analysis performed by the U.S. Nuclear Regulatory Commission (NRC) in evaluating alternative ESP sites is necessarily imprecise. Key factors considered in the alternative site analysis, such as population distribution and density, hydrology, air quality, aquatic and terrestrial ecological resources, aesthetics, land use, and socioeconomics are difficult to quantify in common metrics. Given this difficulty, any evaluation of a particular site must necessarily have a wide range of uncertainty. Second, the applicant's proposed ESP site has been analyzed in detail, with the expectation that most adverse environmental impacts associated with the site have been identified. The alternative sites have not undergone a comparable level of detailed study. For these reasons, a proposed ESP site may be rejected in favor of an alternative site not when the alternative is "marginally better" than the proposed site, but only when it is "obviously superior" (Rochester Gas & Electric Corp. 1978). NEPA does not require that a nuclear plant be constructed on the single best site for environmental purposes. Rather, "all that NEPA requires is that alternative sites be considered and that the effects on the environment of building the plant at the alternative sites be carefully studied and factored into the ultimate decision" (New England Coalition on Nuclear Pollution 1978).

The NRC staff's review of alternative sites consists of a two-part sequential test for obvious superiority (NRC 2000). The first part of the test determines whether there are "environmentally preferred"[(a)] sites among the candidate ESP sites. The staff considers whether SERI has (1) reasonably identified alternative sites, (2) evaluated the likely environmental impacts of

(a) An "environmentally preferred" alternative site is one for which the environmental impacts are sufficiently less than for the proposed site so that environmental preference for the alternative site can be established (NRC 2000).

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. Based on its independent review, the staff then determines whether any of the alternative sites are environmentally preferable to the applicant's proposed ESP site.

If the staff determines that one or more alternative ESP sites are environmentally preferable, it will then compare the estimated costs (environmental, economic, and time) of constructing the proposed nuclear power plant at the proposed site and at the environmentally preferable site or sites (NRC 2000). To find an obviously superior alternative site, the staff must determine that (1) one or more important aspects, either singly or in combination, of a reasonably available alternative site are obviously superior to the corresponding aspects of the applicant's proposed site and (2) the alternative site does not have offsetting deficiencies in other important areas.

9.1 Comparison of the Proposed Site with the Alternatives

The staff reviewed the environmental report submitted by System Energy Resources, Inc. (SERI) 2003c) and supporting documentation and conducted site visits at the proposed Grand Gulf ESP site and the three alternative sites. The staff found that SERI had reasonably identified alternative sites, evaluated the environmental impacts of construction and operation, and used a logical means of comparing sites. The following section summarizes the staff's independent assessment of the proposed and alternative sites.

The staff's characterization of the expected environmental impacts of constructing and operating one or more new nuclear unit(s) at the Grand Gulf ESP site and alternative sites within the bounds of SERI's plant parameter envelope are summarized in Tables 9-1 and 9-2. Explanations for the particular characterizations are in Chapters 4 and 5 for the Grand Gulf ESP site, Section 8.4.4 for the River Bend site, Section 8.4.5 for the Pilgrim site, and Section 8.4.6 for the James A. FitzPatrick site.

Some environmental impacts considered for the Grand Gulf ESP site and for the alternative sites are generic for all sites and, therefore, do not influence the comparison of impacts between the Grand Gulf ESP site and the alternative sites. The generic environmental impacts common to all sites are air quality, nonradiological and radiological health impacts, and environmental impacts from postulated accidents and hydrologic alterations. Generic impacts are discussed in Section 8.4.3.

Table 9-1. Comparison of the Construction Impacts at the Proposed and Alternative Early Site Permit Sites

Impact Area Category	Grand Gulf Site	River Bend Site	Pilgrim Site	FitzPatrick Site
Land use	–	–	–	–
Site and vicinity	SMALL	SMALL	SMALL	SMALL
Power transmission corridors and offsite areas	SMALL	SMALL	SMALL	SMALL
Air quality	SMALL	SMALL	SMALL	SMALL
Water-related	–	–	–	–
Water use	SMALL	SMALL	SMALL	SMALL
Water quality	SMALL	SMALL	SMALL	SMALL
Ecological	–	–	–	–
Terrestrial ecosystems	MODERATE	MODERATE	SMALL to MODERATE	MODERATE to LARGE
Aquatic ecosystems	SMALL	SMALL	SMALL	SMALL
Threatened and endangered species	SMALL	SMALL to MODERATE	MODERATE to LARGE	SMALL
Socioeconomic	–	–	–	–
Physical impacts	SMALL	SMALL	SMALL	SMALL
Demography	SMALL	SMALL	SMALL	SMALL
Social and economic	LARGE Beneficial to SMALL Beneficial	SMALL Beneficial to MODERATE Beneficial	MODERATE Beneficial to MODERATE Adverse	SMALL Beneficial to MODERATE Beneficial
Infrastructure and community services	SMALL to MODERATE	MODERATE[(a)]	MODERATE[(b)]	MODERATE[(c)]
Historic and cultural resources	SMALL	SMALL	SMALL	SMALL
Environmental justice	LARGE Beneficial to MODERATE Adverse	SMALL	SMALL	SMALL
Nonradiological health	SMALL	SMALL	SMALL	SMALL
Radiological health	SMALL	SMALL	SMALL	SMALL

(a) Most of the adverse impact would be related to effects on transportation.
(b) Most of the adverse impact would be related to effects on transportation and housing.
(c) Most of the adverse impact would be related to effects on transportation near the facility.

Table 9-2. Comparison of the Operational Impacts at the Proposed and Alternative Early Site Permit Sites

Impact Area Category	Grand Gulf Site	River Bend Site	Pilgrim Site	FitzPatrick Site
Land use	–	–	–	–
Site and vicinity	SMALL	SMALL	SMALL	SMALL
Power transmission corridors and offsite areas	SMALL	SMALL	SMALL	SMALL
Air quality	SMALL	SMALL	SMALL	SMALL
Water-related	–	–	–	–
Water use	SMALL	SMALL	SMALL	SMALL
Water quality	SMALL	SMALL	SMALL	SMALL
Hydrological alterations	SMALL	SMALL	SMALL	SMALL
Ecological	–	–	–	–
Terrestrial ecosystems	SMALL	SMALL	SMALL to MODERATE	SMALL
Aquatic ecosystems	SMALL	SMALL	SMALL to MODERATE	SMALL
Threatened and endangered species	SMALL	SMALL	SMALL to MODERATE	SMALL
Socioeconomic	–	–	–	–
Physical impacts	SMALL	SMALL	SMALL	SMALL
Demography	SMALL to MODERATE	SMALL	SMALL	SMALL
Social and economic	LARGE Beneficial to SMALL Beneficial	SMALL Beneficial to MODERATE Beneficial	MODERATE Beneficial to MODERATE Adverse	SMALL Beneficial to MODERATE Beneficial
Infrastructure and community services	SMALL to MODERATE	SMALL	MODERATE[(a)]	SMALL
Historic and cultural resources	SMALL	SMALL	SMALL	SMALL
Environmental justice	LARGE Beneficial to MODERATE Adverse	SMALL	SMALL	SMALL
Nonradiological health	SMALL	SMALL	SMALL	SMALL
Radiological health	SMALL	SMALL	SMALL	SMALL
Impact of postulated accidents	SMALL	SMALL	SMALL	SMALL

(a) Most of the adverse impact would be related to effects on transportation and housing.

The environmental impact areas shown in Tables 9-1 and 9-2 have been evaluated using the NRC's three-level standard of significance – SMALL, MODERATE, or LARGE – based on the Council on Environmental Quality guidelines and set forth in the footnotes to Table B-1 of Title 10 of the Code of Federal Regulations (CFR) Part 51, Subpart A, Appendix B:

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.

The staff determined the impact level from construction for most of the environmental issues at the sites is SMALL (see Table 9-1). For terrestrial ecology and threatened and endangered species, there are factors related to a site that could cause the impact level to increase from SMALL to MODERATE and, in the case of FitzPatrick, to LARGE because of probable impacts to forests and wetlands and associated protected species at that site. In addition, socio-economic and environmental justice impacts range 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 taxes. These are explained more fully in Chapter 4 for the Grand Gulf ESP site and in Chapter 8 for the alternative sites.

Similarly, the staff determined that the impact level from operations for most of the environ-mental issues at most of the sites is SMALL (see Table 9-2). Exceptions are aquatic and terrestrial ecosystems and threatened and endangered species at the Pilgrim site, arising from potential impacts on the redbelly turtle. Additionally, impacts in socioeconomics and environ-mental justice at the alternative sites include SMALL to MODERATE beneficial impacts on local economy and taxes. Impacts at the Grand Gulf ESP site range from SMALL to LARGE beneficial. Impacts on infrastructure and community services range from SMALL to MODERATE adverse at the Grand Gulf ESP site and SMALL to MODERATE adverse at the alternative sites. Environment justice impacts are SMALL at the alternative sites, but up to MODERATE adverse at the Grand Gulf ESP site. These are explained more fully in Chapter 5 for the Grand Gulf ESP site and in Chapter 8 for the alternative sites.

9.2 Environmentally Preferable Sites

This section discusses whether any of the three alternative sites are environmentally preferable to the Grand Gulf ESP site. As noted in the introduction to this chapter, an "environmentally preferred" alternative site is a site for which the environmental impacts are sufficiently less than for the proposed site such that environmental preference for the alternative site can be established. The issue of environmental preferability is discussed in Section 9.2.1 for construction-related impacts and in Section 9.2.2 for operation-related impacts.

9.2.1 Construction

As shown in Table 9-1, the environmental impacts of construction at the Grand Gulf ESP site are characterized by the staff as SMALL for most impact categories. The exceptions include the impacts on terrestrial ecosystems, infrastructure and community services, and environmental justice categories, which may involve MODERATE impacts. Aspects related to tax revenues would have beneficial impacts ranging from SMALL to LARGE.

At the three alternative ESP sites, the construction-related impacts are also predominately characterized as SMALL. The exceptions are that (1) impacts on terrestrial ecosystems are characterized as MODERATE at the River Bend site, SMALL to MODERATE at the Pilgrim site, and as MODERATE to LARGE at the FitzPatrick site, (2) impacts on threatened and endangered species are characterized as SMALL to MODERATE at the River Bend site, SMALL at the FitzPatrick site, and MODERATE to LARGE at the Pilgrim site, and (3) impacts on infrastructure and community services are characterized as MODERATE at all three alternative sites. The economy in the vicinity of the Pilgrim site could also be negatively affected. The Grand Gulf ESP site and three alternative sites would also have various beneficial impacts for the social and economic subcategories of economy and taxes.

While there are some differences in the environmental impacts of construction at the proposed and alternative ESP sites, the staff concludes that none of these differences is sufficient to determine that any of the alternative sites is environmentally preferable to the Grand Gulf ESP site.

9.2.2 Operations

As shown in Table 9-2, the environmental impacts of operations at the Grand Gulf ESP site are characterized by the staff as SMALL for most impact categories. Demographic impacts at the Grand Gulf ESP site range from SMALL to MODERATE, as do impacts on infrastructure and community services. Social and economic impacts include SMALL beneficial to LARGE beneficial effects, while environmental justice impacts range from LARGE beneficial to MODERATE adverse, depending in large part on sharing of tax revenues by the State.

At the three alternative ESP sites, the operations-related impacts are also predominately characterized as SMALL. The primary exception is the Pilgrim site, where ecological impacts are characterized as SMALL to MODERATE, and the possibility of a MODERATE adverse impact on local infrastructure and community services and on social and economic components exists. Effects on social and economic components at the other alternatives range from SMALL beneficial to MODERATE beneficial.

While there are some differences in the environmental impacts of operation at the proposed and alternative ESP sites, the staff concludes that none of these differences is sufficient to determine that any of the alternative sites is environmentally preferable to the Grand Gulf ESP site.

9.3 Obviously Superior Sites

None of the alternative sites was determined to be environmentally preferable to the Grand Gulf ESP site. Therefore, none of the alternative sites is obviously superior to the Grand Gulf ESP site.

9.4 Comparison with the No-Action Alternative

The no-action alternative refers to a scenario in which NRC denies the ESP request. Denial of the ESP application would prevent early resolution of safety and environmental issues for the site. These issues would have to be addressed during a future licensing action (ESP, construction permit, or combined license), should an applicant decide to pursue construction and operation activities for a nuclear facility at the site at a later time.

In the event that NRC denies the ESP application, SERI could follow any of several paths to satisfy its electric power needs: (1) seeking an ESP for a different location, (2) purchasing power from other electricity providers, (3) establishing conservation and demand-side management programs, (4) constructing new generation facilities other than nuclear at the Grand Gulf ESP site, (5) constructing new generation facilities at other locations, (6) delaying retirement of existing Entergy generating facilities, or (7) reactivating previously retired Entergy generating facilities. The preceding paths could be pursued individually or in combination. Each of the paths would have associated environmental impacts.

No significant environmental impacts would be avoided by the no-action alternative because no such impacts are caused by a site-suitability determination.

9.5 References

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

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10.0 Conclusions and Recommendations

By letter dated October 16, 2003, System Energy Resources, Inc. (SERI), submitted an application to the U.S. Nuclear Regulatory Commission (NRC) for an early site permit (ESP) for property co-located with the existing Grand Gulf Nuclear Station near Port Gibson, Mississippi (SERI 2003c). The proposed Grand Gulf ESP site is located in Claiborne County, Mississippi, approximately 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. The Grand Gulf ESP site will include one or more nuclear power facilities to be sited adjacent to the existing Unit 1 of the Grand Gulf Nuclear Station.

An ESP is a Commission approval of a location for siting for one or more nuclear power facilities, and is separate from the filing of an application for a construction permit (CP) or combined license (COL) for such a facility. An ESP application may refer to a reactor or reactor characteristics or plant parameter envelope (PPE), which is a set of postulated design parameters that bound the characteristics of a reactor or reactors that might be built at a selected site. Alternatively, an ESP may refer to a detailed reactor design. The ESP is not a license to build a nuclear power plant; rather, the application for an ESP initiates a process undertaken to assess whether a proposed site is suitable should the applicant decide to pursue a CP or COL.

Section 102 of the National Environmental Policy Act of 1969 (NEPA) (42 USC 4332) directs that an environmental impact statement (EIS) be prepared for major Federal actions that significantly affect the quality of the human environment. Subpart A of Title 10 of the Code of Federal Regulations (CFR) Part 52 contains the NRC regulations related to ESPs. The NRC has implemented Section 102 of NEPA in 10 CFR Part 51. As set forth in 10 CFR 52.18, the Commission has determined that an EIS will be prepared during the review of an application for an ESP. The purpose of SERI's requested action, issuance of the ESP, is for the NRC to determine whether the Grand Gulf ESP site is suitable for one or more new nuclear units by resolving certain safety and environmental issues before SERI incurs the substantial additional time and expense of designing and seeking approval to construct such facilities at the site. Under the provisions of 10 CFR 52.21, an ESP is described as a "partial construction permit." An applicant for a CP or COL for a nuclear power plant or plants to be located at the site for which an ESP was issued can reference the ESP, thus reducing the need to review siting issues at that stage of the licensing process. However, issuance of a CP or COL to construct and operate a nuclear power plant is a separate licensing action that requires its own environmental review in accordance with 10 CFR Part 51.

Three primary issues – site safety, environmental impacts, and emergency planning – must be addressed in the ESP application. Likewise, in its review of the application, the NRC assesses

SERI's proposal in relation to these issues and determines if the application meets the requirements of the Atomic Energy Act of 1954 and NRC regulations. This EIS addresses the potential environmental impacts resulting from construction and operation of up to two new nuclear units at the proposed and alternative sites.

Upon acceptance of the SERI application, the NRC began the environmental review process described in 10 CFR Part 51 by publishing in the *Federal Register* a Notice of Intent to prepare an EIS and conduct scoping (68 FR 75656). The staff visited the Grand Gulf ESP site on July 29, 2003, January 21, 2004, and April 12 and 13, 2004 to gather information and become familiar with the site and its environs. The staff held a public scoping meeting on January 21, 2004, in Port Gibson, Mississippi to obtain public input on the scope of the environmental review. Subsequent to the site visit and the scoping meeting and in accordance with NEPA and 10 CFR Part 51, the staff has determined and evaluated the potential environmental impacts of constructing and operating one or two new nuclear units at the Grand Gulf ESP site. Included in this EIS are (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 the alternatives; and (4) the staff's recommendation regarding the proposed action.

During the preparation of this EIS, the staff reviewed the SERI environmental report; consulted with Federal, State, Tribal, and local agencies; and conducted an independent review of the issues following the guidance set forth in NRC's review standard RS-002, *Processing Applications for Early Site Permits* (NRC 2004). The review standard draws from the previously published NUREG-0800, *Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants* (NRC 1987), and NUREG-1555, *Environmental Standard Review Plan* (NRC 2000). In addition, the NRC considered public comments received during the scoping process. Applicable public comments are provided in Appendix D of this EIS.

A 75-day comment period will begin on the date of publication of the U.S. Environmental Protection Agency Notice of Availability of the draft EIS to allow members of the public to comment on the results of the NRC staff's review. During this comment period, a public meeting will be held in Port Gibson, Mississippi. At the meeting, the staff will describe the results of the NRC environmental review, answer questions related to the review, and provide members of the public with information to assist them in formulating their comments.

Following the precedent of the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (NUREG-1437) (NRC 1996) and supplemental license renewal EISs, environmental issues are evaluated using the three-level standard of significance – SMALL, MODERATE, or LARGE – developed by NRC using guidelines from the Council on

Environmental Quality. Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, provides the following definitions of the three significance levels:

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.

Mitigation measures were considered for each environmental issue and are discussed in the appropriate sections. During its environmental review, the staff considered planned activities and actions that SERI indicates it will take should it decide to apply for a CP or COL. Key activities and actions considered by the staff in determining the level of impacts to a resource are discussed throughout the report and are listed in Appendix J.

NEPA requires that an EIS include information on:

- any adverse environmental effects that cannot be avoided should the proposal be implemented
- any irreversible and irretrievable commitments of resources that would be involved if the proposed action is implemented
- the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity.

10.1 Unavoidable Adverse Environmental Impacts

Section 102(C)(ii) of NEPA requires that an EIS include information on any adverse environmental effects that cannot be avoided should the proposed action be implemented. Unavoidable adverse environmental impacts are those potential impacts of construction and operation of the proposed new unit(s) that cannot be avoided and for which no practical means of mitigation are available.

If granted, the ESP will not authorize any activities by SERI that would have an environmental impact. This is because SERI did not include a site redress plan in its application as provided by 10 CFR 52.17(c) and 10 CFR 52.25 and did not request that it be authorized to perform any of the activities provided by 10 CFR 50.10(e)(1). Consequently, there are no unavoidable adverse environmental impacts associated with implementing the proposed action: granting an ESP to SERI for the Grand Gulf ESP site. However, issuance of an ESP would likely lead to construction and operation of a new nuclear facility under a CP or COL, either of which would require their own environmental review in accordance with 10 CFR Part 51. Although definitive assessment of adverse environmental impacts from construction and operation of one or more new nuclear units at the Grand Gulf ESP site would be performed at the CP or COL stage, a summary of the impacts based on the analyses presented in this EIS is given below.

10.1.1 Unavoidable Adverse Impacts During Construction

Chapter 4 discusses the impacts from construction in detail. The unavoidable adverse impacts related to construction are listed in Table 10-1 and summarized below. The primary unavoidable adverse environmental impacts during construction would be related to land use. All construction activities for a new nuclear facility, including ground-disturbing activities, would occur within the existing Grand Gulf site boundary. According to SERI, the area that would be affected as a result of permanent facilities is approximately 50.6 ha (125 ac). Much of this area was previously disturbed during construction of the existing Grand Gulf Nuclear Station. An additional 109.4 ha (295 ac) would be disturbed on a short-term basis as a result of temporary activities and facilities and laydown areas (SERI 2003a).

Impacts of construction on the terrestrial ecology of the site would be both short-term and long-term. Construction of a new nuclear facility would result in the removal of approximately 59 ha (145 ac) of upland hardwood forest and 43 ha (105 ac) of upland fields, with approximately 17 ha (43 ac) of forested habitat permanently lost. The Grand Gulf ESP site does not contain any old-growth timber, nor any unique or sensitive plants or communities. Therefore, construction activities would not noticeably reduce the local or regional diversity of plants or plant communities. There are no important animal species or habitats known on the Grand Gulf ESP site. No areas designated by the U.S. Fish and Wildlife Service as critical habitat for threatened or endangered species exist at or near the site; however, a number of terrestrial and aquatic threatened or endangered plants or animals are known to exist in the vicinity of the site, and preconstruction surveys would be required to ensure these species are protected. Loss of upland and lowland forest would be noticeable. Construction would not permanently affect any aquatic species, and disturbance to the Federally threatened Louisiana black bear is considered to be negligible. Socioeconomic impacts of construction include an increase in traffic and potential strain on housing and educational institutions in Claiborne County. Atmospheric and meteorological impacts include fugitive dust from construction activities that would be mitigated by dust control plans. Radiological doses to construction workers from the adjacent unit are expected to be well below regulatory limits. Regarding environmental justice, the impacts are dependent on the allocation of tax revenues between the State and Claiborne County.

Table 10-1. Unavoidable Adverse Environmental Impacts from Construction

Impact Category	Adverse Impacts Based on SERI's Proposal	Actions to Mitigate Impacts[a]	Unavoidable Adverse Impacts
Land use	Yes	Comply with requirements of applicable Federal, State, and Local permits	50.6 ha (125 ac) disturbed on a long-term basis; 109.4 ha (295 ac) additional land disturbed on a temporary basis
Hydrological and water use	Yes	Obtain a CWA 401 Certification prior to site-preparation activities; construction would use best management practices	Dewatering systems would depress the water table in the general vicinity, but the impacts would be localized and temporary. Some dredging and shoreline alterations
Ecological			
Terrestrial	Yes	Conduct survey for protected species prior to construction	Loss of wildlife habitat
Aquatic	Yes	Stabilize embankments; Install silt fences	Lowered water quality onsite
Socioeconomic	Yes	Implement flexible construction shifts	Potential impacts on housing and educational institutions in Claiborne County
Radiological	Yes	Use of as low as reasonably achievable (ALARA) principles	Dose to site preparation workers
Atmospheric and meteorological	Yes	Implement actions to reduce fugitive dust	Equipment emissions and fugitive dust from operation of earth-moving equipment
Environmental justice	Yes	Not applicable - dependent on actions of the State	Dependent upon State tax allocations, adverse socioeconomic impacts could be disproportionate on local minority/low-income community

(a) Additional mitigation measures are presented in Section 4.10. SERI's commitments and the staff's assumptions regarding sources and levels of impact and mitigation are also presented in Appendix J.

10.1.2 Unavoidable Adverse Impacts During Operation

Chapter 5 provides a detailed discussion of the impacts from operation. The unavoidable adverse impacts related to operation are listed in Table 10-2 and summarized below. The unavoidable adverse impacts from operation for land use are small. Hydrological, water use, and water quality impacts during operation are small resulting from very limited use of Mississippi River flow. Ecological impacts are also small for both ecosystems and threatened and endangered species because of the lack of key habitat at the site. Socioeconomic impacts are primarily increased demand for services in Claiborne County and Port Gibson, along with impacts on infrastructure and community services in this area. Dependent on allocation of tax revenue with the State, environmental justice impacts could be moderate. Meteorological and radiological impacts are expected to be negligible. Pollutants emitted during operations are considered insignificant.

Table 10-2. Unavoidable Adverse Environmental Impacts from Operation

Impact Category	Adverse Impacts Based on SERI's Proposal	Actions to Mitigate Impacts[a]	Unavoidable Adverse Impacts
Land use	Yes	Follow local land management plans	Upgrade/modification of existing transmission corridors probably needed
Hydrological and water use	Yes	Comply with State permit limits	Use of Mississippi River water
Ecological			
Terrestrial	Yes	Use best management practices	Wildlife collisions with structures and traffic
Aquatic	Yes	Use impingement/ entrainment screens for intake; diffuser for thermal discharge	Losses of species in larval state
Socioeconomic	Yes	Implement flexible work hours and road improvements	Potential impacts on housing and educational institutions in Claiborne County; increased traffic
Radiological	Yes	Use as low as is reasonably achievable (ALARA) principles	Dose to workers, the public, and biota

Table 10-2. (contd)

Impact Category	Adverse Impacts Based on SERI's Proposal	Actions to Mitigate Impacts[(a)]	Unavoidable Adverse Impacts
Atmospheric and meteorological	No	Comply with State permit limits	Equipment emissions, cooling tower drift and electromagnetic field exposure
Environmental justice	Yes	Not applicable - dependant on actions of the State	Dependent upon State tax allocations, adverse socioeconomic impacts could be disproportionate on local minority/low income community

(a) Additional mitigation measures are presented in Section 5.11. SERI's commitments and the staff's assumptions regarding sources and levels of impact and mitigation are also presented in Appendix J.

10.2 Irreversible and Irretrievable Commitments of Resources

Section 102(C)(v) of NEPA requires that an EIS include information on any irreversible and irretrievable commitments of resources that would occur should the proposed action be implemented. There will be no irreversible and irretrievable commitments of resources should the proposed action be implemented. If granted, the ESP will not authorize any activities by SERI that would have an environmental impact. SERI did not include a site redress plan in its application as provided by 10 CFR 52.17(c) and 10 CFR 52.25 and did not request that it be authorized to perform any of the activities as provided by 10 CFR 50.10(e)(1). Because the proposed action therefore does not involve commitment of resources, a complete assessment of irreversible and irretrievable commitments of resources would be performed at the CP or COL stage if SERI is granted an ESP and later applies for a CP or COL.

Irretrievable commitments of resources during construction of the proposed new units generally would be similar to that of any major construction project. The actual commitment of construction resources (concrete, steel, and other building materials) would depend on the reactor design selected at the CP or COL stage. Hazardous materials such as asbestos would not be used, if possible. If materials such as asbestos were used, it would be in accordance with safety regulations and practices. The actual estimate of construction materials would be performed at the CP or COL stage when the reactor design is selected.

The staff expects that the use of construction materials in the quantities associated with those expected for the new ESP unit or units, while irretrievable, would be of small consequence, with respect to the availability of such resources.

The main resource that would be irretrievably committed during operation of a new nuclear unit or units would be uranium. The availability of uranium ore and existing stockpiles of highly enriched uranium in the United States and Russia that could be processed into fuel is sufficient, so that the irreversible and irretrievable commitment would be of small consequence.

10.3 Relationship Between Short-Term Uses and Long-Term Productivity of the Human Environment

Section 102(C)(iv) of NEPA requires that an EIS include information on the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity. There will be no short-term use of the environment should the proposed action be implemented because SERI is not authorized to perform any site preparation activities. The evaluation of the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity for the construction and operation of the ESP unit or units can only be performed by discussing the benefits of operating the unit. The benefit is the production of electricity. In accordance with 10 CFR 52.18, an EIS for an ESP does not need to include an assessment of the benefits of the proposed action. Therefore, an assessment of the evaluation of the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity for the construction and operation of a new nuclear unit would be performed at the CP or COL stage should SERI be granted an ESP and later seek a CP or COL.

10.4 Cumulative Impacts

The staff considered the potential cumulative impacts resulting from construction and operation of the proposed unit(s) in the context of past, present, and future actions at the Grand Gulf ESP site in Chapter 7 of this EIS. For each impact area, the staff's determination is that the potential cumulative impact resulting from construction and operation would be generally SMALL, and further mitigation would not be warranted. The geographical area over which past, present, and future actions could contribute to cumulative impacts is dependent on the type of action considered. Several issues have the potential for MODERATE adverse impacts, most of which would occur under temporary circumstances or as the result of a larger than expected concentration of construction workers settling near the Grand Gulf ESP site.

10.5 Staff Conclusions and Recommendations

The staff's recommendation to the Commission related to the environmental impacts of the proposed action is that the ESP should be issued. The staff's evaluation of the safety and emergency preparedness aspects of the proposed action will be documented in a separate safety analysis report prepared in accordance with 10 CFR Part 52. This recommendation is based on (1) the environmental report submitted by SERI (2003c); (2) consultation with Federal, State, Tribal, and local agencies; (3) the staff's independent review; (4) the staff's consideration of comments received during the public scoping process; (5) the assessments summarized in this EIS, including the potential mitigation measures identified in the environmental report and in this EIS; and (6) the staff's conclusion there are no environmentally preferable or obviously superior alternative sites.

A comparative summary showing the staff's estimate of the environmental significance of locating one or two new nuclear units at the Grand Gulf ESP site and at any of the alternative sites is shown in Table 10-3. The estimated environmental significance of the no-action alternative, or denial of the ESP application, is also shown. Table 10-3 shows that the significance of the environmental impacts of the construction and operation of one or two new nuclear units is generally SMALL for all impact categories at all sites, with the exception of certain ecological, socioeconomic, and environmental justice categories. The alternative sites may have environmental effects in at least some categories that reach MODERATE or LARGE significance. The staff concludes that none of the alternative sites assessed are obviously superior to the Grand Gulf ESP site.

Table 10-3. Summary of Environmental Significance of Nuclear Power Plant Construction and Operation at the Grand Gulf Early Site Permit Site, at Alternative Sites, and for the No-Action Alternative

	Proposed Action	No-Action Alternative	Alternative Site Options		
Impact Category	**ESP Permit at Grand Gulf**	**Denial of ESP**	**River Bend**	**Pilgrim**	**FitzPatrick**
Land use	SMALL	SMALL	SMALL	SMALL	SMALL
Ecology	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL to LARGE	SMALL to LARGE
Water use and quality	SMALL	SMALL	SMALL	SMALL	SMALL
Air quality	SMALL	SMALL	SMALL	SMALL	SMALL
Radiological and nonradiological health	SMALL	SMALL	SMALL	SMALL	SMALL

Table 10-3. (contd)

	Proposed Action	No-Action Alternative	Alternative Site Options		
Impact Category	**ESP Permit at Grand Gulf**	**Denial of ESP**	**River Bend**	**Pilgrim**	**FitzPatrick**
Socioeconomics	LARGE Beneficial to MODERATE Adverse	SMALL	MODERATE Beneficial to MODERATE Adverse	MODERATE Beneficial to MODERATE Adverse	MODERATE Beneficial to MODERATE Adverse
Historic and cultural resources	SMALL	SMALL	SMALL	SMALL	SMALL
Environmental justice	LARGE Beneficial MODERATE Adverse	SMALL	SMALL	SMALL	SMALL

10.6 References

10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities."

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 52. Code of Federal Regulations, Title 10 *Energy*, Part 52, "Early Site Permits, Standard Design Certifications, and Combined Licenses for Nuclear Power Plants."

68 FR 75656. December 31, 2003. "System Energy Resources, Inc., Grand Gulf Site; Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process." *Federal Register*, U.S. Nuclear Regulatory Commission.

Atomic Energy Act of 1954. 42 USC 1011, et seq.

National Environmental Policy Act of 1969, as amended (NEPA). 42 USC 4321, et seq.

System Energy Resources, Inc. (SERI). 2003c. "Part 3 Environmental Report." *Grand Gulf Site Early Site Permit Application*, Jackson, Mississippi. Available at http://www.nrc.gov/reading-rm/adams.html, Accession No. ML032960315.

U.S. Nuclear Regulatory Commission (NRC). 1987. *Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants*. NUREG-0800, Washington, D.C. Available at http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0800/.

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants.* NUREG-1437, Volumes 1 and 2. Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2000. *Environmental Standard Review Plan.* NUREG-1555, Washington, D.C. Available at http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1555/.

U.S. Nuclear Regulatory Commission (NRC). 2004. *Processing Applications for Early Site Permits.* RS-002, Washington, D.C. Available at http://www.nrc.gov/reactors/new-licensing/esp/esp-public-comments-rs-002.html.

Appendix A

Contributors to the Environmental Impact Statement

Appendix A

Contributors to the Environmental Impact Statement

The overall responsibility for the preparation of this environmental impact statement was assigned to the Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission (NRC). The statement was prepared by members of the Office of Nuclear Reactor Regulation with assistance from other NRC organizations and the Pacific Northwest National Laboratory.

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(a) Pacific Northwest National Laboratory is operated for the U.S. Department of Energy by Battelle Memorial Institute.

Appendix B

Organizations Contacted

Appendix B

Organizations Contacted

During the course of the staff's independent review of potential environmental impacts from siting one or two new nuclear units at Grand Gulf Early Site Permit site, the following Federal, State, Tribal, regional, and local agencies and organizations were contacted:

Advisory Council on Historic Preservation, Washington, D.C.

Alcorn State University, Alcorn State, Mississippi
- Center for Rural Life and Economic Development
- Extension Program

Cape Cod Times (newspaper)

Central New York Regional Planning and Development Board, Oswego, New York

Claiborne County, Port Gibson, Mississippi
- Administrator
- Board of Supervisors - President
- Chancery Clerk
- E 911 Coordinator
- Hospital
- Sheriff's Department - Sheriff
- Tax Assessor/Collector

Clinton Main Street (economic development organization)

Cornell Cooperative Extension of Oswego County, New York

Department of Health and Human Services - Office of Public Health, Clinton, Louisiana

Fayette, Louisiana
- City Council
- Mayor

Feliciana County/Parish, Louisiana
- East Feliciana County, Saint Francisville, Louisiana
- West Feliciana Parish
  - Assessor
  - Sheriff's Department

Grand Gulf Military Park, Civil War Battlefield and Museum, Claiborne County, Mississippi

Jefferson County, Fayette, Louisiana
- Board of Supervisors
  - Administrator
  - Purchasing Clerk
  - Receiving Clerk
- Civil Defense
- Chancery Clerk
- Circuit Clerk
- Department of Human Services
- E911 Coordinator
- Economic Development District
- Sheriff
- Supervisor

Louisiana Department of Wildlife and Fisheries, Baton Rouge, Louisiana

Louisiana Division of Archaeology, Baton Rouge, Louisiana

Louisiana State University Agricultural Center Research and Extension, Tensas Parish, Saint Joseph, Louisiana

Massachusetts Division of Fisheries and Wildlife, Westborough, Massachusetts

Mississippi Department of Archives and History, Jackson, Mississippi

Mississippi Department of Environmental Quality, Jackson, Mississippi

Mississippi Department of Wildlife, Fisheries, and Parks, Jackson, Mississippi

Mississippi Development Authority, Port Gibson, Mississippi

Mississippi Southern Bank - President, Port Gibson, Mississippi

Mississippi State University Extension Services, Fayette, Mississippi

National Association for the Advancement of Colored People - Claiborne County Chapter, Port Gibson, Mississippi

National Marine Fisheries Service
- Northeast Regional Office, Gloucester, Massachusetts
- Southeast Regional Office, Saint Petersburg, Florida

New York Division of Fish, Wildlife and Marine Resources, Albany, New York

NSTAR Electric, Plymouth, Massachusetts

OCO Inc. (Oswego County Opportunity)

Old County Memorial (newspaper), Plymouth, Massachusetts

Operation Oswego County (economic development organization)

Oswego County, Oswego, New York
- Department of Planning and Community Development
- Legislative Chairman
- Legislature Clerk
- Sheriff

Oswego Health (integrated health system that includes Oswego Hospital, The Manor at Seneca Hill, Springside at Seneca Hill, the Fulton Health Services Center and other health and residential living facilities), Oswego, New York

Peppercorns, Inc. - Owner (developer), Oswego, New York

Pilgrim Watch (Massachusetts Citizens for Safe Energy), Plymouth, Massachusetts

Pine Hills LLC (real estate development), Plymouth, Massachusetts

Plymouth, Massachusetts
- Director of Planning
- Manager

Plymouth Area Chamber of Commerce, Plymouth, Massachusetts

Plymouth Center Steering Committee/WATD Radio Station, Plymouth, Massachusetts

Plymouth Regional Economic Development Foundation, Inc., Plymouth, Massachusetts

Port Gibson, Mississippi - Mayor

Port Gibson Chamber of Commerce - President and Executive Director, Port Gibson, Mississippi

Port Gibson-Claiborne County Civil Defense - Director, Port Gibson, Mississippi

River Region Health System, Vicksburg, Mississippi

Saint Francisville, Louisiana
- Chief of Police
- Community Development Foundation
- Town Alderman

State University of New York, Oswego, New York

Tribal Nations
- Choctaw Nation of Oklahoma, Durant, Oklahoma
- Mississippi Band of Choctaw Indians, Chokta, Mississippi
- Tunika Biloxi Indian Tribe of Louisiana, Marksville, Louisiana

U.S. Army Corps of Engineers, Vicksburg District, Vicksburg, Mississippi

U.S. Fish and Wildlife Service
- Louisiana Ecological Services Office, Baton Rouge, Louisiana
- New England Ecological Services Office Concord, New Hampshire
- New York Ecological Services Office, Cortland, New York

Vicksburg, Mississippi
- Planning Director
- Vicksburg Warren School District

Vicksburg Chamber of Commerce - President, Vicksburg, Mississippi

Vicksburg Warren County Economic Development Foundation, Vicksburg, Mississippi

Warren County, Vicksburg, Mississippi
- Board of Supervisors
- Emergency Management Agency
- Port Commission - President
- Sheriff
- Tax Collectors Office

Appendix C

Chronology of NRC Staff Environmental Review Correspondence Related to System Energy Resources Inc.'s Application for an Early Site Permit (ESP) at the Grand Gulf ESP Site

Appendix C

Chronology of NRC Staff Environmental Review Correspondence Related to System Energy Resources Inc.'s Application for an Early Site Permit (ESP) at the Grand Gulf ESP Site

This appendix contains a chronological listing of correspondence between the U.S. Nuclear Regulatory Commission (NRC) and System Energy Resources, Inc. (SERI), and other correspondence related to the NRC staff's environmental review, under Title 10 of the Code of Federal Regulations (CFR) Part 51, of SERI's application for an early site permit (ESP) at the Grand Gulf ESP site near Port Gibson, Mississippi. All documents, with the exception of those containing proprietary information, have been placed in the Commission's Public Document Room, at One White Flint North, 11555 Rockville Pike (first floor), Rockville, Maryland, and are available electronically from the Public Electronic Reading Room found on the Internet at the following web address: http://www.nrc.gov/reading-rm.html. From this site, the public can gain access to the NRC's Agencywide Documents Access and Management System (ADAMS), which provides text and image files of NRC's public documents in the Publicly Available Records component of ADAMS. The ADAMS accession numbers or Federal Register citation for each document are included below.

September 30, 2003	Letter from NRC to Ms. Nancy Butler, Harriette Person Memorial Library, regarding maintenance of documents at the public library related to application by System Energy Resources, Inc. for an early site permit at the Grand Gulf site. (Accession No. ML032731680)
October 16, 2003	Letter from Entergy to NRC, Early Site Permit Application. (Accession No. ML032960373)
October 22, 2003	Letter from Entergy to NRC, Early Site Permit Application - Reformat and Correction. (Accession No. ML032960315 - package)
November 7, 2003	Letter from NRC to W. A. Eaton, SERI, regarding Notice of Receipt and Availability of Application for Early Site Permit for the Grand Gulf ESP Site. (Accession No. ML033020020 - package)
November 24, 2003	Letter from NRC to W. A. Eaton, SERI, regarding Acceptance of the System Energy Resources, Inc. Application for an Early Site Permit for the Grand Gulf Site. (Accession No. ML033180657 - package)

December 23, 2003	Letter from NRC to Entergy forwarding Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Related to Early Site Permit for Grand Gulf. (Accession No. ML033630515)
December 31, 2003	*Federal Register* Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process. (68 FR 75636)
January 6, 2004	Letter from NRC to the National Oceanic and Atmospheric Administration, Fisheries Southeast Regional Office, requesting a list of endangered, threatened, and candidate or proposed species and critical habitat that are known to occur or could potentially occur in Claiborne County, Mississippi and West Feliciana Parish, Louisiana. (Accession No. ML040081014)
January 6, 2004	Letter from NRC to the Advisory Council on Historic Preservation, regarding analyses of the potential impact to historic and cultural resources to be included in the environmental impact statement related to the application by Entergy for an early site permit for the Grand Gulf site. (Accession No. ML040081042)
January 6, 2004	Letter from NRC to New York Ecological Services Office of the U.S. Fish and Wildlife Service, requesting a list of endangered, threatened, and candidate or proposed species and critical habitat that are known to occur or could potentially occur in Oswego County, New York. (Accession No. ML040081119)
January 6, 2004	Letter from NRC to National Oceanic and Atmospheric Administration Fisheries Northeast Regional Office, requesting a list of endangered, threatened, and candidate or proposed species and critical habitat that are known to occur or could potentially occur in Oswego County, New York and Plymouth County, Massachusetts. (Accession No. ML040081088)
January 6, 2004	Letter from NRC to New England Ecological Services Office of the U.S. Fish and Wildlife Service, requesting a list of endangered, threatened, and candidate or proposed species and critical habitat that are known to occur or could potentially occur in Plymouth County, Massachusetts. (Accession No. ML040081108)

January 7, 2004	*Federal Register* Notice of Hearing and Opportunity to Petition for Leave to Intervene - Early Site Permit for the Grand Gulf Site, Docket No. 52-009. (Accession No. ML033430298)
January 7, 2004	Notice of public meeting to discuss the environmental scoping process for the Grand Gulf early site permit review. (Accession No. ML040090364)
January 8, 2004	Letter from NRC to the Mississippi Ecological Services Office of the U.S. Fish and Wildlife Service, requesting a list of endangered, threatened, and candidate or proposed species and critical habitat that are known to occur or could potentially occur in Claiborne, County, Mississippi. (Accession No. ML040090099)
January 8, 2004	Letter from NRC to the Louisiana Ecological Services Office of the U.S. Fish and Wildlife Service, requesting a list of endangered, threatened, and candidate or proposed species and critical habitat that are known to occur or could potentially occur in West Feliciana County, Louisiana. (Accession No. ML040090141)
January 8, 2004	Letter from NRC to the Choctaw Nation of Oklahoma inviting participation in the environmental scoping process for the Grand Gulf early site permit review. (Accession No. ML040090309)
January 8, 2004	Letter from NRC to the Tunika Biloxi Indian Tribe of Louisiana inviting participation in the environmental scoping process for the Grand Gulf early site permit review. (Accession No. ML040090330)
January 8, 2004	Letter from NRC to the Mississippi Band of Choctaw Indians inviting participation in the environmental scoping process for the Grand Gulf early site permit review. (Accession No. ML040090292)
January 8, 2004	Letter from NRC to the Mississippi Department of Archives and History regarding inclusion of analyses of the potential impact to historic properties in the environmental impact statement for an early site permit at the Grand Gulf site. (Accession No. ML040090125)
January 13, 2004	Letter from NRC to multiple addressees concerning environmental scoping meeting to be held in the Town Hall in Port Gibson, Mississippi on January 21, 2004. (Accession No. ML033530010)

January 21, 2004	Letter from Mississippi Field Office, U.S. Fish and Wildlife Service, responding to NRC letter dated January 8, 2004 and providing list of threatened and endangered species that could be found near the Grand Gulf site. (Accession No. ML040260250)
January 26, 2004	Letter from David A. Stilwell, U.S. Fish and Wildlife Service, New York Field Office, to P.T. Kuo, NRC, responding to NRC letter dated January 6, 2004, requesting a list of threatened and endangered species in the vicinity of the FitzPatrick Nuclear Power Plant, in the Town of Scriba, Oswego County, New York. (Accession No. ML040370323)
January 28, 2004	Letter from Northeast Region, National Oceanic and Atmospheric Administration Fisheries Service, responding to NRC letter dated January 6, 2004, and providing list of threatened and endangered species under National Oceanic and Atmospheric Administration Fisheries jurisdiction in the vicinity of the Grand Gulf site. (Accession No. ML040350504)
January 29, 2004	Letter from NRC to Mayor of Port Gibson, Mississippi, in appreciation of the facility used to host the Grand Gulf early site permit environmental scoping meeting on January 21, 2004. (Accession No. ML040330342)
February 5, 2004	Letter from Russell C. Watson, U.S. Fish and Wildlife Service, Louisiana Field Office, to P.T. Kuo, NRC, responding to NRC letter dated January 8, 2004, requesting a list of threatened and endangered species in West Feliciana Parish, Louisiana. (Accession No. ML040500681)
February 9, 2004	Letter from Michael J. Amaral, U.S. Fish and Wildlife Service, New England Field Office, to P.T. Kuo, NRC, regarding the application for an early site permit for the Grand Gulf ESP site. (Accession No. ML040650620)
February 18, 2004	Summary of public environmental scoping meeting held on January 21, 2004, in Port Gibson, Mississippi, related to application by Entergy for an early site permit for the Grand Gulf site. (Accession No. ML040510279, ML040510288 - package)

April 14, 2004	Letter from Mr. Curtis B. James, U.S. Fish and Wildlife Service, Mississippi Field Office, to Dr. Michael T. Masnik, NRC, providing information on federally listed threatened and endangered species as it pertains to the preparation of the environmental impact statement for the early site permit for the Grand Gulf site. (Accession No. ML041310449)
May 5, 2004	Summary of site audit to support the environmental review of early site permit for the Grand Gulf site. (Accession No. ML041270478)
May 11, 2004	Issuance of Environmental Scoping Summary Report associated with the staff's review of the application by SERI for an early site permit for the Grand Gulf site. (Accession No. ML041330230)
May 19, 2004	Letter from NRC to SERI requesting additional information related to the staff's environmental review of the Grand Gulf ESP. (Accession No. ML041420530)
May 19, 2004	Followup to Early Site Permit Application Environmental Audit - Response No. 1. (Accession No. ML041890361)
May 19, 2004	Followup to Early Site Permit Application Environmental Audit - Response No. 2. (Accession No. ML041470464)
July 1, 2004	Letter from System Energy Resources, Inc. transmitting their response to NRC's staff request for additional information (Letter No. 1). Available at http://www.nrc.gov/reading-rm/adams.html, Accession No. ML050380151.
July 2, 2004	Letter from Entergy to NRC transmitting responses to NRC staff's request for additional information regarding the staff's environmental review of the Grand Gulf ESP, Partial Response No. 1. (Accession No. ML050380156)
July 15, 2004	Letter from Entergy to NRC transmitting responses to NRC staff's request for additional information dated May 19, 2004, related to the staff's environmental review of the Grand Gulf ESP. (Accession No. ML041610345)

July 19, 2004	Letter from Entergy to NRC transmitting responses to NRC staff's request for additional information regarding to the staff's environmental review of the Grand Gulf ESP, Partial Response No. 2. (Accession No. ML050380151)
July 22, 2004	Letter from Entergy to NRC transmitting responses to NRC staff's request for additional information regarding to the staff's environmental review of the Grand Gulf ESP, Partial Response No. 3. (Accession No. ML050380170)
August 10, 2004	Letter from Entergy to NRC transmitting responses to NRC staff's request for additional information regarding to the staff's environmental review of the Grand Gulf ESP, Partial Response No. 4. (Accession No. ML050380162)
August 16, 2004	Followup to Early Site Permit Application Environmental Audit - Partial Response 5. (Accession No. ML042400267 - package)
August 16, 2004	Letter from Entergy to NRC transmitting responses to NRC staff's request for additional information regarding to the staff's environmental review of the Grand Gulf ESP, Letter 2, Partial Response No. 1. (Accession No. ML050380166)
August 26, 2004	Letter from NRC to W. A. Eaton, SERI, regarding supplemental request for additional information related to the staff's environmental review of the Grand Gulf ESP. (Accession No. ML042390512)
September 30, 2004	Letter from Entergy to NRC transmitting responses to NRC staff's request for additional information regarding to the staff's environmental review of the Grand Gulf ESP. (Accession No. ML042810132)
October 28, 2004	Letter from NRC to W.A. Eaton, SERI, regarding second supplemental request for additional information related to the staff's environmental review of the Grand Gulf ESP. (Accession No. ML043020633)
December 10, 2004	Letter from Entergy to NRC transmitting responses to NRC staff's request for additional information regarding to the staff's environmental review of the Grand Gulf ESP, Letter No. 5. (Accession No. ML050380174)

January 14, 2005	Letter from PNNL to NRC forwarding information gathered and referenced in the Grand Gulf early site permit environmental impact statement. (Accession No. ML050350147.
February 3, 2005	Letter from Entergy to NRC transmitting responses to NRC staff's request for additional information regarding the staff's environmental review of the Grand Gulf ESP. (Accession No. ML050380489)
February 14, 2005	Letter from Entergy to NRC transmitting responses to NRC staff's request for additional information regarding the environmental review of the Grand Gulf ESP. (Accession No. ML050470890)
February 18, 2005	E-mail from PNNL to NRC regarding correspondence for the Grand Gulf ESP between Entergy and PNNL on threatened and endangered species at Pilgrim Nuclear Station. (Accession No. ML050550333)
February 23, 2005	E-mail from Pacific Northwest Laboratories to NRC transmitting files containing logs of personal communication made in the process of updating Grand Gulf ESP EIS Chapters 2, 4, and 5 with Federally threatened and endangered species information. (Accession No. ML050600222)

Appendix D

Scoping Meeting Comments and Responses

Appendix D

Scoping Meeting Comments and Responses

On December 31, 2003, the U.S. Nuclear Regulatory Commission (NRC) published a Notice of Intent in the *Federal Register* (68 FR 75656) to notify the public of the staff's intent to prepare an environmental impact statement (EIS) to support the early site permit (ESP) application of System Energy Resources, Inc. for the proposed Grand Gulf ESP site. This EIS is being prepared in accordance with the National Environmental Policy Act of 1969 (NEPA), Council on Environmental Quality guidelines, and Title 10 of the Code of Federal Regulations (CFR) Parts 51 and 52. As outlined by NEPA, the NRC initiated the scoping process with the issuance of the *Federal Register* Notice. The NRC also invited the applicant; Federal, Tribal, State, and local government agencies; local organizations; and individuals to participate in the scoping process by providing oral comments at a scheduled public meeting and/or submitting written suggestions and comments no later than February 12, 2004.

The scoping process included a public meeting, which was held at the Port Gibson City Hall in Port Gibson, Mississippi, on January 21, 2004. The NRC announced the meeting in local newspapers (*The Clarion-Ledger* and the *Port Gibson Reveille*), issued press releases, and distributed flyers locally. Approximately 68 members of the public attended the meeting. This session began with NRC staff members providing a brief overview of the ESP process and the NEPA process. Following the NRC's prepared statements, the meeting was opened for public comments. Eighteen (18) attendees provided either oral comments or written statements that were recorded and transcribed by a certified court reporter. The transcript of the meeting can be found as an attachment to the meeting summary, which was issued on February 18, 2004. Additional comments received after the meeting are also available. The meeting summary is available for public inspection by local residents at the Harriette Person Memorial Library. The meeting summary is also available in the NRC Public Document Room or electronically from the Publicly Available Records (PARS) component of NRC's document system (ADAMS) under accession number ML0040510288. ADAMS is accessible from the NRC website at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room). Note that the URL is case-sensitive.

The scoping process provides an opportunity for public participants to identify issues to be addressed in the EIS and highlight public concerns and issues. The Notice of Intent identified the following objectives of the scoping process:

- define the proposed action which is to be the subject of the EIS

- determine the scope of the EIS and identify significant issues to be analyzed in depth

- identify and eliminate from detailed study those issues that are peripheral or that are not significant
- identify any environmental assessments and other EISs that are being prepared or will be prepared that are related to but not part of the scope of the EIS being considered
- identify other environmental review and consultation requirements related to the proposed action
- indicate the relationship between the timing of the preparation of the environmental analyses and the Commission's tentative planning and decision making schedule
- identify any cooperating agencies and, as appropriate, allocate assignments for preparation and schedules for completing the EIS to the NRC and any cooperating agencies
- describe how the EIS will be prepared and include any contractor assistance to be used.

At the conclusion of the scoping period, the NRC staff and its contractor reviewed the transcripts and all written material received and identified individual comments. Forty-seven (47) emails containing comments were also received during the scoping period. All comments and suggestions received orally during the scoping meeting or in writing were considered. Each set of comments from a given commenter was given a unique alpha identifier (commenter ID letter), allowing each set of comments from a commenter to be traced back to the transcript, letter, or email in which the comments were submitted.

Preparation of the EIS will take into account all the relevant issues raised during the scoping process. The EIS will be made available for public comment. The comment period for the EIS will offer the next opportunity for the applicant; interested Federal, Tribal, State, and local government agencies; local organizations; and members of the public to provide input to the NRC's environmental review process. The comments received on the draft EIS will be considered in the preparation of the final EIS. The final EIS, along with the staff's Safety Evaluation Report, will provide much of the basis for the NRC's decision on whether to grant System Energy Systems, Inc. an ESP.

Each comment applicable to this environmental review is summarized in this appendix. This information, which was extracted from the *Grand Gulf Scoping Summary Report*, is provided for convenience of those interested in the scoping comments applicable to this environmental review. The comments that are general or outside the scope of the environmental review for the proposed Grand Gulf ESP site are not included here. More detail regarding the disposition of general or inapplicable comments can be found in the summary report. The ADAMS accession number for the summary report is ML0040510288. This accession number is provided to facilitate access to the document through the Public Electronic Reading Room (ADAMS) at http://www.nrc.gov/reading-rm.html.

Table D-1 identifies individuals who provided comments and the Commenter ID number associated with each person's set(s) of comments. The individuals are listed in the order in which they spoke at the public meeting and in alphabetical order for the comments received by letter or e-mail.

Table D-1. Individuals Providing Comments During Scoping Comment Period

Commenter ID	Commenter	Affiliation (if stated)	Comment Source and ADAMS Accession #
A	George A. Williams	Entergy	Public Meeting Transcript (ML040360176)
B	Curtis James	U.S. Fish and Wildlife Service	Public Meeting Transcript (ML040360176)
C	Landon Huey	Concerned Citizen	Public Meeting Transcript (ML040360176)
D	Paul Gunter	Nuclear Information Resource Service	Public Meeting Transcript (ML040360176)
E	A. C. Garner	Claiborne County Chapter, National Association for the Advancement of Colored People	Public Meeting Transcript (ML040360176)
F	Soloman Wilson	Concerned Citizen	Public Meeting Transcript (ML040360176)
G	Rose Johnson	Mississippi Chapter Sierra Club	Public Meeting Transcript (ML040360176)
H	Evan Doss, Jr.	Concerned Citizen	Public Meeting Transcript (ML040360176)
I	Nathalie Walker	Advocates for Environmental Human Rights	Public Meeting Transcript (ML040360176)

Table D-1. (contd)

Commenter ID	Commenter	Affiliation (if stated)	Comment Source and ADAMS Accession #
J	Alexander Martin	Concerned Citizen	Public Meeting Transcript (ML040360176)
K	Becky Gillette	Mississippi Chapter Sierra Club	Public Meeting Transcript (ML040360176)
L	Martha Ferris	Concerned Citizen	Public Meeting Transcript (ML040360176)
M	J. Scott Peterson	Nuclear Energy Institute	Public Meeting Transcript (ML040360176)
N	Phil Segrest	Concerned Citizen	Public Meeting Transcript (ML040360176)
O	Monique Harden	Advocates for Environmental Human Rights	Public Meeting Transcript (ML040360176)
P	Jerry Landrum	Concerned Citizen	Public Meeting Transcript (ML040360176)
Q	Ruth Pullen	Concerned Citizen	Public Meeting Transcript (ML040360176)
R	David Ritter	Public Citizen/Critical Mass	Public Meeting Transcript (ML040360176)
S	Claiborne County Chapter, NAACP	Concerned Citizen	Attachment to Transcript (ML040360176)
T	J. Scott Peterson	Nuclear Energy Institute	Attachment to Transcript (ML040360176)
U	Cheryl Catranbone	Concerned Citizen	E-Mail (ML040540768)
V	Barbara Powell	Concerned Citizen	E-Mail (ML040540776)
W	Edward A. Mainland	Concerned Citizen	E-Mail (ML040540774)
X	Ned Ford	Concerned Citizen	E-Mail (ML040540772)

Table D-1. (contd)

Commenter ID	Commenter	Affiliation (if stated)	Comment Source and ADAMS Accession #
Y	Gilbert Woolley	Concerned Citizen	E-Mail (ML040540766)
Z	Reilly Morse	Concerned Citizen	E-Mail (ML040540765)
AA	Lorraine Kitman	Concerned Citizen	E-Mail (ML040540755)
AB	Jane W. Lusk	Concerned Citizen	E-Mail (ML040540857)
AC	Tony Bland	Concerned Citizen	E-Mail (ML040540758)
AD	Cynthia Sarthou	Gulf Restoration Network	E-Mail (ML040540753)
AE	Mark M. Gonzalez	Concerned Citizen	E-Mail (ML040540787)
AF	Julianna Padgett	Concerned Citizen	E-Mail (ML040540783)
AG	Micah Walker Parkin	Alliance for Affordable Energy	E-Mail (ML040540795)
AH	Wendy King	Concerned Citizen	E-Mail (ML040540793)
AI	Leonard Levine	Concerned Citizen	E-Mail (ML040540791)
AJ	Paula Vassey	Concerned Citizen	E-Mail (ML040540797)
AK	Videojan	Concerned Citizen	E-Mail (ML040540799)
AL	Paul Gunter	Nuclear Information and Resource Service	E-Mail (ML040540801)
AM	Ruth Pullen	Concerned Citizen	E-Mail (ML040540802)
AN	Chris Holly	Concerned Citizen	E-Mail (ML040540812)
AO	Tom Pullen	Concerned Citizen	E-Mail (ML040540805)
AP	Tiffany Elyce Crane	Concerned Citizen	E-Mail (ML040540821)
AQ	Charlie Brenner	Concerned Citizen	E-Mail (ML040540826)
AR	Susan Hall	Concerned Citizen	E-Mail (ML040540827)
AS	Marianne Hill	Concerned Citizen	E-Mail (ML040540829)
AT	Ginnette Lolli	Concerned Citizen	E-Mail (ML040540831)

Table D-1. (contd)

Commenter ID	Commenter	Affiliation (if stated)	Comment Source and ADAMS Accession #
AU	Betty Daugherty	Concerned Citizen	E-Mail (ML040540834)
AV	Tom Mann	Concerned Citizen	E-Mail (ML040540836)
AW	Alex Major	Concerned Citizen	E-Mail (ML040540839)
AX	K. Brad Ott	Concerned Citizen	E-Mail (ML040540843)
AZ	J. Scott Peterson	Nuclear Energy Institute	E-Mail (ML040540761)
BA	Solomon S. Wilson	Claiborne County Hospital	E-Mail (ML040780554)
BB	Patricia Neveleff	Concerned Citizen	E-Mail (ML040540780)
BC	Davis Mounger	Concerned Citizen	E-Mail (ML040540782)
BD	Martha Ferris	Concerned Citizen	E-Mail (ML040540786)
BE	William Ferris	Concerned Citizen	E-Mail (ML040540792)
BF	Takasha Lewis	Concerned Citizen	E-Mail (ML040540798)
BG	Michael Berk	Mississippi State University	E-Mail (ML040540751)
BH	Bob Kochtitzky	Mississippi 2020 Network	E-Mail (ML040540752)
BI	Sallie E. Davis	Concerned Citizen	E-Mail (ML040540760)
BJ	Becky Gillette	Mississippi Chapter Sierra Club	E-Mail (ML040540764)
BK	Judy Treichel	Concerned Citizen	E-Mail (ML040540769)
BL	Arthur D. Unger	Concerned Citizen	E-Mail (ML040540773)
BM	Christine Blair	Concerned Citizen	E-Mail (ML040540799)
BN	Lavaree Jones	Concerned Citizen	E-Mail (ML040540845)
BO	Christine Murphey	Concerned Citizen	E-Mail (ML040540853)
BP	Katherine B. Senter	Concerned Citizen	E-Mail (ML040540861)

The comments that are considered in the evaluation of the environmental impact in this EIS are summarized in the following pages. To review all the comments received during scoping, refer to the meeting summary (Accession No. ML040510288). The responses provided here have been updated to provide the appropriate section in the EIS where the subject is addressed.

Parenthetical numbers after each comment refer to the commenter's ID letter and the comment number. Comments can be tracked to the commenter and the source document through the ID letter and comment number listed in Table D-1.

Comments are grouped by the following categories:

D.1 Comments Concerning Air Quality
D.2 Comments Concerning Surface Water Use and Quality
D.3 Comments Concerning Aquatic Ecology
D.4 Comments Concerning Threatened or Endangered Species
D.5 Comments Concerning Socioeconomics
D.6 Comments Concerning Environmental Justice
D.7 Comments Concerning Radiological Impacts
D.8 Comments Concerning Uranium Fuel Cycle and Waste Management
D.9 Comments Concerning Decommissioning
D.10 Comments Concerning Cumulative Impacts
D.11 Comments Concerning Alternative Energy Sources and Conservation
D.12 Comments Concerning Operational Safety.

D.1 Air Quality

Comment: Nuclear power is clean, and it is emission-free. You can easily get a lot of large generation with one unit. (A-4)

Comment: Today, nuclear energy provides electricity to power one out of every five U.S. homes and businesses. It is the only large-scale, emission-free electricity source that can be readily expanded. Nuclear power plants do not produce sulfur dioxide, nitrogen oxides or the major greenhouse gas, carbon dioxide. I can see every day that we will need more electricity – and we will also need clean air. With nuclear energy, we can have both. Entergy's Grand Gulf Station generates about one-fifth of this state's power. In 2002, operation of Grand Gulf avoided the emission of nearly 50,000 tons of sulfur dioxide and more than 20,000 tons of nitrogen oxide to the state's atmosphere, compared to what would have been emitted by fossil electric generating plants. (T-4)

Comment: Today, nuclear energy provides electricity to power one out of every five U.S. homes and businesses. It is the only large-scale, emission-free electricity source that can be readily expanded. Nuclear power plants do not produce sulfur dioxide, nitrogen oxides or the major greenhouse gas, carbon dioxide. (AZ-4)

Response: The impacts on air quality resulting from construction and operation of proposed units at Grand Gulf are discussed in Chapters 4 and 5 of the environmental impact statement.

D.2 Surface Water Use and Quality

Comment: The impacts on the Mississippi River arising from any increased intake of cooling water for the operation of any new proposed nuclear power units should be included. Now, Grand Gulf right now operates on a cooling tower, and that does provide some reduced impact on the Mississippi as it were – and like most other units draw directly from the water source, and they discharge directly into the water source. But we don't know for a fact that this new design won't in fact use a once-through cooling system, which might be taking in as much as 2-1/2 billion gallons of water a day out of the Mississippi River. And because we are not being provided with a specific design, we don't really know what the water intake is. So in fact again all the potential impacts on the Mississippi River arising from that need to be incorporated into this environmental impact statement. Also, all the impacts associated with the possibility of flooding of the Mississippi River on the safe operation of this proposed facility, as well as the existing facility, but clearly we have seen indications that the flooding and the river itself can change. So clearly an environmental impact statement needs to take into account and closely study how changes in the Mississippi River might affect future operation. (D-5)

Response: The impact from any cooling system using the parameters identified in the plant parameter envelope (PPE) have been be reviewed in accordance with the environmental standard review plan (NUREG-1555) and discussed in the EIS in Sections 4.3 and 5.3. At this time, the applicant has indicated that a closed cooling system employing a cooling tower will be used and not a once-through cooling system. Therefore, the early site permit will not consider once-through cooling. If the applicant were subsequently to decide that they were interested in once-through designs it would require a new application. The particular cooling system ultimately chosen by the applicant will have to fall within the PPE submitted by the applicant. The impact associated with the possibility of flooding of the Mississippi River on the safe operation of the existing facility is outside the scope of this EIS. The impact associated with the possibility of flooding of the Mississippi River on the safe operation of this proposed facility was reviewed as part of the Site Safety Analysis Report per 10 CFR 52.17 and the NRC's Office of Nuclear Reactor Regulation Review Standard RS-002 Section 2.4, and is presented in the Safety Evaluation Report Section 2.4. This topic also is outside the scope of this EIS.

Comment: The EIS for the Grand Gulf nuclear power station is therefore required to address all of the following. All impacts on the Mississippi River arising from any increased intake of reactor cooling water for the operation of any proposed new nuclear power units. (AL-1)

Response: Impact on the Mississippi River arising from any increased intake of reactor cooling water for the operation of any proposed new nuclear power units was reviewed in accordance *with the environmental standard review plan (NUREG-1555, Section 5.2) and discussed in the EIS in Sections 4.3 and 5.3.*

Comment: The EIS for the Grand Gulf nuclear power station is therefore required to address all of the following. All impacts on the Mississippi River arising from the increase in the routine discharge of chemicals, heavy metals, cleaning solvents, biocides and radioactive isotopes into the Mississippi River arising from the operation of additional nuclear power units. (AL-4) (D-8)

Response: *Impact on the Mississippi River arising from the increase in the routine discharge of chemicals, heavy metals, cleaning solvents, and biocides into the Mississippi River arising from the operation of additional nuclear power units was reviewed in accordance with the environmental standard review plan (NUREG-1555, Section 5.2) and discussed in the EIS in Sections 4.3 and 5.3. Impact on the Mississippi River arising from the radioactive isotopes released into the Mississippi River from the operation of additional nuclear power units was reviewed in accordance with the environmental standard review plan (NUREG-1555) and discussed in the EIS in Sections 4.3 and 5.3.*

D.3 Aquatic Ecology

Comment: Well, wetlands, and I don't even know if wetlands, since it is on this site, would even be involved, but that would be a concern to the Fish and Wildlife Service. (B-1)

Comment: All impacts on the aquatic environment of the Mississippi River arising out of any increase in thermal discharge into the river from cooling water need to be addressed from these additional units. (D-6)

Comment: All impacts on the Mississippi River arising from the increased impingement and entrainment, or the sucking in and pinning of fish or fish spawn, or other aquatic life and nutrients arising out of increased reactor cooling water intake. (D-7)

Comment: When I was a child, I would go to that creek and I would kick over rocks, and I would walk it, and I would fish out of it. So when I got back, I went to the creek again. And I went down and I picked up a rock. Now, years ago when I picked up a nice-sized rock, I would find nice little crawly things under it. Sometimes just little crawling things under it. But when I came back this time, I picked up a rock, and I looked, and there was nothing there. And then I thought that nuclear power plant. (F-1)

Comment: I would like to emphasize the need to truly look at all those things, and then as you do the impact study, to make sure that we are informed in a very meaningful way on whether or not when I catch a fish over there in Louisiana that has a funny look on it, and got a little growth on it, I think nuclear power plant, and I need to know that it is not. (F-3)

Comment: All impacts on the aquatic environment of Mississippi River arising from any increase in thermal discharge of reactor cooling water as result of the operation of additional nuclear power units. (AL-2)

Comment: All impacts on Mississippi River arising from the increased impingement and entrainment of fish, fish spawn, other aquatic life and nutrients arising from the increased reactor cooling water intake for any proposed additional nuclear power units. (AL-3)

Comment: All impacts on the Mississippi River arising from any increased intake of reactor cooling water for the operation of any proposed new nuclear power units. (AL-20)

Response: *The impacts on aquatic ecology resulting from construction and operation of proposed units at Grand Gulf are discussed in Chapters 4 and 5 of the EIS.*

D.4 Threatened or Endangered Species

Comment: Federally-listed species, and those would include the endangered Interior least tern, the endangered pallid sturgeon found in the lower Mississippi River. The threatened Bayou darter, and I am not saying – I am saying that these would be species that we would be concerned with and inform the NRC. The threatened bald eagle, and the Federally-listed threatened Louisiana black bears. Particularly secondary impacts to threatened and endangered species. (B-2)

Response: *The U.S. Nuclear Regulatory Commission (NRC) consulted with the U.S. Fish and Wildlife Service (USFWS) to request a list of Federal threatened, endangered, proposed, and candidate species that are known to occur, or that potentially could occur, on the Grand Gulf site or in the vicinity (and on or in the vicinity of the alternate sites) and that could thus be impacted by activities that are the subject of the EIS for the Grand Gulf early site permit. The NRC also requested from USFWS a statement of concerns regarding such species. NRC evaluated impacts, both direct and indirect, to such species in consideration of the concerns expressed by the USFWS. NRC presented these results in Chapters 4 and 5 of the EIS.*

D.5 Socioeconomics

Comment: Shame on you, [Entergy], trying to hold the Claiborne County residents hostage because of job shortages. (G-6)

Comment: But back to the tax issue. The money was divvied up by the Legislature to the other counties, and their rationale was that the people from the other counties were paying an electric bill that came from Grand Gulf, and therefore they ought to benefit some back from it. Well, I think that we ought to take that same thing and I think we ought to challenge our political leaders in the county here, and in the city, to go back to the Legislature and say our people go to the gaming facilities in Vicksburg, and we want our share of that money. (N-2)

Comment: We have talked about the poverty level, and the poverty level here is because we don't have enough industry, and that's why I say can anybody really say that we have not all benefitted from what Grand Gulf has brought to this county. I would hate to think where we are now or where we would be now if we had not had the benefits from Grand Gulf. So we need to address education and how our money is being spent, more than how much more money we need, although I do agree that we need more. (N-8)

Response: *The basis of these comments is not clear. Existing socioeconomic conditions, including tax payments, are covered in Chapter 2 of the EIS and the potential impact of new plants in Chapters 4 and 5.*

Comment: Due to a lack of adequate distribution of local tax revenue from the plant, local government and emergency services are prevented from being fully prepared to protect the public health and safety and provide an adequate emergency plan. (S-12)

Comment: One major concern is inadequate emergency planning and infrastructure in Claiborne County and beyond. Due to the Mississippi Legislature's decision to take away $200 million in tax revenues generated from Grand Gulf and give them to other counties in the state, Claiborne County's emergency planning infrastructure is woefully underfunded to deal with the present nuclear plant – let alone a new plant. There is not adequate money available to fund the Sheriff's Department, Civil Defense or the Fire Department. There is only one fire station in the rural county, and the hospital in Port Gibson is not open 24 hours per day. The radiological emergency plan relies heavily on teachers to shelter and evacuate school children without obtaining adequately informed consent or any statutory authority. There are significant impediments to emergency planning to safeguard area residents in case of an accident or act of terrorism at the facility. (U-7)

Comment: One major concern is inadequate emergency planning and infrastructure in Claiborne County and beyond. Due to the Mississippi Legislature's decision to take away $200 million in tax revenues generated from Grand Gulf and give them to other counties in the state, Claiborne County's emergency planning infrastructure is woefully underfunded to deal with the present nuclear plant-let alone a new plant. There is not adequate money available to fund the Sheriff's Department, Civil Defense or the Fire Department. There is only one fire station in the rural county, and the hospital in Port Gibson is not open 24 hours per day. The radiological emergency plan relies heavily on teachers to shelter and evacuate school children without obtaining adequately informed consent or any statutory authority. (X-12) (AE-8) (BE-8) (BF-8) (BH-8) (BJ-9)

Comment: Another important concern is inadequate emergency planning and infrastructure in Claiborne County and beyond. Claiborne County's emergency planning infrastructure is woefully underfunded to deal with the present nuclear plant – let alone a new plant, because the Mississippi Legislature took away $200 million in tax revenues generated from Grand Gulf and give it to other counties in the state. There is not adequate money available to fund the Sheriff's Department, Civil Defense or the Fire Department. There is only one fire station in the rural county, and the hospital in Port Gibson is not open 24 hours per day. The radiological emergency plan relies heavily on teachers to shelter and evacuate school children without obtaining adequately informed consent or any statutory authority. (Z-6)

Comment: Not unlike other nuclear power plant sites, a major concern is inadequate emergency planning and infrastructure. Specifically though, due to the Mississippi Legislature's decision to take away $200 million in tax revenues generated from Grand Gulf from Claiborne County and give them to other counties in the state, Claiborne County's emergency planning infrastructure is woefully underfunded to deal with the present nuclear plant – let alone a new plant. There is not adequate money available to fund the Sheriff's Department, Civil Defense or the Fire Department. There is only one fire station in the rural county, and the hospital in Port Gibson is not open 24 hours per day. The radiological emergency plan relies heavily on teachers to shelter and evacuate school children without obtaining adequately informed consent or any statutory authority. Obviously, there are significant impediments to emergency planning to safeguard area residents in case of an accident or act of terrorism at the facility. (AA-7)

Comment: Moreover, Claiborne County's emergency planning infrastructure is woefully under funded and could not adequately deal with any incident at the present nuclear plant – let alone a new plant. Sadly, existing emergency planning and infrastructure in Claiborne County and beyond are simply inadequate to address a potential incident. (AD-8)

Comment: There has been little emergency planning to safeguard area residents and there does not appear to be resources for emergency planning for a new plant, in case of an accident or act of terrorism at the facility. (AF-10)

Comment: Another major concern is inadequate emergency planning and infrastructure in Claiborne County and beyond. Money that should be available for this planning, has been distributed to other counties in Mississippi. This has left Claiborne County's emergency planning infrastructure extremely underfunded to deal with the present nuclear plant and unable to add a new plant. If we look at all the related services, it can be seen that there is not adequate money available to fund the Sheriff's Department, Civil Defense or the Fire

Department. There is only one fire station in the rural county, and the hospital in Port Gibson is not open 24 hours per day. Unfortunately, the emergency plan relies heavily on teachers to shelter and evacuate school children, even though the teachers may not have obtained consent from parents and guardians. This heavy burden should not be born just by the teachers. There needs to be a coordinated system of emergency services. (AF-11)

Comment: Another major concern is information we have received regarding inadequate emergency planning and infrastructure in Claiborne County. The Mississippi Legislature's decision to take away $200 million in tax revenues generated from Grand Gulf and give them to other counties in the state has crippled Claiborne County's emergency planning infrastructure leaving it underfunded and unprepared to deal with the present nuclear plant, much less a new plant. It has been brought to our attention that there is not adequate money available to fund the Sheriff's Department, Civil Defense or the Fire Department, there is only one fire station in the rural county, the hospital in Port Gibson is not open 24 hours per day, and the radiological emergency plan relies heavily on teachers to shelter and evacuate school children without obtaining adequately informed consent or any statutory authority. This is far from the ideal scenario should the worst occur. (AG-7)

Comment: One of my major concerns about your permitting this nuclear power plant is inadequate emergency planning and infrastructure in Claiborne County and beyond. Due to the Mississippi Legislature's decision to take away $200 million in tax revenues generated from Grand Gulf and give them to other counties in the state, Claiborne County's emergency planning infrastructure is woefully underfunded to deal with the present nuclear plant, let alone a new plant. There is not adequate money available to fund the Sheriff's Department, Civil Defense or the Fire Department. There is only one fire station in the rural county, and the hospital in Port Gibson is not open 24 hours per day. The radiological emergency plan relies heavily on teachers to shelter and evacuate school children without obtaining adequately informed consent or any statutory authority. (AH-8)

Comment: One primary concern is inadequate emergency planning and infrastructure in Claiborne County and beyond. Due to the Mississippi Legislature's decision to take away $200 million in tax revenues generated from Grand Gulf and give them to other counties in the state, Claiborne County's emergency planning infrastructure is woefully underfunded to deal with the present nuclear plant – let alone a new plant. There is not enough money to fund the Sheriff's Department, Civil Defense or the Fire Department. There is only one fire station in the rural county, and the hospital in Port Gibson is not open 24/7. The radiological emergency plan relies heavily on teachers to shelter and evacuate school children without obtaining adequately informed consent or any statutory authority. (AI-8)

Comment: I am also concerned about the inadequate emergency planning and infrastructure in Claiborne County and beyond. Claiborne County's emergency planning infrastructure is too under-funded to deal with the present nuclear plant – let alone a new plant. There is not adequate money available to fund the Sheriff's Department, Civil Defense or the Fire Department. There is only one fire station in the rural county, and the hospital in Port Gibson is not open 24 hours per day. (AM-8) (AQ-8) (AS-11) (AW-9) (BN-10)

Comment: I am also concerned about the inadequate emergency planning and infrastructure in Claiborne County and beyond. Claiborne County's emergency planning infrastructure is too under-funded to deal with the present nuclear plant – let alone a new plant. (AO-7)

Comment: Another major concern is that of inadequate emergency planning and infrastructure in Claiborne County and beyond. Claiborne County's emergency planning infrastructure is woefully under funded and currently, the county cannot even support the present nuclear plant, let alone a new facility. There is only one fire station in the rural county, and the hospital in Port Gibson is not open 24 hours per day. The radiological emergency plan relies heavily on teachers to shelter and evacuate school children without obtaining adequately informed consent or any statutory authority. There are significant impediments to emergency planning, thus providing no safeguard to area residents in case of an accident or act of terrorism. (AP-8)

Comment: I am also concerned for security reasons since the infra structure in Claiborne County is under funded and not developed. (AU-4)

Comment: New Orleans has no evacuation plan for hurricanes. What's the point? There's no way out! If the area can't handle mother nature, how are we suddenly going to become savvy in emergency planning and infrastructure compensation in case of a nuclear power plant breakdown? Claiborne County in Mississippi, the site of the plant, lost $200 million in tax revenues generated from Grand Gulf due to a state legislative redistribution. The County is underfunded to deal with the present nuclear plant-let alone a new plant. There is only one fire station in the county! Not only is the proposal life-threatening to the community, it is socially irresponsible as well. (BO-6)

Response: *The economic consequences of implementing the emergency preparedness plan from proposed construction and operation of the Grand Gulf units are addressed in Chapters 4 and 5 of the EIS.*

Comment: All impacts on public health and safety arising out of a severe accident, including the impacts of the accident itself, sheltering, evacuation, radiation exposure, treatment, and reoccupation, or relocation of populations, entire communities, and as we have seen in the accident that happened at the [Chernobyl] Power Station. (D-11)

Comment: Claiborne County was receiving all of the tax monies that came to this county. Well, sometime during that particular period, it was decided that the monies needed to be redistributed, okay? And what happened was that Claiborne County ended up receiving just a small portion, and the rest of it was distributed to other counties. (E-2)

Comment: With respect to the tax revenues generated by the facility, and you have heard a little bit about that already tonight, and I understand that could be a huge issue. And if you are getting huge tax benefits and you want to take the attendant risks, I am not here to judge you. But that is not the situation that you are in. Claiborne County receives a very small portion of the tax revenues generated by the facility. That was not true at first, but soon after the facility began operating, it all changed. So that there are now 48 counties that share the tax revenues generated by the facility. The facility is not in 48 counties, It is in this county, and since that change happened, we are basically talking about somewhere in the neighborhood of $200 million that should have come to this county. (I-3)

Comment: One cost that you have to look at is the Gulf of Mexico. If there is an accident at this plant, and it goes down the Mississippi River, you will destroy the seafood industry that now creates hundreds of millions of dollars in revenue and food for people to eat. (K-4)

Comment: There are tax benefits here even though the tax money, a large portion of it, was taken away from the county, and I think that Mr. Doss, who was a tax collector here and assessor for a number of years, could attest to this. (N-7)

Comment: And I guess the main thing that I wanted to talk about that some people have kind of referred to, but I would like to go into a little more detail, is the issue of the contamination of the Mississippi River in the case of catastrophic accident or a high release of nuclear waste. I think Becky addressed the issue of the fisheries, but if this river was contaminated many of the communities the length of the river from here down depends on the river for water, and there is an industrial corridor from Baton Rouge to New Orleans that depends on the river water for all their industrial usage. New Orleans itself depends on the river for drinking water, and there is also the issue of wetlands, which have been used for water purification and hurricane mitigation. There is the fisheries, and also the current could potentially carry this waste from Florida to Texas. So you are talking about just incomprehensible damage if this whole area was contaminated, and I think that is something that really needs to be considered. (Q-2)

Comment: Benefits to this area briefly with 11 percent unemployment for Claiborne County, and I guess within the last decade or so there has been a loss of population to the county, this is not typically interpreted as something as signs of a prosperous area when you are losing population, and you have unemployment rates like that. (R-10)

Comment: The deeper one digs into the past and present practices of the nuclear industry, the less supportable it becomes. I understand this plant is to be sited in a community with little economic resources, and there will probably be promised of riches to be had in the form of property tax relief, or new schools and hospitals, or the other similar bribes that have been offered to similar communities in the past. Well, in Ohio, we cannot point to a single person who has died from radioactive exposure from the nuclear plants here. However, as much of the State has experienced the loss of billions of dollars in the form of disproportionate rate increases for a modest amount of power, it is inevitable that thousands of lives have been lost and will be lost because of the degradation of public services, personal and corporate wealth and the other impacts of draining a few percentage points of the entire local economy have accrued. (X-9)

Comment: All potential socio-economic impacts from the elevated national security requirements and countermeasures to protect a larger target of terrorism with the expansion of the nuclear power station site including the indefinite and possibly permanent closure of Mississippi River to public access for commercial, sporting, recreation and other means of economic livelihood. (AL-21)

Response: *Distribution of tax monies for the existing plants is described in Chapter 2 of the EIS. The impact on government finances of construction and operation of the proposed plants will be described in Chapters 4 and 5.*

Comment: The distribution of tax revenues, and who bears the risks, and who reaps the benefits; and existence and/or adequacy of the emergency evacuation plans; and environmental justice issues, and this is huge, and class and race issues and they must be addressed. (R-2)

Response: *U.S. Nuclear Regulatory Commission staff analyzed both socioeconomic and environmental impact from an environmental justice perspective in Chapters 4 and 5 of the EIS.*

Comment: Terrorist sabotage or accidents could poison the Mississippi River, New Orleans, and the Gulf of Mexico. Damage could affect seafood industries that bring in millions of dollars of benefits to the state economy. (W-5)

Comment: All socio-economic impacts arising out of a severe nuclear accident at an expanded Grand Gulf site on the including commerce on the Mississippi River and the Gulf of Mexico fishing industry. (AL-8)

Comment: It is also near an area of the River that would allow easy access for terrorists, particularly from a boat or barge. An accident or act of sabotage at this facility and its stored nuclear waste could contaminate the Mississippi River and the Gulf of Mexico. This would be disastrous to the communities downstream that depend on the River for drinking water. Also, the extensive industrial corridor between Baton Rouge and New Orleans depends on the River water for processing. These industries would have to be shut down. Contamination of vital wetlands that provide 'nurseries' for larval and other developmental stages of fish, for shrimp, oysters, etc., could devastate the seafood industry. Certainly the tourist industries in Florida, Mississippi, Louisiana, and Texas would be affected. We are talking potentially billions of dollars and innumerable lives lost or changed because of an accident at this plant. (AM-9)

Comment: An accident or act of sabotage at this facility and its stored nuclear waste could contaminate the Mississippi River and the Gulf of Mexico. This would be disastrous to the communities downstream that depend on the River for drinking water. Also, the extensive industrial corridor between Baton Rouge and New Orleans depends on the River water for processing. These industries would have to be shut down and shipping on the MS River curtailed. Contamination of vital wetlands that provide 'nurseries' for larval and other developmental stages of fish, shrimp, oysters, etc., could devastate the seafood industry. Additionally, the tourist industries in Florida, Mississippi, Louisiana, and Texas would be affected. We are talking potentially billions of dollars and innumerable lives lost or changed because of an accident at this plant. (AO-8)

Comment: An increased threat to human health is not the only serious risk that this facility will pose, it can also be devastating economically. If the environment becomes contaminated, we can lose the very foundation upon which we depend for sustenance. Most areas along the river are agricultural, supplying the nation with food crops for human consumption and animal feed. Those crops not directly consumed by people will eventually be consumed through the foodweb. Other industries such as gaming (hunting and fishing) and seafood harvest could be destroyed. Economic collapse would be inevitable and billions of dollars lost. (AP-5)

Comment: An increased threat to human health is not the only serious risk that this facility will pose, it can also be devastating economically. If the environment becomes contaminated, we can lose the very foundation upon which we depend for sustenance. Most areas along the river are agricultural, supplying the nation with food crops for human consumption and animal feed. Those crops not directly consumed by people will eventually be consumed through the foodweb. Other industries such as gaming (hunting and fishing) and seafood harvest could be destroyed. Economic collapse would be inevitable and billions of dollars lost. (AP-9)

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Comment: Before NRC considers granting this preliminary permit, it should answer a number of questions: How would a release of radiation affect the seafood industry and agriculture in the area? (BI-6)

Response: *The economic impact of postulated accidents was evaluated, and the results are presented in Chapters 4 and 5 of the EIS.*

Comment: There are very few Port Gibson residents that have jobs at that facility. It is a small percentage, and it is a small portion. (I-2)

Response: *The geographic distribution of current Grand Gulf employment is covered in Chapter 2 of the EIS and the impact of new plants on the employment in the area in Chapters 4 and 5.*

Comment: You hear a lot about the jobs, and that is an issue that can't be avoided by anyone that wants to take the issue seriously whether a new plant makes sense or not. But I did appreciate the comments from Rose Johnson that it is a false choice or a bad choice when a community needs to choose between their health and future generation's health, and being able to have some kind of job to put the food on the table and a roof over one's head. (R-12)

Comment: It is hard to persuade other needed businesses to come to small towns, much less to come and locate next to a nuclear reactor facility, that is knowingly storing onsite, cancer causing toxic nuclear waste. In effect the permitting board is sentencing a community to die or become ill. (AJ-7)

Comment: As a historically poor state Mississippi has [lagged] behind in industrial and commercial [development]. Some might believe that we are behind the curve, I would argue that this has given us the opportunity to see how industrial and commercial [development] has affected the areas this type [development] have been implemented. At this time, Mississippi is trying to catch up and bring in new development and jobs. As a long time resident of this state I believe it is time we start looking at the consequences of such decisions, learn from what has happened and use that information to put ourselves ahead of the game. I do not believe that this plant will put us ahead of the game and make us more attractive to future [business] and [development]. (AT-3)

Response: *These comments on future business development opportunities facing the local community are not within the scope of the EIS. They have not been considered further in the staff's environmental review.*

Comment: How can we even consider adding another nuclear reactor when Entergy has failed to deliver on its 25 or so year old promise of job creation in this area. What happened, and why is there now double-digit unemployment in this area, which is one or among the highest in the State of Mississippi. And in addition to the unemployment, you have to add to that is the situation that you have a situation where the young people who work here move away. Why? Because they don't have the kinds of job opportunities that they would be interested in pursuing and they work elsewhere. (O-6)

Comment: Grand Gulf has been less than responsible to the surrounding community, specifically Claiborne County, in hiring, training, and promoting its citizens in that the majority of Grand Gulf's permanent workforce do not live in Claiborne County. (S-6)

Response: *These comments on actions not taken and not required of the applicant by any regulatory body are not within the scope of the EIS. They are not considered further in the staff's environmental review.*

D.6 Environmental Justice

Comment: The comment about the racism and where nuclear power plants are located. With 103 reactors that are in the country, a large percentage, and I would say greater than 90 percent, are located in non-minority areas. And I know that a lot of people are thinking that this is a race issue, we just need to make sure that we get the information correct, and I would say that if at all that I felt that the issue of potentially building another unit at Grand Gulf was potentially racial in nature that I would not be standing here tonight, and that is one thing that I can tell you for sure. (A-11)

Comment: And finally all of the above need to be considered as environmental justice issues given that the risks and the hazards associated with Grand Gulf site expansion disproportionately impact the people of Claiborne County, given that the county is 84 percent African-American, with 34 percent living under the poverty line, with a per capita income of $11,000 annually, and that is from the Census data from 2000. (D-12)

Comment: Once again in Mississippi, low income African-Americans are being placed at the greatest risk of harm so a greedy corporation can make big profits. To place another nuclear reactor in Claiborne County doesn't make any sense when there is already concerns about the present plant. This is a crime and blatant example of environmental racism. Claiborne County is 84 percent African-American, with 34 percent living below the poverty line. (G-2)

Comment: And chief among these enormously important issues that have got to be considered in the NEPA process is certainly environmental justice. With this project once again we are talking about an African-Community that is basically going to receive all of the burdens of this proposed project, and very few of the benefits. And that is environmental racism. (I-1)

Comment: And as the Nuclear Regulatory Commission held in the Louisiana Energy Services case just a few years ago, which I did litigate, environmental justice is used such as these have to be considered as part of the NEPA process. (I-7)

Comment: I want to echo the sentiments of the local people who talked about environmental racism. That is a genuine issue that must be considered when this application is being reviewed, and why Claiborne County, Mississippi, and why Grand Gulf Nuclear Station. As our African-American population continues to thrive, and our Caucasian population diminishes, 20 years from now what will the population be. As we study demographics across the Nation, we already know that we can project what the population in this community will be, and we just reiterate those comments regarding environmental racism. And I call upon the governing body of this county tonight to be ever mindful of the tax inequity that exists, and I don't know if this is an NRC problem, or a State of Mississippi problem, or what. But there is a tremendous tax inequity that currently exists with regard to the distribution of tax dollars. And this should not be about money, and I hope that we don't sit down and say that if all of the tax dollars could come here, then we should be for the approval of this permit. But certainly the reverse is that why should we assume the risk and distribute those funds, those resources, across the State of Mississippi to people who are less at risk than we are. Let's keep that in mind, and I direct those comments specifically to the residents of Claiborne County, and ask that we constantly call upon our elected officials to do everything possible to see that the NRC and this application process is taken seriously, and to see that those tax dollars are returned to Claiborne County if there is going to be a second site here. (J-1)

Comment: I wanted to begin my comments by focusing on the Louisiana Energy Services case. It was in this case that two African-American communities in Louisiana, the communities of Forest Grove and Cedar Springs, were successful in stopping the licensing of a uranium enrichment facility on environmental justice grounds, and the decision maker was the Nuclear Regulatory Commission. In that case the Nuclear Regulatory Commission was compelled to set up a very important national environmental justice precedent, and in that decision I quote the Nuclear Regulatory Commission held, and I quote, that this great impact analysis is our principal took for advancing environmental justice under the National Environmental Policy Act. The NRC's goal is to identify and adequately weigh and mitigate the effects on low income and minority communities that become apparent only by considering factors peculiar to those communities. (O-1)

Comment: The risk to public health, safety, and security associated with building more atomic power plants at the Grand Gulf site is disproportionately placed on the people of Claiborne County and the surrounding communities. (S-10)

Comment: Entergy wants to dump yet another dangerous facility on the mostly African American residents who live in Claiborne County, which is 82 percent African American. This is a clear case of environmental racism. (U-3) (X-13) (AE-3) (AH-3) (AI-3) (BD-7) (BE-3) (BF-4) (BH-3)

Comment: Claiborne County, where this dangerous facility will be dumped, is 82 percent African American, which unfortunately evokes the issue of environmental racism. (W-3)

Comment: A third important concern is environmental racism. Entergy wants to dump yet another dangerous facility on the mostly African American residents who live in Claiborne County, which is 82 percent African American. The adverse impacts from this project will disproportionately impact a racial minority group with weak political and economic means to advocate on it behalf. This is a clear case of environmental racism. Please deny this request for an early site permit for expansion of Grand Gulf Nuclear. (Z-3)

Comment: Entergy wants another nuclear facility in the backyards of the mostly African American residents who live in Claiborne County, which is 82 percent African American. This is a clear case of environmental racism. (AA-3)

Comment: In addition, and specific to the Port Gibson facility, I object to yet another "undesirable" facility being located in a predominately African-American community. (AC-4)

Comment: Additionally, this proposal raises significant environmental justice issues. Claiborne County is 82 percent African American. The placement of this facility within Claiborne County would, therefore, have a disproportionate effect on African American communities. (AD-5)

Comment: 82 percent of Claiborne County is African American, making the proposal to put another dangerous facility in this community a clear case of environmental racism. (AF-4)

Comment: The community surrounding the facility is 82 percent African American, which makes this proposal ring of environmental racism. (AG-3)

Comment: The nuclear facility is located in a small town, mostly minority, low income, residential community, called Port Gibson, Mississippi. (AJ-2)

Comment: There is and will be a disproportionately high and adverse impact on low income or minority populations. (AJ-12)

Comment: The time is past for the people and the Nuclear Regulatory Commission to allow (permit) facilities that generate vast amounts of toxic air pollution, soil contamination, water pollution and toxic radioactive wastes that has to be stored onsite or disposed of in some other community that doesn't want it. This could be considered another Environmental Justice issue! President Bill Clinton's Executive Order 12898 in it's ruling "To the greatest extent practible and permitted by law... each federal agency shall make [achieving] Environmental Justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health, or environmental effects of its programs, policies, and activities on minority populations and low income populations in the United States." The last time I checked Port Gibson, Mississippi is still in the United States, therefore why would the commission even consider permitting this facility in a low income minority community? Companies, industries and others should be ashamed of themselves and not be allowed to bribe or coerce the citizens desperate for jobs into acceptance of (with the offer of good paying jobs, positive economic impact or other incentives) or exchange for industries that spew toxic pollution on the people! (AJ-16)

Comment: All of the above need to be considered as environmental justices issues given that the risks and hazards associated with the Grand Gulf site expansion disproportionately impact the people of Claiborne County given that the county is 84 percent African American with 34 percent living under the poverty line at a per capita income of $11,000 annually. (AL-13)

Comment: I have heard much discussion of environmental racism and also believe this is a relevant issue. Claiborne county is largely minority in population – I don't believe this plant would be considered in a wealthier, more affluent area. (AM-4) (AQ-4) (AW-5)

Comment: I have heard much discussion of environmental racism and also believe this is a relevant issue. (AS-8)

Comment: IT'S ABOUT JUSTICE Entergy wants to dump yet another dangerous facility on the mostly African American residents who live in Port Gibson. This is a clear case of environmental racism. Why do Entergy and other polluting companies promise only dangerous and dirty jobs to African Americans and other people of color? (BG-8)

Comment: Before NRC considers granting this preliminary permit, it should answer a number of questions: Will this facility affect communities of color more than other communities? (BI-7)

Comment: This may be a siting decision now, but the considerations range far beyond geological stability and availability of plentiful cooling water. This is a decision to saddle an economically depressed county with greater risk in order to produce electricity by one of the most expensive and environmentally unsound methods that exists today. (BI-9)

Comment: Entergy wants to dump yet another dangerous facility on the mostly African American residents who live in Claiborne County, which is 82 percent African American. This is a clear case of environmental racism that ignores significant impediments to emergency planning to safeguard area residents in case of an accident or act of terrorism at the facility. We believe it is no accident that low-income African Americans in Mississippi are being placed at the greatest risk of harm so a large corporation can make big profits. Entergy would not be trying to build the first new nuclear plant in decades in the U.S. in predominantly white Madison or Ridgeland, Miss. Just like you don't have hog factories, creosote waste sites and chemical plants located next to these affluent, white communities. This is another example of environmental racism in a state where African Americans are already bearing the brunt of the pollution burden. African American women in Mississippi have the worst health of any population group in the U.S. Adding additional sources of dangerous pollution is simply unacceptable. It is a blatant case of environmental racism to expect this community to accept the risk from building another nuclear power plant considering concerns about health impacts from the present plant and the threat of terrorist attacks. This would simply make the terrorist target bigger. (BJ-3)

Comment: Here in California, we site hazardous waste facilities in poor Hispanic areas. I guess in Mississippi one uses poor black areas. I am told Claiborne County, is 82 percent African American; do many of low income minority persons live near the proposed Power Plant? (BL-3)

Comment: I have heard much discussion of environmental racism and also believe this is a relevant issue. Claiborne county is largely minority in population – I don't believe that this plant would be considered in a more affluent area. (BN-4)

Comment: 82 percent of it population is African American. This is a clear case of environmental racism. (BO-3)

Comment: Justifying permit because of the economic benefits they provide is disgusting. Projects should not be allowed to destroy the public health safety, and welfare of any community, especially a low income, minority community that does not have the political clout, financial clout or resources to fight these terrifying nuclear reactor projects! By not having the resources available to fight this situation, this could be an Environmental Justice issue in itself! I sincerely believe this to be an Environmental Justice problem and hope that some health organization or environmental group will be notified of this project and join together to fight against this project and be prepared to file lawsuits challenging this permit request. Why do these types of projects never request to be located in densely populated upper class (white-Caucasian) communities, such as Madison, Clinton, or North Jackson? (AJ-14)

Response: *Environmental justice analysis in a U.S. Nuclear Regulatory Commission (NRC) EIS deals with disproportionate environmental impact on low income and minority communities, including socioeconomic impact. NRC staff analyzed socioeconomic impacts from an environmental justice perspective in Chapters 4 and 5 of the EIS.*

Comment: Before NRC considers granting this preliminary permit, it should answer a number of questions: Would the benefits from any jobs related to the construction and operation of a second nuclear facility be fairly distributed. That is, will this project mean good jobs with good benefits to the African American residents of Claiborne County? (BI-8)

Response: *Whether current or future Claiborne County residents will be hired for construction and operations jobs would depend on a number of factors, including job requirements, occupational skills of the local workforce, and availability of training programs. The geographic distribution of current Grand Gulf employment is covered in Chapter 2 of the EIS and the impact of any new plant(s) on the employment in the area in Chapters 4 and 5. Issues with the equity of hiring practices and equal employment opportunity is the responsibility of the U.S. Equal Employment Opportunity Commission and is not considered further in the staff's environmental review.*

Comment: I attended an environmental justice workshop that was put on by the government, ATSDR, and other agencies, in Weblin, Mississippi. At that meeting, there were chiefs of some Indian nations that came to speak about the contamination of their sacred lands by uranium mining. They talked about how difficult it was to tell their people to not eat the fish out of the stream. Do not eat the deer. They are contaminated. Well, these are their sacred lands, and these are the lands that have supported them for many generations, and now they can't use them anymore. (K-2)

Response: *The impacts of the uranium fuel cycle including the onsite storage and eventual disposal of the spent fuel is considered in Chapter 6 of the environmental impact statement. Guidance on the approach is provided in the U.S. Nuclear Regulatory Commission environmental standard review plan (NUREG-1555, Section 5.7).*

Comment: It doesn't have to be that way, and we showed them in Louisiana that we can stop licensing of dangerous and hazardous facilities in our African-American communities, and we will show them again. (O-8)

Response: *This comment provides only general information in opposition to the Grand Gulf early site permit and is not considered further in the staff's environmental review.*

D.7 Radiological Impacts

Comment: Impacts on plant and animal life, and the fish in the Mississippi, and everything that is revolving in that biosphere surrounding Grand Gulf and that biosphere generally and we humans that live in it. (R-4)

Comment: We need to build on our [resources] and enhance our state. One of our largest resources in the state of Mississippi is our natural environment. The river, the forests, the land. By building a power plant we risk destroying and or [polluting] these resources. It is time for the state of Mississippi to start protecting and preserving its natural resources before it is too late. I believe that by allowing Grand Gulf Nuclear to expand its facilities, we are expanding our potential to harm our natural resources and citizens. (AT-4)

Response: *The impact on the Mississippi River arising from the release of radioactive materials into the Mississippi River from the operation of additional nuclear power units will be reviewed in accordance with the environmental standard review plan (NUREG-1555) and discussed in the EIS in Sections 4.3 and 5.3.*

Comment: The Claiborne County residents want what any other community desires; their god-given right to breath clean air, and drink clean water. (G-7)

Response: *The comment provides only a general statement and is not considered further in the staff's environmental review.*

Comment: All impacts on public health and environment arising out of the increase in routine or accidental releases of radioactive gas, and particulate to the air and to our water as it settles on to our land and our agricultural soil as the result of the operation of additional units. Clearly, this analysis should be taken in the most vulnerable of our population, not the most robust, and so we need to be looking at the impact of increased bioconcentration of radioactive isotopes. So while they say that the impact is small, and the releases are minute, we need to realize that there are isotopes that are being routinely released by this plant, like cesium-135, that has a half-life of over 2 million years. So every day that plant operates, and that one isotope, and dozens of isotopes gets out in the environment, it is going to persist in the environment for – well, an effective half-life. And if you want to really get rid of all the hazardous life, you multiply that half-life figure by 10, and that will give you some idea of how long that isotope can be accumulating in the environment, and biomagnifying up through the food chain, and getting through mother's milk, or through the uterus, or in any other number of ways and accumulate. And so all this environmental impact statement needs to be looking at is all and new published data that looks at the epidemiological impact of the routine and accidental emissions. (D-10)

Response: *The early site permit process is designed to determine if the site is suitable for one or more nuclear power reactors. According to 10 CFR 52.17(a)(1), the assessment will contain an analysis and evaluation of components of the facility relating to the potential radiological consequences. Chapters 4 and 5 of the EIS addressed health impacts related to construction and operations.*

Comment: From an environmentalist standpoint for us to build a second site in close proximity of the first unit, and we are talking about over a period of years; whereas, beginning from day one some 20 years ago when Entergy first built the site, they have refused to put one penny into a study to even conduct studies in terms of any help related that perhaps may have come from that site. I don't see us getting into without some kind of commitment based upon some studies here for the local residents, and here with an increase in cancer, or the increase in other various kinds of disease that could have been related to the site, and without any of that, I don't see us proceeding with a second Grant Gulf unit here. (H-1)

Comment: And at the reactor site and the area surrounding it, people are concerned about cancer, and the growing rates of cancer, and what we know that it is a scientific fact that nuclear radiation causes cancer, period. And Entergy's nuclear reactor, the proposed one that we are now talking about, would definitely increase radiation levels as part of its routine operation. (O-4)

Comment: There is a lack of an adequate epidemiological study of the health effects of radiation releases on the residents of Claiborne County from the routine operation of Grand Gulf atomic power plant and any new reactors. (S-7)

Comment: Concerns about elevated cancer rates and the failure of state health authorities to conduct epidemiological studies of the surrounding population. (BD-6)

Response: *As required by 10 CFR 52.17(a)(1), the impact analysis will contain an analysis and evaluation of components of the facility relating to the potential radiological consequences. Chapters 4 and 5 of the EIS addressed the health impacts; however, epidemiological studies are outside the scope of the EIS.*

Comment: So I am saying that this is not just a local issue. It is a global issue. [Chernobyl] gave off radiation 2000 miles away, and so anything that happens here could contaminate a good portion of the world. (K-3)

Comment: As nuclear power proliferates, the availability of highly radioactive building materials which can be used deliberately or accidentally to injure individuals and groups of people increases. Do we all have to buy our own personal Geiger counters so that a handful of corporate executives can enjoy the satisfaction of propping up a failed industry? (X-8)

Comment: The electricity generated at this facility would be sold to other states, why should my state be polluted and Mississippians be exposed to harmful toxic radioactive waste so others can have electricity? The Nuclear Regulatory Commission should permit nuclear reactor facilities to be located where the people receive the benefits and the toxic exposures. (AJ-10)

Comment: The nuclear power industry has historically evaded environmental regulations and shown disregard for the public health, safety, and welfare of nearby or far residents. Please remember towns like Anniston Alabama and PCB pollution, millions of dollars do not replace or pay for good health! (AJ-17)

Response: *These comments refer to health impacts. As required by 10 CFR 52.17(a)(1), the impact analysis contains an analysis and evaluation of components of the facility relating to the potential radiological consequences. Chapters 4 and 5 of the EIS address health impacts.*

Comment: When I passed by the nuclear power plant, I seen the steam coming up, and I noticed the storage there, and I wondered if I was going to get zapped going by here today or not. In my community here, I am talking to people sometimes, and they have an ailment, and a lot of them went to a lawyer, and you know, I didn't have all these things happening, you know, and I wonder if it is that nuclear power plant. (F-2)

Comment: But the fact is that it is not safe. Radioactive release remains very toxic to all life for thousands, to millions, of years. (G-5)

Comment: Residents of Port Gibson are exposed to radiation from the existing facility, and obviously now more exposure is proposed, because we are talking about another facility, another facility that has in fact the capacity for 2 or 3 reactors, and that is possible. Nobody can deny that scientists have documented that radiation exposure increases the risk of cancer and all kinds of serious health problems; birth defects, still births, and the science is there, absolutely. (I-5)

Comment: You would not have to wait for a catastrophe to happen at the reactor to have radiation emissions. These reactors are not as was said earlier emission free, and as part of their daily routine operations, they are leaking and emitting radioactivity into our air, land, and water. (O-5)

Comment: I hear this at every NRC meeting that I go to practically, even if it is not about reactors, because I deal a lot with low level nuclear waste, and not the stuff that will kill you in like 5 minutes if you were next to it, and it wouldn't be in the water, but the stuff that would give you cancer within 10 years or 30 years, and so forth. And that is about radiation and how it is a fact of daily life. We have heard a lot about how the NRC has deemed that the routine releases from plants are safe and pose no substantial health risks to humans. We are told that we live with radiation all around us every day, and that radiation is just another fact of life, but an important distinction to make here is that between radiation exposures that people can't reasonably avoid, unless a person becomes a very desired lifestyle, and wants to avoid the sun completely, and never fly in an airplane to visit relatives on the other side of the world, it is true that there is a lot of radiation out there in nature that is difficult to avoid. But ionizing radiation that comes from a nuclear reactor is an entirely different matter, and that has to do with activities of mankind and how we deal with technology. So it creates a whole other issue that needs to be addressed and if you have exposure to radioisotopes that are in your drinking water, and in the soil, and in the air, that is a whole other matter than a little bit of radiation that may be in a banana. So I just think that it is time to put that to rest, and the whole idea that it is a radioactive world and so let's just throw some more into it. It is time for – you know, that is kind of absurd. (R-5)

Comment: All impacts on the public health and environment arising out of the increase in routine and accidental radioactive emissions to the air and to the water as the result of the operation of additional nuclear power units. The analysis should consider work by Dr. John Gofman, showing that low-level radiation, at levels considered to be safe for medical use, is a significant contributor to deaths from heart disease and cancer. See Radiation from Medical Procedures in the Pathogenesis of Cancer and Ischemic Heart Disease (Committee for Nuclear Responsibility: 1999). (AL-6)

Comment: IT'S ABOUT HEALTH The daily operation of nuclear reactors release radioactivity into our air, water, and soil that can damage human health. It is scientifically established that being exposed to radiation increases your risk of cancer and other severe health problems. Health studies have linked nuclear reactors to increased cancers, leukemia, reproductive damage, still births, and birth defects. (BG-3)

Comment: IT'S ABOUT A CLEAN ENVIRONMENT. Entergy admits that it wants to build a nuclear reactor that would have the capacity equal to two very large reactors. If licensed, this reactor would generate harmful, radioactive waste, daily pollute the air, water, and soil with radiation, and threaten the lives of people with the potential for a nuclear catastrophe. (BG-4)

Response: *The purpose of regulatory limits are to protect workers and the public from the harmful health effects of radiation on humans. The limits, including effluent release limits, are based on the recommendations of standards-setting organizations. Radiation standards reflect extensive ongoing study by national and international organizations (International Commission on Radiological Protection [ICRP], National Council on Radiation Protection and Measurements, and National Academy of Sciences) and are conservative to ensure that the public and workers at nuclear power plants are protected. The NRC radiation exposure standards are presented in 10 CFR Part 20, "Standards for Protection Against Radiation," and are based on the recommendations in ICRP 26 and 30. In addition, the U.S. Environmental Protection Agency has established a whole body dose limit of 25 millirem per year (see 40 CFR Part 190). Finally, Appendix I in 10 CFR Part 50 provides dose design objectives for exposure of the public to radioactive effluents from nuclear reactors. Numerous scientifically designed, peer-reviewed studies of personnel exposed to occupational levels of radiation (versus life-threatening accident doses or medical therapeutic levels) have shown minimal effect to human health, and any effect was from exposures well above the exposure levels of the typical member of the public from normal operation of a nuclear power plant. Regarding health effects to populations around nuclear power plants, NRC relies on the studies performed by the National Cancer Institute (NCI). NCI conducted a study in 1990, "Cancer in Populations Living Near Nuclear Facilities," to look at cancer mortality rates around 52 nuclear power plants, nine U.S. Department of Energy (DOE) facilities, and one former commercial fuel reprocessing facility. The NCI study concluded from the evidence available that there is no suggestion that nuclear facilities may be linked causally with excess deaths from leukemia or from other cancers in populations living nearby. Additionally, the American Cancer Society had concluded that although reports about cancer case clusters in such communities have raised public concern, studies show that clusters do not occur more often near nuclear plants than they do by chance elsewhere in the population. The issue of radioactive effluents and their impacts on human health are evaluated in Chapters 4 and 5 of the EIS.*

D.8 Uranium Fuel Cycle and Waste Management

Comment: In addition, there is substantial doubt about the ability to develop a large amount of nuclear power without a complete reconstruction of the U.S. Department of Energy nuclear fuel refining process, an expense which should not be borne by the taxpayer in a deregulating electric market, and which cannot be borne by the utility industry if new nuclear plants are to pass the laugh test. (X-5)

***Response:** The comment is noted. Restructuring of the U.S. Department of Energy is outside the scope of this environmental review. The impact of the uranium fuel cycle, including the onsite storage and eventual disposal of the spent fuel, is considered in Chapter 6 of the environmental impact statement. Related U.S. Nuclear Regulatory Commission (NRC) staff review guidance is provided in the NRC environmental standard review plan (NUREG-1555, Section 5.7).*

Comment: I guess there was one question about spent fuel capacity. The spent fuel capacity at Grand Gulf is capable of storing fuel in the spent fuel up until 2007. Now, what happens after that, and this technology has already been used at several of our sites, and across the company, utilities have moved towards dry cask storage. That is a technology that has been used for the low radiation fuel bundles, bundles that have been out of the reactor for a significant period of time, such that the dose is relatively low. And these bundles can be safely stored in a dry cache storage facility on the site. It is still on the site location, and many utilities use that already. But with that technology, we can store fuel for as long as it takes to have an alternate main storage for fuel elsewhere, such as Yucca Mountain. (A-8)

Comment: I first would like to say that one of our major concerns here is that we have been talking about nuclear waste, and I know that is a big issue. If I recall, there were 3500 assemblies, and 800 pounds per assembly. That is over a thousand tons there at Grand Gulf sitting in that pool with an uncertain future. And now we are talking about increasing the amount of nuclear waste that could be generated there. And it will be where it is if there is no other place for it to go, and you should be considering that, and certainly the environmental impact statement that we are talking about here is to address that. We also want to know about all impacts arising from the additional accumulation of high level radioactive waste generated and indefinitely stored on the Grand Gulf nuclear site as I originally discussed. (D-2)

Comment: Nuclear power produces extremely hazardous waste from the cradle to the grave. There is dangerous radiation waste from mining uranium, from processing it into fuel, and then from waste material left over after it is used to make power. (G-3)

Comment: One point that I wanted to make on used fuel management. There has been a lot of discussion about can I stand in a room with spent fuel, and is it dangerous. What was not said about used fuel. I have been in a room with used fuel several times. I have taken tours of reporters and policy makers into a used fuel storage room. The fuel is under 30 feet of water, which is a shielding agent for the radiation, and so you can go in this room with the appropriate radiation monitors on, and you can stand in there and look at the pool. You don't want to stand in there a long time, but you are perfectly safe to go into this facility and look at the fuel. The same thing with the dry storage containers that Mr. Williams referenced. These containers are safe, and they are approved by the NRC as safe. You can walk up to one and stand there, and you will not get any heath impacts by standing next to one of these containers. About 28 companies already have gone from using pool fuel storage to these dry storage containers. They are made of concrete and steel, and as one speaker said, you take the oldest fuel out of your fuel pools, and put it in these containers, and you store these on-site with security added to that facility. (M-9)

Comment: The waste issue would be dealt with in this current EIS based on the life of the plant, the life of the nuclear facility, which I am not sure now, but it used to be 20 years, and maybe it is 40 years now. And I don't believe that at that point that there will be a facility to store this waste, and concrete and metal dry casks do not last tens of thousands of years. So I think there is a lot of considerations that need to be dealt with. (Q-3)

Comment: And the best solution found for the waste being just throwing it in a hole in the ground is disturbing. Let's see. The myth that nuclear is a clean air energy, and there is a lot to say here, but the proponent of nuclear energy would like us to believe that uranium fuel rods simply and magically appear in a nuclear reactor's core. This is not the case, and the process is neither simple nor magic. From the front end to the back end of the uranium fuel cycle, there is a considerable reliance on fossil fuels. Uranium mining and uranium milling, processing, and fuel fabrication, all require fossil fuel use in order to deliver fuel rods to the reactor. And, of course, this does not even begin to cover the unfathomable amounts of energy to create a Yucca Mountain, and/or to ship the nation's high level waste from the reactors across the country to the site, or in this case to the sites if we need more than one. (R-6)

Comment: The Grand Gulf site is already accumulating highly radioactive waste without an approved and scientifically valid long-term nuclear waste management site and more atomic power plants would make the radioactive waste problem for Claiborne County worse. (S-1)

Comment: No one knows what to do with the spent nuclear fuel that we have right now. Why generate any more? (AB-3)

Comment: The radioactive waste issue. I am not satisfied with the current means of disposal of nuclear waste. I have heard of no method of disposal of such waste that I consider acceptable. (AC-3)

Comment: Entergy has publicly admitted that by the year 2007 it will no longer have the capacity to store on-site the radioactive waste generated by the current Grand Gulf reactor. Additionally, it is well known that Yucca Mountain when fully operational will not possess sufficient capacity to receive existing waste. Thus, allowing expansion of the proposed expansion will only exacerbate current problems associated with storage and/or disposal of radioactive waste generated at the Port Gibson facility. (AD-2)

Comment: I have been told that the Grand Gulf Nuclear Reactor facility at Port Gibson has publicly stated as of the year 2007, it would no longer have storage capacity onsite for the toxic radioactive waste it is already generating. Where will the old waste and the expected new waste go in the future? To quote the Utah Governor Mike Leavitt who is adamantly opposed to the dumping of toxic waste, "It's pretty clear that utilities are willing to spend billions to move spent fuel out of their backyard into ours"... (AJ-11)

Comment: All impacts arising from the additional accumulation of high-level nuclear waste generated and indefinitely stored on-site at the Grand Gulf nuclear power station as the result of the operation of additional nuclear power reactors. This discussion is required, given that the Waste Confidence Rule applies only to waste generated by "existing facility licenses." 55 Fed. Reg. 38,474 (September 18, 1990). (AL-5)

Comment: In the past, contractors have not met specifications in building plants, unexpected accidents have occurred, and there is still no safe way of disposing of nuclear waste – I expect the plans are for it to stay by the MS River until opposition to the waste being shipped across the country ends. (AS-4)

Comment: Most of my concern is over the continued inability of the nuclear industry to safely dispose of its waste. The bottom line is that there is no safe, long-term, economically viable way to manage this "output". The much-touted "input-output" claims of the industry, which is that the public gets more benefits to cost than from other fuel sources, is not true, when all the real expenses are added in. This means construction, maintenance, use of water and other "inputs," as well as the byproducts (waste) and the collection, storage, transfer, etc. Of course, radiation is a problem that lasts for thousands of years, and is a cumulative effect that no number-crunching can tally. (BC-4)

Comment: While a plant like Grand Gulf may be staffed by competent people and enjoy a commendable safety record, the ugly fact of nuclear waste (48 tons produced annually at the plant) cannot go ignored. A plant official at the recent NRC environmental scoping meeting in Port Gibson stated that on site nuclear waste storage would reach capacity by 2007! To propose construction of new reactors creating even more deadly waste that will still be around thousands of years from now is not just folly, it is the height of arrogance. (BD-3)

Comment: Through a company called "System Energy Resources, Inc.," the Entergy Corp. is seeking a permit that would allow it to build one or more large nuclear reactors next to Entergy's Grand Gulf nuclear reactor in Port Gibson, MS. Entergy publicly admits that by the year 2007 it will no longer have the capacity to store on-site the radioactive waste generated by the current Grand Gulf reactor. Entergy's plans for new nuclear reactors will create more dangerous radioactive waste, and further threaten the health and lives of people who live, work, and attend school in Port Gibson. Here are some important facts. (BG-2)

Response: *The impact of the uranium fuel cycle, including the onsite storage and eventual disposal of the spent fuel, is considered in Chapter 6 of the EIS. Related U.S. Nuclear Regulatory Commission (NRC) staff review guidance is provided in the NRC environmental standard review plan (NUREG-1555, Section 5.7).*

Comment: I cried, because I was so sad that there is a possibility that we are going to be adding another nuclear plant. It's like let's double the amount of poison that we are going to give to our children as their inheritance. Yucca Mountain, that's a dream. That is something that is not going to happen. If it does happen, it will be a disaster. (C-1)

Comment: There is another burden. All of the tons of toxic radioactive waste that have been produced at Grand Gulf are sitting right here on the site. A lot of people don't know that everywhere the county that if you have a nuclear reactor, you have got all of the tons, and tons, and tons of waste that they have produced right there on site, and that is not going to change. It is not going to change. The proposed Yucca Mountain repository for all this nuclear waste that has been talked about for years, and years, and years, and years, is not going to be available for years, and years, and years, if at all. There are well respected scientists who have been weighing in on Yucca Mountain saying that in essence, in layman's terms, what, are you nuts? You can't put nuclear waste there. And let's just assume for a minute that Yucca Mountain ever becomes a reality, what you all need to know in this community is that Yucca Mountain would already be full when the current Grand Gulf facility reactor reaches the end of its operating life. So this pipe dream out there about Yucca Mountain, which I think is a total pipe dream, and if you don't want to believe the pipe dream, fine. But even if it is not a pipe dream, it is not going to be available for the waste from what you have here now, and any additional waste that you get in the future. (I-4)

Comment: And one is that I just absolutely believe that no more nuclear waste should be generated, and if that is not supposed to be dealt with at this point in the process, then it shouldn't be, because I don't think when you generate these deadly wastes that are going to be around for tens of thousands of years, that is an issue that should be dealt with before anything else is considered. I mean, we have billions of dollars in superfund sites now that have not been cleaned up, and in decades have yet to be cleaned up, and we are depending on the government for that, and they aren't funding it, and I think that this is the same kind of situation. If you can't deal with it, and if you can't store it, and if you can't get rid of it, then you shouldn't produce it. (Q-1)

Comment: I am writing to remind you of the experience in Massachusetts when one of our two nuclear plants was closed down some years ago. It has become, to all intents and purposes, a nuclear waste dump. Despite decades of effort by the federal government there is still no approved site to store spent radio active fuel rods and reactor parts, which will be radio active for hundreds of years. You know that the state of New Mexico is still fighting a partially completed underground storage facility and the state may well succeed. The fact is that even the most pro-nuclear power proponents want a nuclear waste facility in their neighborhood. Surely, the licensing of new nuclear facilities should be held back until there is available a secure site for spent fuel rods. (Y-1)

Comment: Also, since there is nowhere in the country to dispose of, or better yet, recycle these highly toxic, long-lived wastes, I believe that no permits should be granted for future nuclear power plants. (AM-6)

Comment: Also, since there is nowhere in the country to dispose of, or better yet, recycle highly toxic, long-lived nuclear wastes, I believe that no permits should be granted for future nuclear power plants. (AO-5)

Comment: Also, since there is nowhere in the country to dispose of, or better yet, recycle these highly toxic, long-lived wastes, I believe that no permits should be granted for future nuclear power plants. (AQ-6)

Comment: We have not come up with solutions to dispose of the waste safely. (AU-2)

Comment: Also, since there is nowhere in the country to dispose of, or better yet, recycle these highly toxic, long-lived wastes, I believe that no permits should be granted for future nuclear power plants. (AW-7)

Comment: Beyond concerns I have about nuclear power plants operations, I am opposed to the construction of new nuclear facilities until the government [satisfactorily] deals with the nuclear waste these facilities already create. (AX-2)

Comment: It is madness to expect future generations for thousands of years to live with the extremely long-lived and hazardous waste that results from nuclear power production. Once fossil fuels run out in a hundred years or so, there could be wide ranging economic disruption that would make it extremely difficult to continue to safeguard nuclear waste. It is a sin against future generations to leave this legacy of poison as the most lasting hallmark of our generation. (BJ-5)

Comment: As a person in Nevada who is deeply concerned about the Yucca Mountain project and the fairness of the NRC licensing process in regard to that project, I am worried about the Commission's consideration of permits for new reactors. The license application has not yet been written for Yucca Mountain so NRC should certainly have no reason to believe that there will be a disposal site for any waste produced by new reactors. Indeed, even if Yucca Mountain were to be licensed, it's legal limit would be reached before any waste from new generation was disposed. (BK-1)

Comment: The people of Nevada are worried that the process will be tilted to the benefit of the Department of Energy and the commercial nuclear industry when the NRC evaluates a license application and determines whether or not Yucca Mountain should be granted a license. Right now there are magnitudes of uncertainty about the ability of Yucca Mountain to isolate waste and no justification for approval of new waste production. (BK-2)

Comment: Also, since there is nowhere in the country to dispose of, or better yet, recycle these highly toxic, long-lived wastes, I believe that no permits should be granted for future nuclear power plants. (BN-7)

Comment: In addition to the inherent risks to the environment of nuclear power, including disposal of low and high-level radioactive waste, and in addition to the high cost of decommissioning nuclear facilities, I oppose this permit for the undue risk it poses to the communities in its shadow and to the residents of New Orleans in the even of a severe accident. (BI-2)

Response: *The environmental impacts of postulated accidents are evaluated and the results of the staff's analysis is presented in Chapter 5 of the EIS.*

D.9 Decommissioning

Comment: Whether existing reactors or looking at new ones, but what about when the plants shut down and eventually that has got to happen at all of these, even if they do the 40 years, plus the additional 20 that nearly all of them are applying for. They have got to shut them down at some point, and it will only make sense for them to shut them down instead of continuing to make repairs. You have decommissioning, and the enormous costs of that, and there was a recent GAO report that indicated that a lot of nuclear plant owner/operators were not doing their best at maintaining the funds that they needed to have built up in order to do a proper decommissioning, which of course has a lot to do with environmental issues. Once they leave, are they going to leave behind a clean site that people would feel comfortable getting close to, or having a park on, or you name it. Is it going to be a green site some day. (R-11)

Response: *The environmental impact from decommissioning a permanently shutdown commercial nuclear power reactor is discussed in Chapter 6 of the EIS. In addition, Supplement 1 to NUREG-0586, Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities, which was published in 2002, may provide information on expected impacts from decommissioning.*

D.10 Cumulative Impacts

Comment: A cumulative impacts analysis is a fundamental and critical part of NEPA, and it can't be trumped by any agency or commission. (I-9)

Comment: All impacts arising from the simultaneous operation of the existing and aging Grand Gulf nuclear power reactor in close proximity to any new proposed advanced reactor design, including the possibility of multiple, simultaneous accidents, whether related (e.g., by fire or natural disaster) or unrelated. (AL-9)

Response: *The cumulative impact associated with the construction and operation of the proposed nuclear power plants is evaluated in Chapter 7 of the EIS.*

Comment: The issue for the NRC is not to look at this proposed reactor in a vacuum. It has got to look at this reactor and connection with the existing reactor that is in Port Gibson here. (O-3)

Response: *The U.S. Nuclear Regulatory Commission's EIS Chapter 7 discusses the cumulative impacts associated with the construction and operation of any new nuclear power plants at a site with existing nuclear power plants.*

Comment: All impacts on public health and safety arising out of a severe accident, including the impacts of the accident itself, sheltering, evacuation, radiation exposure treatment and reoccupation or relocation of entire communities in the event of an accident at an expanded Grand Gulf site. (AL-7)

Response: *As part of the U.S. Nuclear Regulatory Commission's site safety review, the staff considered whether the site characteristics are suitable for the addition of one or more additional nuclear power reactors. The environmental impacts of postulated accidents were evaluated, and the results of this analysis is presented in Chapter 5 of the EIS.*

D.11 Alternative Energy Sources and Conservation

Comment: A fourth concern is the need and the existence of feasible alternatives for power generation. The existing Grand Gulf facility involved significant cost overruns and there is a genuine question whether it has been a cost effective operation. Before expanding this facility further the NRC should require a compelling case of public need for [additional] energy generation in this service area. (Z-4)

Comment: According to Entergy, energy from the plant is not needed at this time. I believe the Site Permit should be denied because there are more viable alternatives to nuclear power and that the money spent on nuclear issues would better be spent developing these alternatives in the state. (AM-5)

Comment: According to Entergy, energy from the plant is not needed at this time. I believe the Site Permit should be denied because there are more viable alternatives to nuclear power and that the money spent on nuclear issues would better be spent developing these alternatives and in promoting energy conservation in the state. (AO-4)

Response: *In accordance with 10 CFR 52.18, the environmental impact statement prepared by the U.S. Nuclear Regulatory Commission (NRC) in conjunction with the early site permit application does not include a discussion of the need for power. NRC practice regarding need for power assessments is consistent with judicial precedent. As part of NRC's compliance with the National Environmental Policy Act, need for power is addressed in connection with the construction of a new nuclear power plant so NRC may weigh the likely benefits (for example, electrical power) against the environmental impact of constructing and operating a nuclear power reactor. In considering the need for power, the NRC does not supplant the states that have traditionally been responsible for assessing the need for power facilities and their economic feasibility and for regulating rates and services.*

Comment: Hydro is being torn down. That leaves nuclear as the only other emission-free source of electricity generation that we have to meet our growing economy. ...the only other option we have is an expansion of nuclear energy using advanced technologies. The smart way to approach that, and this is what Entergy is looking at, and this is what Virginia power, Dominion Energy is looking at in Virginia, and it is what Exelon in Illinois is looking at, is maximizing the value of sites that we have today. (M-3)

Comment: All of our electricity sources have environmental impacts. Every single one of them. The chemicals that they use in the solar industry are toxic, and arsenic is one of them. It never goes away. So they all have drawbacks, every single one of them. Nuclear and wind, when you look at the total lifecycle of these facilities, have the least environmental impact, and they are right there together. There have been studies done in Europe, and there have been studies down in Japan, and when you look at the cradle-to-grave application of nuclear and wind, they are by far the lowest. We have those independent studies on our website if you would like to see them. It is www.nei.org. (M-7)

Comment: The impact of that is rising natural gas prices, both for industries that use natural gas as a feed stock – the chemical industry, the fertilizer industry – and our home heating bills for those of us who use natural gas for heating. So there is an impact, a secondary impact, to an over-reliance on any single fuel source. We are blessed in this country with diversity of fuel supply options for electricity, and we have to continue to use all of them. (M-8)

Comment: But if the Federal Government and the Department of Energy have finally gotten the idea of global warming and the concerns of that, then I think that is great. As to which is the most noxious (inaudible) effects, they brought in fossil fuels, or the nuclear energy, I am not sure. They are both pretty bad. (P-2)

Comment: What I would like to suggest, and which has not been brought out, was to put in a plug for energy conservation. They have these sprinkle replacement light bulbs that you can screw in and replace a 60-watt light bulb and it gives just as much light on about 13 watts, and it costs about two bucks a piece now, $2 to $3, and it pays for itself in about a month in just the energy saving there. But it is even more so in the summer time because I have to have air-conditioning to pump out all of that extra heat that is given off of it, and so that is just one of many. And the Federal Government sponsored this energy star program, and we need to have more of that, and it is a great program, and the new freezers and refrigerators are much thicker and you can save a lot of energy there. (P-3)

Comment: I don't think that the Mississippi Power Company has the arrangement yet to where they will buy electricity back from a small time producer, and that needs to be in place, because that way you use the grid as the battery to store the excess off of, and I really believe – and I think we could also alter our consumption in about half, and you are talking about a 42 percent increase, and I think just energy saving and doing things that don't really hurt your standard of living that much. (P-4)

Comment: Alternative energy, the gentleman that spoke before me I thought raised a lot of good points. But there are also a lot of studies that show that we could go now to viable alternative energy and produce, and satisfy all of our energy needs. And I agree that every energy source has its advantages and disadvantages, but I think those kinds of things should definitely be considered. (Q-4)

Comment: The other thing, also architectural standards, and there is lots of things that you could do with conservation that have not been dealt with. (Q-5)

Comment: But we all have to be responsible in our energy use. I mean, which would you rather have, cut down a little bit on your energy usage, or have Grand Gulf, and you are talking about people that maybe – I don't know how far the grid here goes, but you are talking about people that have an insatiable appetite for energy that are not going to be affected if there is a discharge that is at Grand Gulf. It is the people in Claiborne County and the people down river that are going to be affected. (Q-6)

Comment: Energy efficiency. Regarding our own shared insatiable use of energy, and I wouldn't put all the brunt on Mr. Peterson's kids. I think that we all bear some responsibility here, and we should share that responsibility. (R-8)

Comment: The merits of wind energy, and I guess there is something on NEI's site about that, but additional benefits of wind, particularly compared to nuclear plants, include that windmills would make pretty awful terrorist targets. You are not going to scare or kill many people that way, or harm them with radioisotopes, or whatever other pollutants that we are talking about, toxins. Windmills don't create tons of nuclear waste every year, and they do not require a 10-mile radius evacuation zone and plan, of which I guess the one for Grand Gulf is of questionable use and value. (R-9)

Comment: Although proponents of nuclear power will claim that this technology will reduce global warming, a substantial amount of warming is already committed to by past emissions, and nuclear power is an unrealistic alternative to global warming because of the many cheaper alternatives. The most important alternative to fossil fuel emissions is energy efficiency, and while some parts of the nation have had strong efficiency programs in place and operating for several decades, Mississippi has had nothing of significance. Since efficiency is available in massive quantity and cheaper than the cost of operating a conventional power plant of any sort (the operating cost alone, not including the capital cost of a new plant), the need for the proposed nuclear plants is a fragile assumption. (X-4)

Comment: There are other ways of providing energy that are much safer and sustainable. (AB-2)

Comment: There are too many other ways to generate energy to go this dangerous route. The U.S. needs to invest in sustainable sources of energy production – nuclear power is not a safe or economically viable means. (AF-5)

Comment: The U.S. has given little consideration and investment of alternative sources for energy production. (AF-7)

Comment: There are many alternative sources of energy; such as solar power, wind power, incineration of recyclables, or renewable sources of energy (which could all use million dollar grants). None of these produce toxic nuclear waste. These sources would also produce energy, jobs and economic benefit, but a lot less cost to the taxpayer. (AJ-15)

Comment: Whether effects on the environment would be reduced if Entergy alternatively implemented more applications of energy efficiency technologies and energy conservation rather than the development of additional nuclear power capacity at the Grand Gulf site. The

Renewable Energy Policy Project has demonstrated that innovative and well-managed efficiency programs would reduce annual increases in electric growth by 61 percent, substantially reducing demand over a twenty-year period. (AL-14)

Comment: Whether effects on the environment would be reduced if Entergy alternatively implemented use of passive solar, photovoltaic, wind turbines and hybrid renewable energy systems rather than the development of additional nuclear power capacity at the Grand Gulf site. (AL-15)

Comment: Whether effects on the environment would be reduced if Entergy alternatively implemented greater use of natural gas energy rather than the development of additional nuclear power capacity at the Grand Gulf site. (AL-16)

Comment: Whether effects on the environment would be reduced if Entergy alternatively implemented broader applications of the above mentioned resources as distributed power systems rather than increased reliance on an increasingly vulnerable electrical grid system connecting any additional new power capacity at the Grand Gulf site. (AL-17)

Comment: According to Entergy, energy from the plant is not needed at this time. I believe the Site Permit should be denied because there are more viable alternatives to nuclear power and that the money spent on nuclear issues would better be spent developing these alternatives in the state. (AQ-5)

Comment: The Site Permit should be denied. Viable alternatives to nuclear power should be developed as alternatives in the state. (AR-3)

Comment: There are more viable alternatives to nuclear power and that the money would better be spent developing these alternatives in the state. (AS-3)

Comment: As a concerned citizen, I have to believe that there are more viable, environmentally friendly solutions for power production. (AT-2)

Comment: According to Entergy, energy from the plant is not needed at this time. I believe the Site Permit should be denied because there are more viable alternatives to nuclear power and that the money spent on nuclear issues would better be spent developing these alternatives in the state. (AW-6)

Comment: Although Grand Gulf has not been as notorious as say, Watts Barr in Tennessee, the nuclear option as a power source is not proving to be sustainable. (BC-3)

Comment: At a time when renewable energy is within our grasp, this proposal is a major step backward. (BI-3)

Comment: Instead of granting this permit, the government should focus on major, well-funded efforts to encourage energy conservation and development of alternative, sustainable energy such as solar and wind. (BJ-4)

Comment: It would be better to spend our resources conserving energy. I write this from a house lighted almost entirely by [fluorescent] bulbs. The house is at 58 degrees F.; I am comfortable in a watch cap, imitation fleece slippers and a heavy "miracle fabric" house coat from Sears. I drive high mileage cars. Please let me know if you want more about all the heroic things I do to help you refuse to litter the earth with the wastes from another nuclear plant. America should set an example for France and other generators of nuclear wastes. (BL-4)

Comment: I believe the Site Permit should be denied because there are more viable alternatives to nuclear power and that the money spent on nuclear issues would better be spent developing these alternatives in the state. (BN-6)

Comment: Our energy policy should be aimed at developing safe renewable sources of energy. (BP-4)

Response: *The EIS was prepared in accordance with the requirements of 10 CFR 52.18 and 10 CFR 51, which will include analyses of conservation and alternative energy sources.*

Comment: Whether effects on the environment would be reduced if Entergy alternatively implemented some or all of the above-mentioned applications as security countermeasures to any act of terrorism that would seek to target an expanded nuclear power station site for the purpose of creating widespread radiological catastrophe. (AL-18)

Response: *The EIS was prepared in accordance with the requirements of 10 CFR 52.18 and 10 CFR 51, which included an analysis in Chapter 8 of alternative energy sources. For the current application, the NRC decision will be on whether to grant the early site permit – meaning, whether this site is deemed suitable for one or more new nuclear plants. As part of its evaluation of the application, NRC staff documented in a safety evaluation report whether the site characteristics are such that adequate security plans and measures can be developed (see 10 CFR 100.21). If SERI eventually applies for a construction permit or combined license for the Grand Gulf site, it would have to supply a safeguards contingency plan for NRC staff review in accordance with 10 CFR 50.34.*

D.12 Operational Safety

Comment: Grand Gulf has a tremendous operating record. The plant has been here for almost 20 years, and Grand Gulf has a tremendous reputation in the industry, and that is because of operating the plant soundly, and if you were to talk to anyone that actually knows about plant operations, and they were to tell you what is one of the better plants in the industry, they would reference Grand Gulf. (A-6)

***Response:** The comment is noted. The operating history of the currently operating unit was reviewed in terms of the environmental impact that may be related to the construction and operation of new nuclear facilities at the Grand Gulf early site permit site.*

Comment: SERI is asking the NRC to provide no significant impact, setting aside the Grand Gulf site. There has got to be incidents that have already happened, and I would like to incorporate by requesting that the NRC raise those issues in terms of the new comparison of the new site. And also make those documents available to the local citizens here as well. (H-2)

***Response:** The early site permit process is designed to determine if the site is suitable for one or more nuclear power reactors. The operating history of the currently operating unit was reviewed in terms of the environmental impact that might be related to the construction and operation of new nuclear facilities at the Grand Gulf early site permit (ESP) site. Information regarding the environmental review process for the Grand Gulf ESP is publicly available through the Agencywide Documents Access and Management System (ADAMS) which is the U.S. Nuclear Regulatory Commission's electronic record keeping system that maintains the official records of the agency.*

Comment: Other human-induced accidents could yield similar results. Malfunctions of equipment and/or employee negligence causing accidents could be disastrous. (AP-3)

***Response:** The environmental impact of postulated accidents was evaluated, and the results of this analysis are presented in Chapter 5 of the EIS.*

Comment: And primarily that stripping down as I understand is to make the construction more affordable, and this is one of the ways that the industry and the Federal agency are thinking about making it more affordable. (D-4)

Comment: Another speaker raised the issue of advanced reactor designs, and I think called them stripped-down versions of today's designs. I would look at that in another way. We have got the best engineers in the country, really globally, and in some joint partnerships with other countries, looking at new reactor designs. They are smaller, the same way that our computer mainframes that used to fit in this room now fit in a box. You have got technological advances, and you have got the use of gravity rather than pumps. So that there is less mechanical failures, or at least the chance of mechanical failures, in these designs. So it is not stripped-down and it is the using of advanced technology that like everything else in our world is getting smaller, and smaller, and smaller. (M-6)

Response: *The U.S. Nuclear Regulatory Commission (NRC) decision will be whether to grant the early site permit – meaning, whether the site is deemed suitable for one or more nuclear plants. The applicant has prepared the environmental report to address the environmental impact of construction and operation of one or more nuclear units at the Grand Gulf ESP site. There are several new reactor designs that have been certified for licensing by the NRC, and other designs are in the certification process or are being considered by the applicant. The ER does not address any particular type of nuclear plant but uses the "plant parameter envelope" to describe the operation of the possible nuclear plant and the impact from the nuclear plant's operation. At the construction and operating license stage, the actual design of the reactor(s) will be addressed.*

Appendix E

Draft Environmental Impact Statement
Comments and Responses

Appendix E

Draft Environmental Impact Statement Comments and Responses

This appendix is intentionally left blank. The final environmental impact statement (EIS) will contain the comments and responses on the draft EIS in this appendix.

Appendix F

Key Correspondence

Appendix F

Key Correspondence

Correspondence received during the evaluation process of the early site permit application for System Energy Resources, Inc., at the Grand Gulf ESP site is identified in Table F-1. Copies of the correspondence are included at the end of this appendix.

Table F-1. Key Early Site Permit Consultation Correspondence

Date of Letter (Accession No.)	Topic	Source	Recipient
January 6, 2004 (ML040081014)	Letter requesting a list of endangered, threatened, and candidate or proposed species and critical habitat that are known to occur or could potentially occur in Claiborne County, Mississippi and West Feliciana County, Louisiana	U.S. Nuclear Regulatory Commission (P.-T. Kuo)	National Oceanic and Atmospheric Administration Fisheries Southeast Regional Office (G. Cranmore)
January 6, 2004 (ML040081042)	Letter informing of NRC's review of the ESP submitted by SERI and the subsequent EIS will include analyses of potential impact to historic and cultural resources	U.S. Nuclear Regulatory Commission (P.-T. Kuo)	Office of Federal Agency Programs Advisory Council on Historic Preservation (D. Klima)
January 6, 2004 (ML040081119)	Letter requesting a list of endangered, threatened, and candidate or proposed species and critical habitat that are known to occur or could potentially occur in Oswego County, New York	U.S. Nuclear Regulatory Commission (P.-T. Kuo)	U.S. Fish and Wildlife Service New York Ecological Services Office (D. Stilwell)
January 6, 2004 (ML040081088)	Letter requesting a list of endangered, threatened, candidate, and proposed species and critical habitat that are known to occur or could potentially occur in Oswego County, New York and Plymouth County, Massachusetts	U.S. Nuclear Regulatory Commission (P.-T. Kuo)	National Oceanic and Atmospheric Administration Fisheries Northeast Regional Office (P. Kurkul)

Table F-1. (contd)

Date of Letter (Accession No.)	Topic	Source	Recipient
January 6, 2004 (ML040081108)	Letter requesting a list of endangered, threatened, candidate, and proposed species and critical habitat that are known to occur or could potentially occur in Plymouth County, Massachusetts	U.S. Nuclear Regulatory Commission (P.-T. Kuo)	U.S. Fish and Wildlife Service New England Ecological Services Office (M. Bartlett)
January 8, 2004 (ML040090099)	Letter requesting a list of endangered, threatened, candidate, and proposed species and critical habitat that are known to occur or could potentially occur in Claiborne County, Mississippi	U.S. Nuclear Regulatory Commission (P.-T. Kuo)	U.S. Fish and Wildlife Service Mississippi Ecological Services Office (R. Aycock)
January 8, 2004 (ML040090125)	Letter inviting staff to participate in the review of the Grand Gulf ESP application.	U.S. Nuclear Regulatory Commission (P.-T. Kuo)	Federal and State Review Program Mississippi Department of Archives and History (T. Wagner)
January 8, 2004 (ML040090141)	Letter requesting a list of endangered, threatened, candidate, or proposed species and critical habitat that are known to occur or could potentially occur in West Feliciana County, Louisiana	U.S. Nuclear Regulatory Commission (P.-T. Kuo)	U.S. Fish and Wildlife Service Louisiana Ecological Services Office (R. C. Watson)
January 8, 2004 (ML040090292)	Letter inviting participation in the environmental scoping process for the Grand Gulf ESP review	U.S. Nuclear Regulatory Commission (P.-T. Kuo)	Mississippi Band of Choctaw Indians (P. Martin)
January 8, 2004 (ML040090309)	Letter inviting participation in the environmental scoping process for the Grand Gulf ESP review	U.S. Nuclear Regulatory Commission (P.-T. Kuo)	Choctaw Nation of Oklahoma (G. E. Pyle)
January 8, 2004 (ML040090330)	Letter inviting participation in the environmental scoping process for the Grand Gulf ESP review	U.S. Nuclear Regulatory Commission (P.-T. Kuo)	Tunika Biloxi Indian Tribe of Louisiana (E. J. Barbry, Jr.)
January 21, 2004 (ML040260250)	Letter responding to a January 8 NRC requesting a list of threatened and endangered species. Provides list of threatened and endangered species that could be found near the Grand Gulf site	U.S. Fish and Wildlife Service Mississippi Field Office (C. B. James)	U.S. Nuclear Regulatory Commission (P.-T. Kuo)

Table F-1. (contd)

Date of Letter (Accession No.)	Topic	Source	Recipient
January 26, 2004 (ML040370323)	Letter responding to a January 6 NRC letter that requested a list of threatened and endangered species. No threatened or endangered species live in the vicinity of the FitzPatrick Nuclear Power Plant, in Scriba, Oswego County, New York	U.S. Fish and Wildlife Service New York Field Office (D. A. Stilwell)	U.S. Nuclear Regulatory Commission (P.-T. Kuo)
January 28, 2004 (ML040350504)	Letter responding to a January 6 NRC letter that requested a list of threatened and endangered species. Provides a list of threatened and endangered species under NOAA Fisheries jurisdiction in the vicinity of the Grand Gulf and alternate sites.	National Oceanic and Atmospheric Administration Fisheries Northeast Regional Office (M. A. Colligan)	U.S. Nuclear Regulatory Commission (P.-T. Kuo)
February 5, 2004 (ML040500681)	Letter responding to a January 8 NRC letter requesting a list of threatened and endangered species. Provides a list of threatened and endangered species in West Feliciana Parish, Louisiana	U.S. Fish and Wildlife Service Louisiana Field Office (R. C. Watson)	U.S. Nuclear Regulatory Commission (P.-T. Kuo)
February 9, 2004 (ML040650620)	Letter providing a list of threatened and endangered species for Plymouth County, Massachusetts	U.S. Fish and Wildlife Service New England Field Office (M. J. Amaral)	U.S. Nuclear Regulatory Commission (P.-T. Kuo)
April 14, 2004 (ML041310449)	Letter adding one more species to the list of threatened and endangered species in Claiborne County, Mississippi	U.S. Fish and Wildlife Service Mississippi Field Office (C. B. James)	U.S. Nuclear Regulatory Commission (M. T. Masnik)

Accession No. ML040081014

January 6, 2004

Ms. Georgia Cranmore
Assistant Regional Administrator
NOAA Fisheries Southeast Regional Office
9721 Executive Center Drive North
Saint Petersburg, FL 33702

SUBJECT: APPLICATION FOR AN EARLY SITE PERMIT FOR THE GRAND GULF SITE

Dear Ms. Cranmore:

The U.S. Nuclear Regulatory Commission (NRC) staff is reviewing an application by System Energy Resources, Inc. (SERI) for an early site permit (ESP) for the potential future construction of one or more new nuclear power plants. As part of the review of this application, the NRC is preparing an environmental impact statement (EIS). The impact analysis in the EIS includes the potential impacts of the construction and operation of a new nuclear power plant at the preferred or alternate sites, including the potential impacts to fish and wildlife and threatened and endangered species.

SERI's preferred location for the proposed new power plant(s) is within the site boundaries of the existing Grand Gulf Nuclear Power Station (GGNS), site near the town of Port Gibson in Claiborne County, Mississippi. Three alternate sites will also be evaluated in the EIS. They are River Bend in West Feliciana County, Louisiana; Fitzpatrick in Oswego County, New York; and Pilgrim in Plymouth County, Massachusetts.

The application for an ESP was submitted by System Energy Resources, Inc. (SERI) on October 16, 2003, pursuant to NRC requirements at Title 10 of the *Code of Federal Regulations* Part 52 (10 CFR 52). If approved, the ESP will document the NRC staff's determination regarding the suitability of the proposed site for the construction and operation of one or more new nuclear plants. The ESP would not authorize the applicant to begin construction of the unit(s). However, in its review the NRC staff will evaluate the environmental impacts of construction and operation and will also consider alternatives, including alternative sites.

To support the EIS preparation process and to ensure compliance with Section 7 of the Endangered Species Act of 1973, the NRC requests a list of endangered, threatened, candidate, or proposed species and critical habitat that are known to occur or could potentially occur in Claiborne County, Mississippi and West Feliciana County, Louisiana. In addition, please provide any information you consider appropriate under the provisions of the Fish and Wildlife Coordination Act of 1934.

Accession No. ML040081014

G. Cranmore 2

If you have any questions concerning the ESP application, or other aspects of this project, please contact Ms. Cristina Guerrero, at (301) 415-2981 or by e-mail at CXG3@nrc.gov.

Sincerely,
/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos.: 52-009

Accession No. ML040081042

January 6, 2004

Mr. Don Klima, Director
Office of Federal Agency Programs
Advisory Council on Historic Preservation
Old Post Office Building
1100 Pennsylvania Avenue, NW, Suite 809
Washington, DC 20004

SUBJECT: EARLY SITE PERMIT REVIEW FOR THE GRAND GULF SITE

Dear Mr. Klima:

The U.S. Nuclear Regulatory Commission (NRC) staff is reviewing an application for an early site permit (ESP) submitted by System Energy Resources, Inc. (SERI) on October 16, 2003. An ESP allows an applicant to set aside a site for potential future construction of one or more new nuclear power plants, and provides the opportunity to resolve site safety and environmental issues before construction begins. An ESP does not allow actual construction of a nuclear plant, which must be requested through another application. The ESP site proposed by SERI is on property co-located with the existing Grand Gulf Power Station site near the town of Port Gibson in Claiborne County, Mississippi. The application was submitted by SERI pursuant to NRC requirements at Title 10 of the *Code of Federal Regulations* Part 52 (10 CFR Part 52).

As part of its review of the application, the NRC staff will prepare an environmental impact statement (EIS) pursuant to 10 CFR Part 51, the NRC regulations that implement the National Environmental Policy Act of 1969 (NEPA). In accordance with 36 CFR 800.8, the EIS will include analyses of potential impacts to historic and cultural resources. A draft EIS is scheduled for publication in February 2005, and will be provided to you for review and comment.

If you have any questions or require additional information, please contact Ms. Cristina Guerrero at 301-415-2981 or CXG3@nrc.gov.

Sincerely,
/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No.: 52-009

Accession No. ML040081119

January 6, 2004

Mr. David Stilwell, Field Office Supervisor
U.S. Fish and Wildlife Service
New York Ecological Services Office
3817 Luker Road
Cortland, NY 13045

SUBJECT: APPLICATION FOR AN EARLY SITE PERMIT (ESP) FOR THE GRAND GULF ESP SITE

Dear Mr. Stilwell:

The U.S. Nuclear Regulatory Commission (NRC) staff is reviewing an application by System Energy Resources, Inc. (SERI) for an early site permit (ESP) for the potential future construction of one or more new nuclear power plants. As part of the review of this application, the NRC is preparing an environmental impact statement (EIS). The impact analysis in the EIS includes the potential impacts of the construction and operation of a new nuclear power plant at the preferred or alternate sites, including the potential impacts to fish and wildlife and threatened and endangered species.

SERI's preferred alternative for the location of the proposed new power plant(s) is within the site boundaries of the existing Grand Gulf Nuclear Power Station (GGNS), site near the town of Port Gibson in Claiborne County, Mississippi. Three alternate sites will also be evaluated in the EIS. They are River Bend in West Feliciana County, Louisiana; FitzPatrick in Oswego County, New York; and Pilgrim in Plymouth County, Massachusetts.

The application for an ESP was submitted by SERI on October 16, 2003, pursuant to NRC requirements at Title 10 of the *Code of Federal Regulations* Part 52 (10 CFR 52). If approved, the ESP will document the NRC staff's determination regarding the suitability of the proposed site for the construction and operation of one or more new nuclear plants. The ESP would not authorize the applicant to begin construction of the unit(s). However, in its review the NRC staff will evaluate the environmental impacts of construction and operation and will also consider alternatives, including alternative sites.

To support the environmental impact statement preparation process and to ensure compliance with Section 7 of the Endangered Species Act of 1973, the NRC requests a list of endangered, threatened, candidate, and proposed species and critical habitat that are known to occur or could potentially occur in Oswego County, New York. In addition, please provide any information you consider appropriate under the provisions of the Fish and Wildlife Coordination Act of 1934.

Accession No. ML040081119

If you have any questions concerning the ESP application, or other aspects of this project, please contact Ms. Cristina Guerrero, at (301) 415-2981 or by e-mail at CXG3@nrc.gov.

Sincerely,
/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos.: 52-009

Accession No. ML040081088

January 6, 2004

Ms. Patricia Kurkul
Regional Administrator
NOAA Fisheries Northeast Regional Office
1 Blackburn Drive
Gloucester, MA 01930

SUBJECT: APPLICATION FOR AN EARLY SITE PERMIT (ESP) FOR THE GRAND GULF ESP SITE

Dear Ms. Kurkul:

The U.S. Nuclear Regulatory Commission (NRC) staff is reviewing an application by System Energy Resources, Inc. (SERI) for an early site permit (ESP) for the potential future construction of one or more new nuclear power plants. As part of the review of this application, the NRC is preparing an environmental impact statement (EIS). The impact analysis in the EIS includes the potential impacts of the construction and operation of a new nuclear power plant at the preferred or alternate sites, including the potential impacts to fish and wildlife and threatened and endangered species.

SERI's preferred alternative for the location of the proposed new power plant(s) is within the site boundaries of the existing Grand Gulf Nuclear Power Station (GGNS), site near the town of Port Gibson in Claiborne County, Mississippi. Three alternate sites will also be evaluated in the EIS. They are River Bend in West Feliciana County, Louisiana; FitzPatrick in Oswego County, New York; and Pilgrim in Plymouth County, Massachusetts.

The application for an ESP was submitted by System Energy Resources, Inc. (SERI) on October 16, 2003, pursuant to NRC requirements at Title 10 of the *Code of Federal Regulations* Part 52 (10 CFR 52). If approved, the ESP will document the NRC staff's determination regarding the suitability of the proposed site for the construction and operation of one or more new nuclear plants. The ESP would not authorize the applicant to begin construction of the unit(s). However, in its review the NRC staff will evaluate the environmental impacts of construction and operation and will also consider alternatives, including alternative sites.

To support the environmental impact statement preparation process and to ensure compliance with Section 7 of the Endangered Species Act of 1973, the NRC requests a list of endangered, threatened, candidate, and proposed species and critical habitat that are known to occur or could potentially occur in Oswego County, New York and Plymouth County, Massachusetts. In addition, please provide any information you consider appropriate under the provisions of the Fish and Wildlife Coordination Act of 1934.

Accession No. ML040081088

P. Kurkul 2

If you have any questions concerning the ESP application, or other aspects of this project, please contact Ms. Cristina Guerrero, at (301) 415-2981 or by e-mail at CXG3@nrc.gov.

Sincerely,
/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos.: 52-009

Accession No. ML040081108

January 6, 2004

Mr. Mike Bartlett, Field Office Supervisor
U.S. Fish and Wildlife Service
New England Ecological Services Office
70 Commercial Street, Suite 300
Concord, NH 03301-5087

SUBJECT: APPLICATION FOR AN EARLY SITE PERMIT (ESP) FOR THE GRAND GULF ESP SITE

Dear Mr. Bartlett:

The U.S. Nuclear Regulatory Commission (NRC) staff is reviewing an application by System Energy Resources, Inc. (SERI) for an early site permit (ESP) for the potential future construction of one or more new nuclear power plants. As part of the review of this application, the NRC is preparing an environmental impact statement (EIS). The impact analysis in the EIS includes the potential impacts of the construction and operation of a new nuclear power plant at the preferred or alternate sites, including the potential impacts to fish and wildlife and threatened and endangered species.

SERI's preferred alternative for the location of the proposed new power plant(s) is within the site boundaries of the existing Grand Gulf Nuclear Power Station (GGNS), site near the town of Port Gibson in Claiborne County, Mississippi. Three alternate sites will also be evaluated in the EIS. They are River Bend in West Feliciana County, Louisiana; FitzPatrick in Oswego County, New York; and Pilgrim in Plymouth County, Massachusetts.

The application for an ESP was submitted by SERI on October 16, 2003, pursuant to NRC requirements at Title 10 of the *Code of Federal Regulations* Part 52 (10 CFR 52). If approved, the ESP will document the NRC staff's determination regarding the suitability of the proposed site for the construction and operation of one or more new nuclear plants. The ESP would not authorize the applicant to begin construction of the unit(s). However, in its review the NRC staff will evaluate the environmental impacts of construction and operation and will also consider alternatives, including alternative sites.

To support the environmental impact statement preparation process and to ensure compliance with Section 7 of the Endangered Species Act of 1973, the NRC requests a list of endangered, threatened, candidate, and proposed species and critical habitat that are known to occur or could potentially occur in Plymouth County, Massachusetts. In addition, please provide any information you consider appropriate under the provisions of the Fish and Wildlife Coordination Act of 1934.

Accession No. ML040081108

M. Bartlett 2

If you have any questions concerning the ESP application, or other aspects of this project, please contact Ms. Cristina Guerrero, at (301) 415-2981 or by e-mail at CXG3@nrc.gov.

Sincerely,
/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos.: 52-009

Accession No. ML040090099

January 8, 2004

Mr. Ray Aycock, Field Supervisor
U.S. Fish and Wildlife Service
Mississippi Ecological Services Office
6578 Dogwood View Parkway
Jackson, MS 39213

SUBJECT: APPLICATION FOR AN EARLY SITE PERMIT FOR THE GRAND GULF SITE

Dear Mr. Aycock:

The U.S. Nuclear Regulatory Commission (NRC) staff is reviewing an application by System Energy Resources, Inc. (SERI) for an early site permit (ESP) for the potential future construction of one or more new nuclear power plants. As part of the review of this application, the NRC is preparing an environmental impact statement (EIS). The impact analysis in the EIS includes the potential impacts of the construction and operation of a new nuclear power plant at the preferred or alternate sites, including the potential impacts to fish and wildlife and threatened and endangered species.

SERI's preferred location for the proposed new power plant(s) is within the site boundaries of the existing Grand Gulf Nuclear Power Station (GGNS), site near the town of Port Gibson in Claiborne County, Mississippi. Three alternate sites will also be evaluated in the EIS. They are River Bend in West Feliciana County, Louisiana; Fitzpatrick in Oswego County, New York; and Pilgrim in Plymouth County, Massachusetts.

The application for an ESP was submitted by SERI on October 16, 2003, pursuant to NRC requirements at Title 10 of the *Code of Federal Regulations* Part 52 (10 CFR 52). If approved, the ESP will document the NRC staff's determination regarding the suitability of the proposed site for the construction and operation of one or more new nuclear plants. The ESP would not authorize the applicant to begin construction of the unit(s). However, in its review the NRC staff will evaluate the environmental impacts of construction and operation and will also consider alternatives, including alternative sites.

To support the EIS preparation process and to ensure compliance with Section 7 of the Endangered Species Act, the NRC requests a list of endangered, threatened, candidate, or proposed species and critical habitat that are known to occur or could potentially occur in Claiborne County, Mississippi. In addition, please provide any information you consider appropriate under the provisions of the Fish and Wildlife Coordination Act of 1934.

Accession No. ML040090099

R. Aycock 2

If you have any questions concerning the ESP application, or other aspects of this project, please contact Ms. Cristina Guerrero, at (301) 415-2981 or by e-mail at CXG3@nrc.gov.

Sincerely,
/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos.: 52-009

Accession No. ML04009125

January 8, 2004

Mr. Tom Wagner
Federal and State Review Program
Interagency Coordinator
Mississippi Department of Archives and History
Historic Preservation
P. O. Box 571
Jackson, MS 39205-0571

SUBJECT: EARLY SITE PERMIT (ESP) REVIEW FOR THE GRAND GULF SITE

Dear Mr. Wagner:

The U.S. Nuclear Regulatory Commission (NRC) staff is reviewing an application for an ESP to set aside a site for the potential future construction of one or more new nuclear power plants. The NRC staff is currently seeking information from consulting parties, and other individuals and organizations likely to have knowledge of, or concerns with, historic properties in the area, to identify issues relating to the proposed undertaking's potential effects on historic properties.

If built, the new unit(s) would be co-located with the existing Grand Gulf Nuclear Power Station (GGNS) site near the town of Port Gibson in Claiborne County, Mississippi. The application for an ESP was submitted by System Energy Resources, Inc. (SERI), on October 16, 2003, pursuant to NRC requirements at Title 10 of the *Code of Federal Regulations* Part 52 (10 CFR Part 52). The application is available through the web-based version of the NRC's Agencywide Documents Access and Management System (ADAMS) which can be found at http://www.nrc.gov/reading-rm/adams.html. The application is listed under Accession Number ML032960315.

As part of its review of the application, the NRC staff will prepare an environmental impact statement (EIS) under the provisions of 10 CFR Part 51, the NRC rules that implement the National Environmental Policy Act of 1969 (NEPA). In accordance with 36 CFR 800.8, the EIS will include analyses of potential impacts to historic properties, and will document the NRC staff's determination regarding the suitability of the proposed site for the construction and operation of one or more new nuclear plants.

If approved, the ESP would not authorize the applicant to begin construction of the unit(s). However, in its review the NRC staff will evaluate the environmental impacts of construction and operation and will also consider alternatives, including alternative sites.

Accession No. ML04009125

T. Wagner 2

In the context of the National Historic Preservation Act of 1966, as amended, the NRC staff has determined that the area of potential effect (APE) for this ESP review is the area at the power plant site and its immediate environs which may be impacted by land-disturbing activities associated with the construction and operation of the new unit(s). The power plant site is located in Claiborne County, Mississippi.

We invite you and your staff to participate in the review of the Grand Gulf ESP application. We will also be contacting any Native American Tribes, including the Choctaw Nation of Oklahoma, the Choctaw of Mississippi, and the Tunika Biloxi Indian Tribe of Louisiana that may have a potential interest in the proposed undertaking, affording them the opportunity to participate in this process and identify issues of concern to them. These tribes have been identified by records research with the Bureau of Indian Affairs, State and local governments, tribal organizations, and at a meeting the NRC had with Department of Archives and History staff on July 30, 2003.

On January 21, 2004, the NRC will conduct a public environmental scoping meeting from 7:00 p.m. until 10:00 p.m. at the Port Gibson City Hall, located at 1005 College Street, Port Gibson, Mississippi. You and your staff are invited to attend. Your office will receive a copy of the draft EIS along with a request for comments after it is issued. The draft EIS will include identification of historic properties, assessment of impacts, and our preliminary determination. The anticipated publication date for the draft EIS is February 2005. If you have any questions or require additional information, please contact Ms. Cristina Guerrero at 301-415-2981 or CXG3@nrc.gov.

Sincerely,
/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No.: 52-009

Accession No. ML040090141

January 8, 2004

Mr. Russ Watson
Acting Field Office Supervisor
U.S. Fish and Wildlife Service
Louisiana Ecological Services Office
646 Cajundome Blvd.
Lafayette, LA 70506

SUBJECT: APPLICATION FOR AN EARLY SITE PERMIT FOR THE GRAND GULF SITE

Dear Mr. Watson:

The U.S. Nuclear Regulatory Commission (NRC) staff is reviewing an application by System Energy Resources, Inc. (SERI) for an early site permit (ESP) for the potential future construction of one or more new nuclear power plants. As part of the review of this application, the NRC is preparing an environmental impact statement (EIS). The impact analysis in the EIS includes the potential impacts of the construction and operation of a new nuclear power plant at the preferred or alternate sites, including the potential impacts to fish and wildlife and threatened and endangered species.

SERI's preferred location for the proposed new power plant(s) is within the site boundaries of the existing Grand Gulf Nuclear Power Station (GGNS), site near the town of Port Gibson in Claiborne County, Mississippi. Three alternate sites will also be evaluated in the EIS. They are River Bend in West Feliciana County, Louisiana; Fitzpatrick in Oswego County, New York; and Pilgrim in Plymouth County, Massachusetts.

The application for an ESP was submitted by SERI on October 16, 2003, pursuant to NRC requirements at Title 10 of the *Code of Federal Regulations* Part 52 (10 CFR 52). If approved, the ESP will document the NRC staff's determination regarding the suitability of the proposed site for the construction and operation of one or more new nuclear plants. The ESP would not authorize the applicant to begin construction of the unit(s). However, in its review the NRC staff will evaluate the environmental impacts of construction and operation and will also consider alternatives, including alternative sites.

To support the EIS preparation process and to ensure compliance with Section 7 of the Endangered Species Act, the NRC requests a list of endangered, threatened, candidate, or proposed species and critical habitat that are known to occur or could potentially occur in West Feliciana County, Louisiana. In addition, please provide any information you consider appropriate under the provisions of the Fish and Wildlife Coordination Act of 1934.

Accession No. ML040090141

R. Watson 2

If you have any questions concerning the ESP application, or other aspects of this project, please contact Ms. Cristina Guerrero, at (301) 415-2981 or by e-mail at CXG3@nrc.gov.

Sincerely,

/RA/

Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos.: 52-009

Accession No. ML040090292

January 8, 2004

The Honorable Phillip Martin, Chief
Mississippi Band of Choctaw Indians
P.O. Box 6010 - Choctaw Branch
Choctaw, MS 39350

SUBJECT: EARLY SITE PERMIT (ESP) REVIEW FOR THE GRAND GULF SITE

Dear Chief Martin:

The U.S. Nuclear Regulatory Commission (NRC) staff is reviewing an application for an ESP to set aside a site for the potential future construction of one or more new nuclear power plants. The application was submitted by System Energy Resources, Inc. (SERI), on October 16, 2003, pursuant to NRC requirements at Title 10 of the *Code of Federal Regulations* Part 52 (10 CFR Part 52). If built, the new unit(s) would be co-located with the existing Grand Gulf Nuclear Power Station (GGNS) site near the town of Port Gibson in Claiborne County, Mississippi.

As part of its review of the application, the NRC staff will prepare an environmental impact statement (EIS) under the provisions of 10 CFR Part 51, the NRC rules that implement the National Environmental Policy Act of 1969 (NEPA). The NRC environmental review process includes an opportunity for public participation in the environmental review. The Grand Gulf ESP site is located on land that may be of interest to the Mississippi Band of Choctaw Indians. We want to ensure that you are aware of our efforts and, pursuant to our regulations at 10 CFR 51.28(b), the NRC invites the Mississippi Band of Choctaw Indians to provide input to the scoping process relating to the NRC's environmental review of the application. The following is a description of the application and the environmental review process.

The EIS will document the NRC staff's determination regarding the suitability of the proposed site for the construction and operation of one or more new nuclear plants. In addition, the staff will also consider alternatives to the proposed action, including alternative sites. The EIS will contain the results of the review of the environmental impacts on the area surrounding the Grand Gulf ESP site that are related to terrestrial ecology, aquatic ecology, hydrology, socioeconomic issues, and historic properties (among others), and will contain a recommendation regarding the environmental acceptability of granting an ESP. If approved, the ESP would not authorize the applicant to begin construction of the unit(s).

As part of this review, and in accordance with 36 CFR 800.8, the EIS will include analyses of potential impacts to historic properties. Accordingly, pursuant to 10 CFR 51.28 and 36 CFR 800.2(c), the NRC wishes to ensure that Indian tribes that might have an interest in any potential historic properties in the area of potential effect (APE) are afforded the opportunity to identify their concerns, provide advice on the identification and evaluation of historic properties, including those of traditional religious and cultural importance, and, if necessary, participate in the resolution of any adverse effects to such properties.

Accession No. ML040090292

The Honorable P. Martin

In the context of the National Historic Preservation Act of 1966, as amended, the APE for this ESP review is the area at the power plant site and its immediate environs that may be impacted by land-disturbing activities associated with the construction and operation of the new unit(s). GGNS is located in Claiborne County, Mississippi. The application is available through the web-based version of the NRC's Agencywide Documents Access and Management System (ADAMS) which can be found at http://www.nrc.gov/reading-rm/adams.html. The application is listed under accession number ML032960315.

On January 21, 2004, the NRC will conduct a public environmental scoping meeting from 7:00 p.m. until 10:00 p.m. at the Port Gibson City Hall, located at 1005 College Street, Port Gibson, Mississippi. Representatives of your tribe are invited to attend. The meeting will be preceded by a one-hour open house during which members of the public may meet and talk with NRC staff members on an informal basis.

Please submit any written comments your tribe may have to offer on the scope of the environmental review by February 12, 2004. Comments should be submitted either by mail to the Chief, Rules and Directives Branch, Division of Administrative Services, Mail Stop T-6D59, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001, or by e-mail to *GrandGulfEIS@nrc.gov*.

At the conclusion of the scoping process, the NRC staff will prepare a summary of the significant issues identified and the conclusions reached, and will send a copy to you. In addition, after it is issued, your office will receive a copy of the draft EIS along with a request for comments. The anticipated publication date for the draft EIS is February 2005. If you have any questions or require additional information, please contact Ms. Cristina Guerrero at 301-415-2981 or *GrandGulfEIS@nrc.gov*.

Sincerely,
/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No.: 52-009

Accession No. ML040090309

January 8, 2004

The Honorable Gregory E. Pyle, Chief
Choctaw Nation of Oklahoma
P. O. Drawer 1210
Durant, OK 74702-1210

SUBJECT: EARLY SITE PERMIT (ESP) REVIEW FOR THE GRAND GULF SITE

Dear Chief Pyle:

The U.S. Nuclear Regulatory Commission (NRC) staff is reviewing an application for an ESP to set aside a site for the potential future construction of one or more new nuclear power plants. The application was submitted by System Energy Resources, Inc. (SERI), on October 16, 2003, pursuant to NRC requirements at Title 10 of the *Code of Federal Regulations* Part 52 (10 CFR Part 52). If built, the new unit(s) would be co-located with the existing Grand Gulf Nuclear Power Station (GGNS) site near the town of Port Gibson in Claiborne County, Mississippi.

As part of its review of the application, the NRC staff will prepare an environmental impact statement (EIS) under the provisions of 10 CFR Part 51, the NRC rules that implement the National Environmental Policy Act of 1969 (NEPA). The NRC environmental review process includes an opportunity for public participation in the environmental review. The Grand Gulf ESP site is located on land that may be of interest to the Choctaw Nation of Oklahoma. We want to ensure that you are aware of our efforts and, pursuant to our regulations at 10 CFR 51.28(b), the NRC invites the Choctaw Nation of Oklahoma to provide input to the scoping process relating to the NRC's environmental review of the application. The following is a description of the application and the environmental review process.

The EIS will document the NRC staff's determination regarding the suitability of the proposed site for the construction and operation of one or more new nuclear plants. In addition, the staff will also consider alternatives to the proposed action, including alternative sites. The EIS will contain the results of the review of the environmental impacts on the area surrounding the Grand Gulf ESP site that are related to terrestrial ecology, aquatic ecology, hydrology, socioeconomic issues, and historic properties (among others), and will contain a recommendation regarding the environmental acceptability of granting an ESP. If approved, the ESP would not authorize the applicant to begin construction of the unit(s).

As part of this review, and in accordance with 36 CFR 800.8, the EIS will include analyses of potential impacts to historic properties. Accordingly, pursuant to 10 CFR 51.28 and 36 CFR 800.2(c), the NRC wishes to ensure that Indian tribes that might have an interest in any potential historic properties in the area of potential effect (APE) are afforded the opportunity to identify their concerns, provide advice on the identification and evaluation of historic properties, including those of traditional religious and cultural importance, and, if necessary, participate in the resolution of any adverse effects to such properties.

Accession No. ML040090309

The Honorable G. Pyle -2-

In the context of the National Historic Preservation Act of 1966, as amended, the APE for this ESP review is the area at the power plant site and its immediate environs that may be impacted by land-disturbing activities associated with the construction and operation of the new unit(s). GGNS is located in Claiborne County, Mississippi. The application is available through the web-based version of the NRC's Agencywide Documents Access and Management System (ADAMS) which can be found at http://www.nrc.gov/reading-rm/adams.html. The application is listed under accession number ML032960315.

On January 21, 2004, the NRC will conduct a public environmental scoping meeting from 7:00 p.m. until 10:00 p.m. at the Port Gibson City Hall, located at 1005 College Street, Port Gibson, Mississippi. Representatives of your tribe are invited to attend. The meeting will be preceded by a one-hour open house during which members of the public may meet and talk with NRC staff members on an informal basis.

Please submit any written comments your tribe may have to offer on the scope of the environmental review by February 12, 2004. Comments should be submitted either by mail to the Chief, Rules and Directives Branch, Division of Administrative Services, Mail Stop T-6 D59, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001, or by e-mail to *GrandGulfEIS@nrc.gov.*

At the conclusion of the scoping process, the NRC staff will prepare a summary of the significant issues identified and the conclusions reached, and will send a copy to you. In addition, after it is issued, your office will receive a copy of the draft EIS along with a request for comments. The anticipated publication date for the draft EIS is February 2005. If you have any questions or require additional information, please contact Ms. Cristina Guerrero at 301-415-2981 or *GrandGulfEIS@nrc.gov.*

Sincerely,
/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No.: 52-009

Accession No. ML040090330

January 8, 2004

Earl J. Barbry Jr., State Historic Preservation Officer
Tunika Biloxi Indian Tribe of Louisiana
PO 1589
Marksville, LA 71351

SUBJECT: EARLY SITE PERMIT (ESP) REVIEW FOR THE GRAND GULF SITE

Dear Mr. Barbry:

The U.S. Nuclear Regulatory Commission (NRC) staff is reviewing an application for an ESP to set aside a site for the potential future construction of one or more new nuclear power plants. The application was submitted by System Energy Resources, Inc. (SERI), on October 16, 2003, pursuant to NRC requirements at Title 10 of the *Code of Federal Regulations* Part 52 (10 CFR Part 52). If built, the new unit(s) would be co-located with the existing Grand Gulf Nuclear Power Station (GGNS) site near the town of Port Gibson in Claiborne County, Mississippi.

As part of its review of the application, the NRC staff will prepare an environmental impact statement (EIS) under the provisions of 10 CFR Part 51, the NRC rules that implement the National Environmental Policy Act of 1969 (NEPA). The NRC environmental review process includes an opportunity for public participation in the environmental review. The Grand Gulf ESP site is located on land that may be of interest to the Tunika Biloxi Indian Tribe of Louisiana. We want to ensure that you are aware of our efforts and, pursuant to our regulations at 10 CFR 51.28(b), the NRC invites the Tunika Biloxi Indian Tribe of Louisiana to provide input to the scoping process relating to the NRC's environmental review of the application. The following is a description of the application and the environmental review process.

The EIS will document the NRC staff's determination regarding the suitability of the proposed site for the construction and operation of one or more new nuclear plants. In addition, the staff will also consider alternatives to the proposed action, including alternative sites. The EIS will contain the results of the review of the environmental impacts on the area surrounding the Grand Gulf ESP site that are related to terrestrial ecology, aquatic ecology, hydrology, socioeconomic issues, and historic properties (among others), and will contain a recommendation regarding the environmental acceptability of granting an ESP. If approved, the ESP would not authorize the applicant to begin construction of the unit(s).

As part of this review, and in accordance with 36 CFR 800.8, the EIS will include analyses of potential impacts to historic properties. Accordingly, pursuant to 10 CFR 51.28 and 36 CFR 800.2(c), the NRC wishes to ensure that Indian tribes that might have an interest in any potential historic properties in the area of potential effect (APE) are afforded the opportunity to identify their concerns, provide advice on the identification and evaluation of historic properties, including those of traditional religious and cultural importance, and, if necessary, participate in the resolution of any adverse effects to such properties.

Accession No. ML040090330

The Honorable E. J. Barbry

In the context of the National Historic Preservation Act of 1966, as amended, the APE for this ESP review is the area at the power plant site and its immediate environs that may be impacted by land-disturbing activities associated with the construction and operation of the new unit(s). GGNS is located in Claiborne County, Mississippi. The application is available through the web-based version of the NRC's Agencywide Documents Access and Management System (ADAMS) which can be found at http://www.nrc.gov/reading-rm/adams.html. The application is listed under accession number ML032960315.

On January 21, 2004, the NRC will conduct a public environmental scoping meeting from 7:00 p.m. until 10:00 p.m. at the Port Gibson City Hall, located at 1005 College Street, Port Gibson, Mississippi. Representatives of your tribe are invited to attend. The meeting will be preceded by a one-hour open house during which members of the public may meet and talk with NRC staff members on an informal basis.

Please submit any written comments your tribe may have to offer on the scope of the environmental review by February 12, 2004. Comments should be submitted either by mail to the Chief, Rules and Directives Branch, Division of Administrative Services, Mail Stop T-6 D59, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001, or by e-mail to *GrandGulfEIS@nrc.gov*.

At the conclusion of the scoping process, the NRC staff will prepare a summary of the significant issues identified and the conclusions reached, and will send a copy to you. In addition, after it is issued, your office will receive a copy of the draft EIS along with a request for comments. The anticipated publication date for the draft EIS is February 2005. If you have any questions or require additional information, please contact Ms. Cristina Guerrero, at 301-415-2981 or *GrandGulfEIS@nrc.gov*.

Sincerely,
/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No.: 52-009

Accession No. ML030260250

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mississippi Field Office
6578 Dogwood View Parkway, Suite A
Jackson, Mississippi 39213
January 21, 2004

Proj-720
52-009

Mr. Pao-Tsin Kuo
Office of Nuclear Reactor Regulation
Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Mr. Kuo:

The U.S. Fish and Wildlife Service (Service) received your letter dated January 8, 2004, regarding the preparation of an Environmental Impact Statement (EIS) for the construction of one or more new nuclear power plants in Claiborne County, Mississippi. Our comments are submitted in accordance with the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.).

The following listed species could be found in the proposed project area:

The endangered interior least tern (*Sterna antillarum*) migrates up the Mississippi River and lays its eggs directly on the sandbars associated with the river. Hundreds of these birds may nest together to form a colony.

The endangered pallid sturgeon (*Scaphirhynchus albus*) is found in the lower Mississippi River, although it is rare throughout its range. These fish require large, turbid, free-flowing riverine habitats, and feed mainly on other fish. They are usually found near the bottom of streams or lakes in sand flats or gravel bars. Little information is known on spawning or migration habits of these fish, although spawning likely occurs in the spring and summer months.

The breeding/spawning season for terns and sturgeons is approximately May through July. Avoidance of these areas during the above time would prevent adverse impacts to either species. Both species can change nesting/spawning areas from year to year, so an onsite survey for both species just before start of construction is recommended.

The threatened Bayou darter (*Etheostoma rubrum*) is found only in Bayou Pierre and its tributaries: White Oak Creek, Foster Creek, and Turkey Creek. The darter prefers stable gravel riffles or sandstone exposures with large sized gravel or rock. Habitat loss or degradation has been a major contributor to the reduction in bayou darter numbers.

Add: Laura Dades
Steve Koenick
Andy Kugler
Tom Kenyon
Jim Wilson

D069

Accession No. ML030260250

The threatened bald eagle (*Haliaeetus leucocephalus*) is the only species of "sea eagle" regularly occurring on the North American continent. The bald eagle is predominantly a winter migrant in the southeast; however, increasing occurrences of nesting have been observed. The bald eagle nests in the transitional area between forest and water. They construct their nests in dominant living pines or bald cypress trees. Eagles often use alternate nests in different years with nesting activity occurring between September and January of each year. Young are usually fledged by midsummer.

The federally listed threatened Louisiana black bear (*Ursus a. luteolus*) occurs primarily in bottomland hardwood and floodplain forests along the Mississippi River and the southern part of the state. Although the bear is capable of surviving under a range of habitat types, some necessary habitat requirements include hard mast, soft mast, escape cover, denning sites, forested corridors, and limited human access. Forest management practices, agricultural, commercial and industrial development, and highways can cause adverse impacts to bear habitats by increasing human disturbance, fragmenting forests, and removing den trees.

All of the above listed species are very sensitive to human disturbance, and could be affected directly and also indirectly by the proposed projects. Therefore, before the use or transportation of any heavy construction equipment, or the removal of any vegetation within potential habitats, the Service recommends a qualified biologist conduct a visual survey for these species. Areas surveyed should also include ingress and egress areas, equipment storage areas, and staging areas.

The Service will provide you additional information and specific project recommendations during the EIS preparation process. If you have any additional questions, please feel free to contact Kathy Lunceford in this office, telephone: (601) 321-1132.

Sincerely,

Curtis B. James

Curtis B. James
Assistant Field Supervisor

Accession No. ML040370323

United States Department of the Interior

FISH AND WILDLIFE SERVICE
3817 Luker Road
Cortland, NY 13045

January 26, 2004

Proj 720
52-009

Mr. Pao-Tsin Kuo
Program Director
License Renewal & Environmental Impacts
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Attention: Ms. Cristina Guerrero

Dear Mr. Kuo:

This responds to your letter of January 6, 2004, requesting information on the presence of endangered or threatened species in the vicinity of the proposed Grand Gulf ESP alternate site, the Fitzpatrick Nuclear Power Plant, in the Town of Scriba, Oswego County, New York.

Except for occasional transient individuals, no Federally listed or proposed endangered or threatened species under our jurisdiction are known to exist in the project impact area. In addition, no habitat in the project impact area is currently designated or proposed "critical habitat" in accordance with provisions of the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.). Therefore, no further Endangered Species Act coordination or consultation with the U.S. Fish and Wildlife Service (Service) is required. Should project plans change, or if additional information on listed or proposed species or critical habitat becomes available, this determination may be reconsidered. The most recent compilation of Federally listed and proposed endangered and threatened species in New York* is available for your information.

The above comments pertaining to endangered species under our jurisdiction are provided pursuant to the Endangered Species Act. This response does not preclude additional Service comments under other legislation.

For additional information on fish and wildlife resources or State-listed species, we suggest you contact the appropriate New York State Department of Environmental Conservation regional office(s),* and:

DA69

Accession No. ML040370323

New York State Department of Environmental Conservation
New York Natural Heritage Program Information Services
625 Broadway
Albany, NY 12233-4757
(518) 402-8935

Since wetlands may be present, you are advised that National Wetlands Inventory (NWI) maps may or may not be available for the project area. However, while the NWI maps are reasonably accurate, they should not be used in lieu of field surveys for determining the presence of wetlands or delineating wetland boundaries for Federal regulatory purposes. Copies of specific NWI maps can be obtained from:

Cornell Institute for Resource Information Systems
302 Rice Hall
Cornell University
Ithaca, NY 14853
(607) 255-4864

Work in certain waters of the United States, including wetlands, may require a permit from the U.S. Army Corps of Engineers (Corps). If a permit is required, in reviewing the application pursuant to the Fish and Wildlife Coordination Act, the Service may concur, with or without recommending additional permit conditions, or recommend denial of the permit depending upon potential adverse impacts on fish and wildlife resources associated with project construction or implementation. The need for a Corps permit may be determined by contacting the appropriate Corps office(s).*

If you require additional information or assistance please contact Michael Stoll at (607) 753-9334.

Sincerely,

Mark W. Clough

Acting For

David A. Stilwell
Field Supervisor

*Additional information referred to above may be found on our website at: http://nyfo.fws.gov/es/esdesc.htm.

cc: NYSDEC, Syracuse, NY (Environmental Permits)
NYSDEC, Albany, NY (Natural Heritage Program)
COE, Buffalo, NY

2

Accession No.-ML040350504

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
One Blackburn Drive
Gloucester, MA 01930-2298

Proj 720
52-009

JAN 28 2004

Pao-Tsin Kuo
Program Director, License Renewal and Environmental Impacts
Division of Regulatory Improvement Projects
Office of Nuclear Reactor Regulation
United States Nuclear Regulatory Commission
Washington, DC 20555-0001

Re: Docket No. 52-009

Dear Mr. Kuo,

This responds to your letter dated January 6, 2004, requesting information on the presence of any federally listed threatened or endangered species and/or designated critical habitat for listed species under the jurisdiction of the National Marine Fisheries Service (NOAA Fisheries) in the vicinity of two sites for potential new nuclear power plants. The US Nuclear Regulatory Commission (NRC) is currently reviewing an application submitted by System Energy Resources Inc. (SERI) for an early site permit for the potential future construction of one or more new nuclear power plants. The preferred alternative for the location of the proposed new power plants is within the site boundaries of the existing Grand Gulf Nuclear Power Station (GGNS), site near the town of Port Gibson in Clairborne County, Mississippi. As part of the review of this application, the NRC is preparing an environmental impact statement (EIS). Three alternate sites will also be evaluated in the EIS. They are River Bend in West Feliciana County, Louisiana; FitzPatrick in Oswego County, New York; and Pilgrim in Plymouth County, Massachusetts.

The sites in Mississippi and Louisiana fall under the jurisdiction of NOAA Fisheries' Southeast Regional Office. It is our understanding that in a July 2002 letter, that office indicated that the Grand Gulf Site is within the historic range of the threatened Gulf sturgeon (*Acipenser oxyrinchus desotoi*). Biological information on federally protected sea turtles, sturgeon, Gulf sturgeon, Gulf sturgeon critical habitat, and other listed and candidate species potentially present near the River Bend site can be found at the following website address: NOAA Fisheries Southeast Regional Office (http://caldera.sero.nmfs.gov/protect/protect.htm). The Southeast Regional Office can be contacted at: 9721 Executive Center Drive North, St. Petersburg, Florida 33702 or (727)570-5333.

No federally listed or proposed threatened or endangered species under the jurisdiction of

D069

Accession No. ML040350504

NOAA Fisheries are known to exist in the vicinity of the existing FitzPatrick Site. However, several threatened and endangered species are known to exist in Cape Cod Bay in the vicinity of the Pilgrim Site. Four species of federally threatened or endangered sea turtles and three species of endangered whales are found seasonally in Massachusetts waters. The sea turtles in northeastern nearshore waters are typically small juveniles with the most abundant being the federally threatened loggerhead (*Caretta caretta*) followed by the federally endangered Kemp's ridley (*Lepidochelys kempi*). Loggerhead turtles have been found to be relatively abundant off the Northeast coast (from near Nova Scotia, Canada to Cape Hatteras, North Carolina). From November to March in 1985 through 1988, 130 cold-stunned turtles were collected along the Long Island shoreline, including 97 Kemp's ridleys. Loggerheads and Kemp's ridleys have been documented in waters as cold as 11°C, but generally migrate northward when water temperatures exceed 16°C. As such, these species usually arrive in Southern New England in June. Green sea turtles may occur sporadically in Massachusetts waters, but those instances would be rare. Federally endangered leatherback sea turtles (*Dermochelys coriacea*) are located in near shore New England waters during the warmer months as well.

Federally endangered North Atlantic right whales (*Eubalaena glacialis*), humpback whales (*Megaptera novaeangliae*), and fin whales (*Balaenoptera physalus*) may all also be found seasonally in Massachusetts waters. North Atlantic right whales have been documented in the nearshore waters of New England from January through September. Humpback whales feed during the spring, summer, and fall over a range that encompasses the eastern coast of the United States. Fin whales are common in waters of the United States Exclusive Economic Zone, principally offshore from Cape Hatteras northward.

While not protected under the Endangered Species Act (ESA) of 1973, as amended, minke whales (*Balaenoptera acutorostrata*), gray seals (*Halichoerus grypus*), harbor seals (*Phoca vitulina*), harbor porpoises (*Phocoena phocoena*), and white-sided dolphins (*Lagenorhynchus acutus*) are common residents of Massachusetts waters and may be present in the vicinity of the Plymouth Site. All marine mammals receive protection under the Marine Mammal Protection Act of 1972 (MMPA).

Section 7(a)(2) of the Endangered Species Act (ESA) states that each Federal agency shall, in consultation with the Secretary, insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. Because listed species may be present in the vicinity of several of the proposed sites and may be affected by the construction and operation of a new nuclear power project, an action at these sites would have to undergo Section 7 consultation. The federal action agency, in this case the NRC, would be responsible for initiating Section 7 consultation. If one of the sites where listed species are present is chosen, please submit a description of the project along with an assessment of the projects impacts on listed species to the appropriate NOAA Fisheries Regional Office. After reviewing this information, NOAA Fisheries will then be able to conduct a consultation under Section 7 of the ESA. If you have any questions or concerns about these comments or about

Accession No.=ML040350504

the consultation process in general, please contact Julie Crocker of my staff at (978) 281-9328 ext. 6530 (Northeast Region) or Dr. Stephania Bolden at (727)570-5312 (Southeast Region).

Sincerely,

Mary A. Colligan
Assistant Regional Administrator
for Protected Resources

Cc: Bolden, F/SER3

File Code: Sec 7 NRC Massachusetts

Accession No. ML040500681

United States Department of the Interior

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USNRC

FISH AND WILDLIFE SERVICE
646 Cajundome Blvd.
Suite 400
Lafayette, Louisiana 70506
February 5, 2004

Mr. Pao-Tsin Kuo
U.S. Nuclear Regulatory Commission
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation
Washington, District of Columbia 20555-0001

12/31/03
68 FR 75656
(1)

Dear Mr. Kou:

Please reference your January 8, 2004, letter regarding the application by System Energy Resources, Incorporated for an early site permit for the potential future construction of a nuclear power plant in one or more of the following locations: Port Gibson, Claiborne County, Mississippi; River Bend, West Feliciana Parish, Louisiana; Fitzpatrick, Oswego County, New York; and Pilgrim, Plymouth County, Massachusetts. Your letter requests information regarding threatened and endangered species, as well as environmentally sensitive areas, which may occur within West Feliciana Parish, Louisiana. The requested information will assist in the preparation of the environmental impact statement (EIS) by the U.S. Nuclear Regulatory Commission (NRC). As such, this letter also serves as our input to the Notice of Intent published in the December 31, 2003, Federal Register. Various U.S. Fish and Wildlife Service offices have reviewed the information you provided; pertaining solely to the River Bend Alternative in West Feliciana Parish, Louisiana, the Lafayette Field Office offers the following comments in accordance with the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.), and the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

The threatened Louisiana black bear (*Ursus americanus luteolus*) is primarily associated with forested wetlands; however, it utilizes a variety of habitat types, including marsh, spoil banks, and upland forests. Within forested wetlands, black bear habitat requirements include soft and hard mast for food, thick vegetation for escape cover, vegetated corridors for dispersal, large trees for den sites, and isolated areas for refuge from human disturbance. Remaining Louisiana black bear populations occur in the Tensas River Basin, the Upper Atchafalaya River Basin, and coastal St. Mary and Iberia Parishes. The primary threats to the species are continued loss of bottomland hardwoods, fragmentation of remaining forested tracts, and human-caused mortality (e.g., illegal killing and accidental collisions with motor vehicles).

Louisiana black bears, particularly pregnant females, normally den from December through April. In order to avoid disturbance of denning bears and possible abandonment of cubs, the Service recommends that any work in the project area be prohibited during the denning season.

E-RIDS = ADM-03
Add = James Wilson (JHW1)

Template = ADM-013

Accession No. ML040500681

To further protect denning bears, the Service, through the final rule, has extended legal protection to candidate or actual den trees. These are defined in the final rule as bald cypress (*Taxodium distichum*) and tupelo gum (*Nyssa* sp.) with visible cavities, having a diameter at breast height of 36 inches or greater, and occurring in or along rivers, lakes, streams, bayous, sloughs, or other water bodies. If construction is to be performed during the denning season or if bald cypress or tupelo gum with diameters at breast height of 36 inches or greater will be removed or destroyed, further consultation with this office will be necessary.

The pallid sturgeon (*Scaphirhynchus albus*) is an endangered fish found in both the Mississippi and Atchafalaya Rivers (with known concentrations in the vicinity of the Old River Control Structure Complex); it is possibly found in the Red River as well. The pallid sturgeon is adapted to large, free-flowing, turbid rivers with a diverse assemblage of physical habitats that are in a constant state of change. Detailed habitat requirements of this fish are not known, but it is believed to spawn in Louisiana. Habitat loss through river channelization and dams has adversely affected this species throughout its range.

As you may be aware, activities that involve wetlands are regulated by the U.S. Army Corps of Engineers (Corps). We, therefore, recommend that you contact the Corps to determine their interest in the proposed projects.

We appreciate the opportunity to provide these initial comments in the planning stages of this proposed project, and look forward to reviewing the forthcoming draft EIS. If you need further assistance, please contact Angela Culpepper (337/291-3137) of this office.

Sincerely,

Russell C. Watson
Supervisor
Louisiana Field Office

cc: USFWS, Mississippi Ecological Services Office, Jackson, MS
USFWS, New York Ecological Services Office, Cortland, NY
USFWS, New England Ecological Services Office, Concord, NH
Chief, Rules and Directives Branch, USNRC, Washington, D.C.
Corps of Engineers, New Orleans, LA
LDWF, Natural Heritage Program, Baton Rouge, LA

Accession No. ML040650620

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Field Office
70 Commercial Street, Suite 300
Concord, New Hampshire 03301-5087

RE: Application for an early site permit (ESP)
Grand Gulf ESP Site

February 9, 2004

Proj 720
52-009

Pao-Tsin Kuo
Office of Nuclear Reactor Regulations
United States Nuclear Regulatory Commission
Washington D.C. 20555-0001

Dear Mr. Kuo:

I have reviewed your request for information on endangered and threatened species and their habitats for the above-referenced project. My comments are provided in accordance with Section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531-1543). This letter addresses only the compliance with the Section 7 of the ESA and not the Fish and Wildlife Coordination Act of 1934.

This office has reviewed the proposed alternative site in Plymouth County, Massachusetts. The following is a list of federally-threatened or endangered species found in the county: northern red-bellied cooter (*Chrysemys rubriventris bangsi*), roseate tern (*Sterna dougallii dougallii*), piping plover (*Charadrius melodus*), and bald eagle (*Haliaeetus leucocephalus*). In order to comply with the Massachusetts Endangered Species Act and the Massachusetts Wetlands Protection Act (310 CMR 10), we suggest that you consult with the Massachusetts Natural Heritage and Endangered Species Program, Route 135, Westborough, MA 01581, telephone (508) 792-7270, extension 200, for information on state-listed species that are present.

Thank you for your cooperation and please contact me at 603-223-2541, extension 23, if we can be of further assistance.

Sincerely yours,

Michael J. Amaral

Michael J. Amaral
Endangered Species Specialist
New England Field Office

D069

Accession No. ML041310449

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mississippi Field Office
6578 Dogwood View Parkway, Suite A
Jackson, Mississippi 39213

April 14, 2004

52-009

Dr. Michael T. Masnik
Office of Nuclear Reactor Regulation
Nuclear Regulatory Commission
Mail Stop: O11F1
Washington, D.C. 20555-0001

Dear Dr. Masnik:

In a letter dated January 21, 2004, the U.S. Fish and Wildlife Service (Service) provided your agency with information on federally listed threatened and endangered species as it pertained to the preparation of an Environmental Impact Statement (EIS) for the construction of one or more new nuclear power plants in Claiborne County, Mississippi. Since that correspondence, another listed species, the endangered fat pocketbook mussel (*Potamilus capax*), has been identified in the project area. Our comments are provided in accordance with the Endangered Species Act (ESA) of 1973, as amended, (16 U.S.C. 1531 et seq.).

In August 2003, Mississippi Museum of Natural Science biologists collected two fresh dead shells of the fat pocketbook in the Ben Lomond Dike Field near Vicksburg in the Mississippi River channel. The Service was notified of the new record and confirmed the identification of the specimens. Service biologists conducted cursory mussel surveys in the area and collected 14 fresh dead shells and one live fat pocketbook.

The fat pocketbook is a broad, rounded, inflated, and slightly angular near the hinge. The anterior margin is very narrow and rounded. The valves do not close perfectly on each other but gape at the posterior margin. The nacre is white or bluish white and often iridescent. The beaks are curved over the hinge ligament.

Fat pocketbooks occur primarily in sand and mud substrates, although the species has been found in fine gravel and hard clay occasionally. Water depth ranges from a few inches to several feet. The life cycle of fat pocketbooks is similar to that of other freshwater mussels, in which the glochidia (larvae) require a fish host to transform to the juvenile stage. Fat pocketbooks are long-term brooders, with females becoming gravid in the fall, retaining glochidia over winter, and releasing the progeny during spring and summer. The fish host for this species is primarily freshwater drum.

The historic range of the fat pocketbook included the upper and middle Mississippi, Ohio,

D069

Accession No. ML041310449

Wabash, White, St. Francis, Black, Spoon, Illinois, Des Moines, Iowa, Cumberland, and Neosho Rivers. However, during the past decade, three populations have been discovered in the lower Mississippi River in Mississippi, and the species was recently discovered surviving in the White River of Arkansas. The greatest impact on the fat pocketbook throughout its historic range has been from activities resulting in the loss of habitat and a reduction in water quality.

Although there is little data regarding the presence of the fat pocketbook mussel in the immediate project vicinity, potential project impacts to this species should be considered during the EIS preparation process. If you have any questions, please feel free to contact Kathy Lunceford in this office, telephone: (601) 321-1132.

Sincerely,

Curtis B. James

Curtis B. James
Assistant Field Supervisor

cc: Pacific Northwest National Laboratory, Richland, WA
Attn: Jim Becker, Amoret L. Bunn
Mississippi Museum of Natural Science, Jackson, MS
Attn: Tom Mann

Appendix G

Authorizations and Consultations

Appendix G

Authorizations and Consultations

This appendix contains in Table G-1 a list of the environmental-related authorization, permits, and certifications potentially required by Federal, State, regional, local, and affected Native American tribal agencies related to the construction and operation of potential new nuclear units at the proposed Grand Gulf early site permit site.

Table G-1. Federal, State, and Local Authorizations

Agency	Authority	Requirement	Activity Covered
U.S. Nuclear Regulatory Commission	10 CFR 50	Domestic Licensing of Production and Utilization Facilities	Construction permit for a new nuclear power plant
U.S. Nuclear Regulatory Commission	10 CFR 52	Combined License	Issuance of combined licenses for nuclear power plants
U.S. Nuclear Regulatory Commission	10 CFR 52.17	Environmental Report	Approval of a site for one or more nuclear power facilities, with limited construction per 10 CFR 50.10(e)(1), if applicable
U.S. Fish and Wildlife Service	Endangered Species Act	Consultation	Consultation concerning potential impacts to threatened and endangered species
		Incidental Take Permit	Survey and possible collection of Federal threatened and endangered species
	Migratory Bird Treaty Act	Consultation	Consultation concerning potential impacts to migratory birds
U.S. Army Corps of Engineers	Clean Water Act	Section 404 Permit	Aquatic resource alteration permit (wetland filling, stream alteration)
	33 CFR 209	Dredge and Fill Discharge Permit	Permit for discharge of dredged spoils
U.S. Coast Guard	14 U.S.C. 81, 83, 85, 633/49 U.S.C. 1655(b)		Navigation markers - authorization to protect river navigation from hazards connected with temporary construction activities in the river.
Federal Aviation Administration	Federal Aviation Act	Permit	Permit for structures over 200 ft in height (construction cranes, cooling towers)

Table G-1. (contd)

Agency	Authority	Requirement	Activity Covered
Mississippi Department of Environmental Quality	Regulation APC-S-2	Permit to Construct Permit to Operate	Permit for the construction and/or operation of air emissions equipment
Mississippi Department of Environmental Quality	Regulation ACP-S-4		Ambient air quality standards
Mississippi Department of Environmental Quality	Regulation APC-S-5	Permit	Mississippi regulations for the prevention of significant deterioration of air quality
Mississippi Department of Environmental Quality	Regulation APC-S-6	Permit	Air operating permit under Title V of the Federal Clean Air Act
Mississippi Department of Environmental Quality	Regulation HW-1	Permit	Hazardous waste management regulations
Mississippi Department of Environmental Quality	Regulation LW-1	Permit	Surface water and groundwater use and protection regulations
Mississippi Department of Environmental Quality	Regulation SW-2	Permit	Non-hazardous solid waste management regulations and criteria
Mississippi Department of Environmental Quality	Regulation UST-2	Permit	Underground storage tank regulations
Mississippi Department of Environmental Quality	Regulation WPC-1	National Pollutant Discharge Elimination System Storm Water Permit	Wastewater regulations for National Pollutant Discharge Elimination System permits, water quality based effluent limitations, and water quality certification
Mississippi Department of Environmental Quality	Regulation WPC-2		Water quality criteria for intrastate, interstate and coastal waters
Mississippi Department of Environmental Quality	Regulation WPC-3	Certification	Regulations for the certification of municipal and domestic wastewater facility operators
Mississippi Department of Wildlife, Fisheries, and Parks	Natural Heritage Program	Scientific Collection Permit	Ecological monitoring programs
Mississippi Public Service Commission	MS Code of 1972 SEC. 77-3-11	Certificate of Public Convenience and Necessity	Certificate that the present and future public convenience and necessity require or will require the operation of such equipment for facility.
Louisiana Department of Wildlife and Fisheries	Natural Heritage Program	Scientific Collection Permit	Ecological monitoring programs

Appendix H

Data and Information to Support Specific Analyses

Appendix H

Data and Information to Support Specific Analyses

The data and information used by Nuclear Regulatory Commission (NRC) staff to support specific analyses in the course of evaluating the proposed Grand Gulf early site permit (ESP) site and included in this appendix are:

- Section H.1 - Support Information for Projected Populations (see Chapter 2 for discussion)
- Section H.2 - Environmental Impacts of Transportation, which discusses the effects of both incident-free transportation and transportation accidents (see Section 6.2 for further discussion)
- Section H.3 - Support Information for Environmental Impacts of Transportation, which discusses the environmental effects of radioactive waste shipments
- Section H.4 - References

H.1 Support Information for Projected Populations (Chapter 2)

The projected population within 16 km (10 mi) of the proposed Grand Gulf ESP facility is shown in Table H-1 and discussed in Chapter 2. The projected population with 80 km (50 mi) of the proposed Grand Gulf ESP facility is shown in Table H-2 and also discussed in Chapter 2.

Table H-1. Projected Population within 16 Kilometers (10 Miles) of the Proposed Grand Gulf Early Site Permit Facility

Sector/Year	0-2 km (0-1 mi)	2-3 km (1-2 mi)	3-5 km (2-3 mi)	5-6 km (3-4 mi)	6-8 km (4-5 mi)	8-16 km (5-10 mi)	Total
			North				
2002	0	3	0	0	0	10	13
2030	0	3	0	0	0	10	13
2040	0	3	0	0	0	10	13
2050	0	3	0	0	0	10	13
2060	0	3	0	0	0	10	13
2070	0	3	0	0	0	10	13

Table H-1. (contd)

Sector/Year	0-2 km (0-1 mi)	2-3 km (1-2 mi)	3-5 km (2-3 mi)	5-6 km (3-4 mi)	6-8 km (4-5 mi)	8-16 km (5-10 mi)	Total
				N-NE			
2002	0	11	0	0	0	3	14
2030	0	11	0	0	0	3	14
2040	0	11	0	0	0	3	14
2050	0	11	0	0	0	3	14
2060	0	11	0	0	0	3	14
2070	0	11	0	0	0	3	14
				NE			
2002	0	0	0	0	29	3	32
2030	0	0	0	0	31	3	34
2040	0	0	0	0	32	3	35
2050	0	0	0	0	33	3	36
2060	0	0	0	0	34	3	37
2070	0	0	0	0	34	4	38
				E-NE			
2002	0	14	0	45	27	102	188
2030	0	15	0	48	29	110	202
2040	0	15	0	50	30	112	207
2050	0	16	0	51	30	115	212
2060	0	16	0	52	31	118	218
2070	0	17	0	53	32	121	223
				East			
2002	0	17	0	84	68	173	342
2030	0	18	0	90	73	186	368
2040	0	19	0	93	75	191	377
2050	0	19	0	95	77	195	386
2060	0	20	0	97	79	200	396
2070	0	20	0	100	81	205	406
				E-SE			
2002	0	0	0	0	0	851	851
2030	0	0	0	0	0	915	915
2040	0	0	0	0	0	938	938

Table H-1. (contd)

Sector/Year	0-2 km (0-1 mi)	2-3 km (1-2 mi)	3-5 km (2-3 mi)	5-6 km (3-4 mi)	6-8 km (4-5 mi)	8-16 km (5-10 mi)	Total
2050	0	0	0	0	0	961	961
2060	0	0	0	0	0	985	985
2070	0	0	0	0	0	1010	1010
SE							
2002	0	0	10	0	212	3312	3534
2030	0	0	11	0	228	3560	3799
2040	0	0	11	0	234	3649	3894
2050	0	0	11	0	239	3741	3991
2060	0	0	12	0	245	3834	4091
2070	0	0	12	0	252	3930	4193
S-SE							
2002	0	6	8	0	42	513	569
2030	0	6	9	0	45	551	612
2040	0	7	9	0	46	565	627
2050	0	7	9	0	47	579	643
2060	0	7	9	0	49	594	659
2070	0	7	9	0	50	609	675
South							
2002	0	0	4	0	0	96	100
2030	0	0	4	0	0	99	103
2040	0	0	4	0	0	100	104
2050	0	0	4	0	0	101	105
2060	0	0	4	0	0	102	106
2070	0	0	4	0	0	103	107
S-SW							
2002	0	0	0	0	0	1362	1362
2030	0	0	0	0	0	1464	1464
2040	0	0	0	0	0	1501	1501
2050	0	0	0	0	0	1538	1538
2060	0	0	0	0	0	1577	1577
2070	0	0	0	0	0	1616	1616
SW							
2002	0	0	0	0	0	6	6

Table H-1. (contd)

Sector/Year	0-2 km (0-1 mi)	2-3 km (1-2 mi)	3-5 km (2-3 mi)	5-6 km (3-4 mi)	6-8 km (4-5 mi)	8-16 km (5-10 mi)	Total
2030	0	0	0	0	0	6	6
2040	0	0	0	0	0	7	7
2050	0	0	0	0	0	7	7
2060	0	0	0	0	0	7	7
2070	0	0	0	0	0	7	7
W-SW							
2002	0	0	0	0	0	98	98
2030	0	0	0	0	0	101	101
2040	0	0	0	0	0	102	102
2050	0	0	0	0	0	103	103
2060	0	0	0	0	0	104	104
2070	0	0	0	0	0	105	105
West							
2002	0	0	0	0	0	101	101
2030	0	0	0	0	0	104	104
2040	0	0	0	0	0	105	105
2050	0	0	0	0	0	106	106
2060	0	0	0	0	0	107	107
2070	0	0	0	0	0	108	108
W-NW							
2002	0	0	0	0	0	6	6
2030	0	0	0	0	0	6	6
2040	0	0	0	0	0	6	6
2050	0	0	0	0	0	6	6
2060	0	0	0	0	0	6	6
2070	0	0	0	0	0	6	6
NW							
2002	0	0	0	0	0	35	35
2030	0	0	0	0	0	35	35
2040	0	0	0	0	0	35	35
2050	0	0	0	0	0	35	35
2060	0	0	0	0	0	35	35

Table H-1. (contd)

Sector/Year	0-2 km (0-1 mi)	2-3 km (1-2 mi)	3-5 km (2-3 mi)	5-6 km (3-4 mi)	6-8 km (4-5 mi)	8-16 km (5-10 mi)	Total
2070	0	0	0	0	0	35	35
N-NW							
2002	0	0	0	0	0	0	0
2030	0	0	0	0	0	0	0
2040	0	0	0	0	0	0	0
2050	0	0	0	0	0	0	0
2060	0	0	0	0	0	0	0
2070	0	0	0	0	0	0	0
Totals							
2002	0	51	22	129	378	6671	7251
2030	0	54	23	139	406	7154	7776
2040	0	55	24	142	417	7327	7964
2050	0	56	25	146	427	7504	8157
2060	0	57	25	149	438	7686	8355
2070	0	58	26	153	449	7872	8557

Sources: USCB 2000; CPRP 2002; LPDC 1997

Table H-2. Projected Population within 80 Kilometers (50 Miles) of the Proposed Grand Gulf Early Site Permit Facility

Sector/Year	16-32 km (10-20 mi)	32-48 km (20-30 mi)	48-64 km (30-40 mi)	64-80 km (40-50 mi)	Subtotal	0-16 km (0-10 mi)	Total
				North			
2002	726	470	653	392	2241	13	2254
2030	770	498	692	416	2375	13	2388
2040	785	508	706	424	2423	13	2436
2050	801	518	720	432	2471	13	2484
2060	817	529	735	441	2521	13	2534
2070	833	539	749	450	2571	13	2584
				N-NE			
2002	20,890	17,721	6377	200	45,188	14	45,202
2030	22,770	19,316	6951	218	49,255	14	49,269
2040	23,453	19,895	7159	225	50,733	14	50,747
2050	24,157	20,492	7374	231	52,255	14	52,269
2060	24,882	21,107	7595	238	53,822	14	53,836
2070	25,628	21,740	7823	245	55,437	14	55,451
				NE			
2002	6000	6132	2005	680	14,817	32	14,849
2030	6450	6592	2155	731	15,928	34	15,962
2040	6611	6757	2209	749	16,326	35	16,361
2050	6777	6926	2264	768	16,735	36	16,771
2060	6946	7099	2321	787	17,153	37	17,190
2070	7120	7276	2379	807	17,582	38	17,620
				E-NE			
2002	836	2213	27,800	48,984	79,833	188	80,021
2030	901	2386	29,968	52,805	86,060	202	86,262
2040	925	2448	30,748	54,178	88,298	207	88,505
2050	949	2511	31,547	55,586	90,593	212	90,805
2060	973	2577	32,367	57,032	92,949	218	93,167
2070	999	2644	33,209	58,514	95,365	223	95,588

Table H-2. (contd)

Sector/Year	16-32 km (10-20 mi)	32-48 km (20-30 mi)	48-64 km (30-40 mi)	64-80 km (40-50 mi)	Subtotal	0-16 km (0-10 mi)	Total
East							
2002	1238	1456	10,900	8,039	21,633	342	21,975
2030	1355	1594	11,930	8,799	23,677	368	24,045
2040	1398	1644	12,306	9,076	24,423	377	24,800
2050	1442	1696	12,693	9,362	25,192	386	25,578
2060	1487	1749	13,093	9,657	25,986	396	26,382
2070	1534	1804	13,506	9,961	26,805	406	27,211
E-SE							
2002	995	1160	7000	8020	17,175	851	18,026
2030	1085	1264	7630	8742	18,721	915	19,636
2040	1117	1302	7859	9004	19,282	938	20,220
2050	1151	1341	8095	9274	19,861	961	20,822
2060	1185	1382	8338	9552	20,457	985	21,442
2070	1221	1423	8588	9839	21,070	1010	22,080
SE							
2002	1200	1613	4151	18,987	25,951	3,534	29,485
2030	1308	1758	4525	20,696	28,287	3,799	32,086
2040	1347	1811	4660	21,317	29,135	3,894	33,029
2050	1388	1865	4800	21,956	30,009	3,991	34,000
2060	1429	1921	4944	22,615	30,910	4,091	35,001
2070	1472	1979	5092	23,293	31,837	4,193	36,030
S-SE							
2002	700	483	1764	4226	7173	569	7742
2030	753	519	1896	4543	7711	612	8323
2040	771	532	1944	4657	7904	627	8531
2050	791	546	1992	4773	8101	643	8744
2060	810	559	2042	4892	8304	659	8963
2070	831	573	2093	5015	8511	675	9186
South							
2002	3900	2222	1242	1087	8451	100	8551
2030	4017	2289	1279	1120	8705	103	8808
2040	4057	2312	1292	1131	8792	104	8896

Table H-2. (contd)

Sector/Year	16-32 km (10-20 mi)	32-48 km (20-30 mi)	48-64 km (30-40 mi)	64-80 km (40-50 mi)	Subtotal	0-16 km (0-10 mi)	Total
2050	4098	2335	1305	1142	8879	105	8984
2060	4139	2358	1318	1154	8968	106	9074
2070	4180	2382	1331	1165	9058	107	9165
S-SW							
2002	1069	8026	16,095	10,600	35,790	1362	37,152
2030	1101	8267	16,578	10,918	36,864	1464	38,328
2040	1112	8349	16,744	11,027	37,232	1501	38,733
2050	1123	8433	16,911	11,137	37,605	1538	39,143
2060	1134	8517	17,080	11,249	37,981	1577	39,558
2070	1146	8602	17,251	11,361	38,361	1616	39,977
SW							
2002	500	1712	5700	8034	15,946	6	15,952
2030	530	1815	6042	8516	16,903	6	16,909
2040	541	1851	6163	8686	17,241	7	17,248
2050	551	1888	6286	8860	17,586	7	17,593
2060	562	1926	6412	9037	17,937	7	17,944
2070	574	1964	6540	9218	18,296	7	18,303
W-SW							
2002	1230	1400	2122	1196	5948	98	6046
2030	1333	1518	2300	1296	6448	101	6549
2040	1371	1560	2365	1333	6628	102	6730
2050	1409	1604	2431	1370	6814	103	6917
2060	1448	1649	2499	1408	7005	104	7109
2070	1489	1695	2569	1448	7201	105	7306
West							
2002	300	698	3463	3098	7559	101	7660
2030	323	752	3733	3340	8149	104	8253
2040	332	772	3830	3426	8360	105	8465
2050	340	792	3930	3516	8578	106	8684
2060	349	813	4032	3607	8801	107	8908
2070	358	834	4137	3701	9030	108	9138

Table H-2. (contd)

Sector/Year	16-32 km (10-20 mi)	32-48 km (20-30 mi)	48-64 km (30-40 mi)	64-80 km (40-50 mi)	Subtotal	0-16 km (0-10 mi)	Total
			W-NW				
2002	2012	1700	4586	5946	14,244	6	14,250
2030	2169	1833	4944	6410	15,355	6	15,361
2040	2225	1880	5072	6576	15,754	6	15,760
2050	2283	1929	5204	6747	16,164	6	16,170
2060	2343	1979	5339	6923	16,584	6	16,590
2070	2403	2031	5478	7103	17,015	6	17,021
			NW				
2002	104	240	1418	7000	8762	35	8797
2030	113	262	1546	7630	9551	35	9586
2040	117	269	1592	7859	9837	35	9872
2050	120	278	1640	8095	10,132	35	10,167
2060	124	286	1689	8338	10,436	35	10,471
2070	128	294	1740	8588	10,749	35	10,784
			N-NW				
2002	700	3338	8300	2069	14,407	0	14,407
2030	768	3663	9109	2271	15,812	0	15,812
2040	793	3783	9405	2345	16,326	0	16,326
2050	819	3905	9711	2421	16,856	0	16,856
2060	846	4032	10,027	2499	17,404	0	17,404
2070	873	4163	10,352	2581	17,970	0	17,970
			Totals				
2002	42,400	50,584	103,576	128,558	325,118	7251	332,369
2030	45,746	54,325	111,279	138,449	349,799	7776	357,575
2040	46,955	55,673	114,054	142,012	358,694	7964	366,658
2050	48,197	57,059	116,904	145,671	367,831	8157	375,988
2060	49,475	58,482	119,831	149,429	377,217	8355	385,572
2070	50,788	59,944	122,838	153,288	386,858	8557	395,415

Sources: USCB 2000; CPRP 2002; LPDC 1997

H.2 Environmental Impacts of Transportation

This appendix discusses the potential environmental effects of transportation of reactor fuel and radioactive waste to and from potential early site permit (ESP) sites. Section H.2.1 briefly discusses the effects of transportation of unirradiated fuel to ESP sites, and Section H.2.2 discusses the effects of transportation of spent fuel from ESP sites to a spent fuel disposal facility. Section H.2.3 discusses the environmental effects of radioactive waste shipments.

H.2.1 Unirradiated Fuel Shipping

This section addresses the number and characteristics of shipments of unirradiated fuel to ESP sites relative to the conditions in 10 CFR 51.52. Comparisons are also made against Table S–4 in 10 CFR 51.52(c) and WASH-1238 (AEC 1972), which provided the data that supports Table S–4. Section H.2.1.1 presents the basic unirradiated fuel shipping requirements for each advanced reactor design. These data were extracted from INEEL (2003). Section H.2.1.2 presents the comparisons to 10 CFR 51.52 conditions.

H.2.1.1 Advanced Reactor Unirradiated Fuel Shipping Data

In WASH-1238 (AEC 1972), a reference boiling water reactor (BWR) and pressurized water reactor (PWR) were used to formulate the basic numbers of unirradiated fuel shipments required for initial core loading and refueling. Both reference reactor types had a net electrical output of 1100 MW(e). The reference BWR assumed an initial core loading of 150 metric tons of uranium (MTU), and the reference PWR assumed 100 MTU. Both reactor types resulted in 18 truck shipments of unirradiated fuel per reactor. Annual reload quantities were assumed to be 30 MTU/yr for both reactor types, which resulted in an additional six truck shipments per year per reactor. In total, about 252 truck shipments of unirradiated fuel are required over a 40-year reactor life, including the initial core and 39 years of reloads, for both reactor types.

The initial fuel loading and annual reload quantities for the Advanced Boiling Water Reactor (ABWR), a 1500-MW(e) reactor, and the Economic Simplified Boiling Water Reactor (ESBWR) are approximately the same: 156.96 MTU per reactor initial core loading and 32.76 MTU/yr per reactor reload quantities (INEEL 2003). This equates to about 872 unirradiated fuel assemblies in the initial core and 213 assemblies per year for refueling. Truck shipment capacities were stated in INEEL (2003) to be 28 to 30 unirradiated fuel assemblies per truck shipment. Assuming 30 fuel assemblies per truck shipment results in about 30 shipments of unirradiated fuel to load the initial core and 6.1 truck shipments per year for refueling. If 28 fuel assemblies per truck shipment are used, the initial core load requires about 32 shipments of unirradiated fuel and annual refueling requires about 6.5 truck shipments per year.

The surrogate AP1000 is a 1150-MW(e) advanced PWR power plant. The initial core load was estimated to be 84.5 MTU per reactor and annual reload requirements were estimated at 24.4 MTU/yr per reactor. The data in INEEL (2003) also indicated that the average uranium mass in an unirradiated surrogate AP1000 fuel assembly was 0.583 MTU and that 12 fuel assemblies per truck shipment would be transported. This resulted in about 14 truck shipments to supply the initial core and about 3.8 truck shipments per year to support refueling. For a site with 2 reactors, these estimates would be doubled.

The ACR-700 is an advanced design Canada Deuterium Uranium (CANDU) reactor assumed to generate 731 MW(e). It was stated in INEEL (2003) that the initial core load for the ACR-700 included 61.3 MTU per reactor and the annual refueling requirements are 33.1 MTU/yr per reactor. Each fuel assembly contains 18 kg of uranium (INEEL 2003). This corresponds to 3406 fuel assemblies in the initial core loading and 1839 fuel assemblies per year for refueling. A range of truck shipment capacities was given in INEEL (2003) to be 180 to 240 fuel assemblies per truck shipment. This equates to 15 to 19 truck shipments to supply the initial core load and from 7.7 to 10.2 annual refueling shipments. For a site with two reactors, these estimates would be doubled.

The International Reactor Innovative and Secure (IRIS) design is a 335-MW(e) advanced PWR. It requires an initial core load of 48.67 MTU or 89 fuel assemblies per unit (546.9 kg of uranium per fuel assembly) (INEEL 2003). For refueling, the IRIS reactor was assumed to require an additional 6.26 MTU/yr of unirradiated fuel per reactor or about 40 unirradiated fuel assemblies every 3.5 years. INEEL (2003) indicates that a "typical" site may contain three reactors. Assuming each truck shipment carries eight fuel assemblies, the initial core load requires 34 truck shipments per three-reactor site and annual refueling requires an additional 4.3 truck shipments per year per three-reactor site.

The Gas Turbine – Modular Helium Reactor (GT-MHR) is a gas-cooled reactor that uses a substantially different fuel design than current and advanced LWRs. The reactor's thermal power level is rated at 600 MW(t) per reactor and electric generation capacity is rated at 285 MW(e) per reactor. A standard GT-MHR site is assumed to comprise four reactors. INEEL (2003) states that the initial core load for a single reactor is about 1020 fuel assemblies. Annual average reload requirements are 510 fuel assemblies per reactor. INEEL (2003) also indicates that each truck shipment can carry 80 fuel assemblies, so for all four reactors it will require about 51 truck shipments to transport the initial core load and about 20 truck shipments per year for the annual reload requirements.

The Pebble Bed Modular Reactor (PBMR) is a gas-cooled reactor that is rated at 400 MW(t) (165 MW(e)) per reactor. A typical PBMR site is assumed to consist of eight reactors. The PBMR uses a substantially different fuel design than a typical LWR. INEEL (2003) states that each reactor requires 260,000 fuel spheres per reactor for its initial core load; 120,000 fuel spheres per reactor are required for annual average reloads. A total of 48,000 fuel spheres is assumed to be transported in a typical truck shipment. As a result, it will take about 44 shipments of fuel spheres to transport the initial core load for all eight reactors and about 20 shipments per year to transport the annual reload quantity for all eight reactors.

To make comparisons to Table S–4, the environmental impacts are normalized to a reference reactor-year. The reference reactor is an 1100 MW(e) reactor that has an 80 percent capacity factor, for a total electrical output of 880 MW(e) per year. The environmental impacts can be adjusted to calculate impacts per site by multiplying the normalized impacts by the ratio of the total electrical output for the advanced reactor sites to the electrical output of the reference reactor.

H.2.1.2 Analysis of the Environmental Impacts of Unirradiated Fuel Shipments

As required by 10 CFR 51.52, applicants are required to submit a statement that the reactor and the transportation of fuel and waste to and from the reactor meet all the conditions specified in 10 CFR 51.42(a) or 10 CFR 51.52(b). The conditions specified in 10 CFR 51.52(a) that apply to unirradiated fuel include the following:

(1) The reactor core has a thermal loading less than 3800 MW.

(2) The reactor fuel is in the form of sintered UO_2 pellets not exceeding 4 percent uranium-235 by weight and the pellets are encapsulated in zircaloy rods.

(3) Unirradiated fuel is shipped to the reactor by truck.

(4) The environmental impacts of transportation of fuel and waste are as set forth in Summary Table S–4 in 10 CFR 51.52(c).

Unirradiated fuel shipment information for the advanced reactors is discussed below for each of these criteria.

Reactor Core Thermal Loading

The thermal output ratings of the seven advanced reactor types, as given in INEEL (2003), are as follows:

- ABWR – 4300 MW(t) (single reactor)
- ESBWR – 4000 MW(t) (single reactor)
- surrogate AP1000 – 3400 MW(t) (single reactor)
- ACR-700 – 1982 MW(t) per reactor x two reactors per site = 3964 MW(t) per site

- IRIS – 1000 MW(t) per reactor x three reactors per site = 3000 MW(t) per site
- GT-MHR – 600 MW(t) per reactor x four reactors per site = 2400 MW(t) per site
- PBMR – 400 MW(t) per reactor x eight reactors per site = 3200 MW(t) per site.

As shown above, single-unit ABWR and ESBWR plants exceed the 3800-MW(t) condition in 10 CFR 51.52(a)(1). In addition, the twin-reactor ACR-700 site exceeds the core thermal power condition.

Reactor Fuel Form

All of the advanced LWRs (i.e., the ABWR, ESBWR, surrogate AP1000, IRIS, and ACR-700) use sintered UO_2 fuel pellets encapsulated in zircaloy rods. The average enrichment for the ACR-700 fuel is about 2 percent, well within the 10 CFR 51.52(a)(2) condition. The average enrichments for the other advanced LWR fuels exceed the 4 percent uranium-235 by weight condition in 10 CFR 51.52(a)(2).

The gas-cooled reactors (i.e., the GT-MHR and PBMR) have a substantially different fuel form than described in 10 CFR 51.52(a)(2). The fuel forms for these reactors are coated uranium oxycarbide fuel kernels (GT-MHR) or coated uranium dioxide fuel kernels (PBMR). The fuel kernels are coated with layers of pyrolitic carbon and silicone carbide. Thus, these fuel forms are not the same as the conditions specified in 10 CFR 51.52(a)(2). Furthermore, the equilibrium enrichments for these fuels are 12.9 percent (PBMR) and 19.8 percent (GT-MHR). Therefore, the advanced gas-cooled reactor fuel forms are not the same as the conditions specified in 10 CFR 51.52(a)(2).

Shipping Mode

All the reactor types, as stated in INEEL (2003), use trucks to ship unirradiated fuel to the various sites (INEEL 2003).

WASH-1238 and Table *S–4 of 10 CFR 51.52(c)*

The Table S–4 condition that applies to shipment of unirradiated fuel limits the number of shipments of fuel and waste to and from a commercial nuclear power plant to less than one per day. Table H-3 summarizes the number of truck shipments of unirradiated fuel required for each reactor type. The table also normalizes the numbers of shipments to the net electrical generation output for the reference reactor in WASH-1238 (AEC 1972), or 880 MW(e) (1100-MW(e) plant operating at 80-percent annual capacity factor).

Table H-3. Numbers of Truck Shipments of Unirradiated Fuel for Each Advanced Reactor Type

Reactor Type	Number of Shipments per Site: Initial Core[(a)]	Number of Shipments per Site: Annual Reload	Number of Shipments per Site: Total[(b)]	Site Electric Generation, MW(e)[(c)]	Capacity Factor[(c)]	Normalized, Shipments per 1100 MW(e)[(d,e)]
Reference LWR (WASH-1238)	18	6	252	1100	0.8	252
ABWR/ESBWR[(d,e)]	30	6.1	267	1500[(f)]	0.95	165
Surrogate AP1000	14	3.8	161	1150[(f)]	0.95	130
ACR-700	30	15.4	628	1462[(g)]	0.9	420
IRIS	34	4.3	201	1005[(h)]	0.96	184
GT-MHR	51	20	831	1140[(i)]	0.88	729
PBMR	44	20	824	1320[(j)]	0.95	579

NOTE: The reference LWR shipment values have all been normalized to 880 MW(e) net electrical generation.
(a) Shipments of the initial core have been rounded up to the next highest whole number.
(b) Total shipments of unirradiated fuel over a 40-year plant lifetime (i.e., initial core load plus 39 years of average annual reload quantities).
(c) Unit capacities and capacity factors were taken from INEEL (2003).
(d) Normalized to net electric output for WASH-1238 reference LWR (i.e., 1100 MW(e) reactor at 80 percent or net electrical output of 880 MW(e)).
(e) Ranges of capacities are given in INEEL (2003) for these reactor unirradiated fuel shipments. The unirradiated fuel shipment data for these reactors were derived using the upper limit of the ranges.
(f) The ABWR/ESBWR site includes one reactor at 1500 MW(e) and the surrogate AP1000 site includes one reactor at 1150 MW(e).
(g) The ACR-700 site includes two reactors at 731 MW(e) per reactor.
(h) The IRIS site includes three reactors at 335 MW(e) per reactor.
(i) The GT-MHR site includes four reactors at 285 MW(e) per reactor.
(j) The PBMR site includes eight reactors at 165 MW(e) per reactor.

As shown, the ACR-700, PBMR, and GT-MHR advanced reactor types exceed the number of truck shipments estimated for the reference LWR in WASH-1238 (AEC 1972). The largest number of shipments, in excess of 700 shipments over 40 years, is for the GT-MHR. However, this equates to far less than one truck shipment per day. Consequently, the numbers of shipments for all the advanced reactor types are within the conditions specified in Table S–4 of 10 CFR 51.52. Table S–4 includes a condition that the truck shipments not exceed 33,000 kg (73,000 lb) as governed by Federal or State gross vehicle weight restrictions. All of the advanced reactors were indicated in INEEL (2003) to be capable of meeting this restriction for unirradiated fuel shipments.

Finally, Table S–4 includes conditions related to radiological doses to transport workers and members of the public along transport routes. These doses are a function of the radiation dose rate emitted from the unirradiated fuel shipments, the number of exposed individuals and their locations relative to the shipment, the time in transit (including travel time and stop time), and number of shipments to which the individuals are exposed. The radiological dose impacts of the transportation of unirradiated fuel were calculated using the RADTRAN 5 computer code (Neuhauser et al. 2003). The RADTRAN 5 calculations were performed to develop estimates of the worker and public doses associated with annual unirradiated fuel shipments to the ESP sites.

One of the key assumptions in WASH-1238 (AEC 1972) for the reference LWR unirradiated fuel shipments is that the radiation dose rate at 1 m (3 ft) from the transport vehicle is about 0.001 mSv/hr (0.1 mrem/hr). This assumption was also used in the analysis of advanced reactor unirradiated fuel shipments. This assumption is reasonable for all the advanced reactor fuel types because the fuel materials will be low-dose-rate uranium radionuclides and will be packaged similarly (i.e., inside a metal container that provides little radiation shielding). The numbers of shipments per year were obtained by dividing the normalized shipments in Table H-3 by 40 years of operation. Other key input parameters used in the radiation dose analysis for unirradiated fuel are shown in Table H-4.

The RADTRAN 5 results for this "generic" unirradiated fuel shipment are as follows:

- Worker dose: 1.71×10^{-5} person-Sv/shipment (1.71×10^{-3} person-rem/shipment)

- General public dose (onlookers - persons at stops and sharing the highway): 6.65×10^{-5} person/Sv shipment (6.65×10^{-3} person-rem/shipment)

- General public dose (along route - persons living near a highway): 1.61×10^{-6} person-Sv/shipment (1.61×10^{-4} person-rem/shipment).

These values were combined with the average annual shipments of unirradiated fuel for each advanced reactor type (see Table H-3) normalized to the WASH-1238 (AEC 1972) reference LWR electric output (880 MW(e)) to calculate annual doses to the public and workers. The results are compared to Table S–4 conditions. The results are shown in Table H-5. As shown, the calculated radiation doses for shipping unirradiated fuel to advanced reactor sites are within the Table S–4 conditions.

Although radiation may cause cancers at high doses and high dose rates, currently there are no data that unequivocally establish the occurrence of cancer following exposures to low doses and dose rates, below about 100 mSv (10,000 mrem). However, radiation protection experts conservatively assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. Simply stated, any increase in dose, no

Table H-4. RADTRAN 5 Input Parameters for Unirradiated Fuel Shipments

Parameter	RADTRAN 5 Input Value	Source
Shipping distance, km	3200	AEC (1972)[a]
Travel fraction – rural	0.90	NRC (1977)
Travel fraction – suburban	0.05	
Travel fraction – urban	0.05	
Population density – rural, persons/km^2	10	DOE (2002a)
Population density – suburban, persons/km^2	349	
Population density – urban, persons/km^2	2260	
Vehicle speed – rural, km/hr	88.49	Based on average speed in rural areas given in DOE (2002a)
Vehicle speed – suburban, km/hr	88.49	
Vehicle speed – urban, km/hr	88.49	
Traffic count – rural, vehicles/hr	530	DOE (2002a)
Traffic count – suburban, vehicles/hr	760	
Traffic count – urban, vehicles/hr	2400	
Dose rate at 1 m from vehicle, mSv/hr	0.001	AEC (1972)
Packaging length, m	7.3	Approximate length of two LWR fuel element packages placed on end
Number of truck crew	2	AEC (1972), NRC (1977), and DOE (2002a)
Stop time, hr/trip	4.5	Based on 0.0014-hour stop time per km (Hostick et al. 1992)
Population density at stops, persons/km^2	64,300	Based on 20 people in annular ring extending from 1 to 10 m (3.3 to 33 ft) from the vehicle

(a) AEC (1972) provides a range of shipping distances between 40 km (25 mi) and 4800 km (3000 mi) for unirradiated fuel shipments. A 3200-km (2000-mi) "average" shipping distance was assumed here.

matter how small, results in an incremental increase in health risk. This theory is accepted by the NRC as a conservative model for estimating health risks from radiation exposure, recognizing that the model probably over-estimates those risks.

Based on this model, the staff estimates the risk to the public from radiation exposure using the nominal probability coefficient for total detriment (730 fatal cancers, nonfatal cancers, and severe hereditary effects per 10,000 person-Sv [1,000,000 person-rem]) from International Commission on Radiation Protection (ICRP) Publication 60 (ICRP 1990). All the public doses presented in Table H-5 are less than 0.001 person-Sv/yr (0.1 person-rem/yr); therefore, the total detriment estimates associated with these doses would all be less than 1 x 15^{-4} fatal cancers, nonfatal cancers, and severe hereditary effects per year. These risks are very small compared to the fatal cancers, nonfatal cancers, and severe hereditary effects that the same population would incur annually from exposure to natural sources of radiation.

Table H-5. Radiological Impacts of Transporting Unirradiated Fuel to ESP Sites

Plant Type	Normalized Average Annual Shipments	Cumulative Annual dose, person-Sv/yr[(a)] per 1100 MW(e)		
		Workers	Public – Onlookers	Public – Along Route
Reference LWR (WASH-1238 [AEC 1972])	6.1	1.1×10^{-4}	4.2×10^{-4}	1.0×10^{-5}
ABWR/ESBWR	4.1	7.1×10^{-5}	2.7×10^{-4}	6.6×10^{-6}
Surrogate AP1000	3.3	5.6×10^{-5}	2.2×10^{-4}	5.2×10^{-6}
ACR-700	10.5	1.8×10^{-4}	7.0×10^{-4}	1.7×10^{-5}
IRIS	4.6	7.9×10^{-5}	3.1×10^{-4}	7.4×10^{-6}
GT-MHR	18.2	3.1×10^{-4}	1.2×10^{-3}	2.9×10^{-5}
PBMR	14.5	2.5×10^{-4}	9.6×10^{-4}	2.3×10^{-5}
10 CFR 51.52, Table S—4 Condition	<1 per day	4×10^{-2}	3×10^{-2}	3×10^{-2}

(a) Multiply person-Sv/yr times 100 to obtain dose in person-rem/yr.

H.2.1.3 Transportation Accidents

Accidents involving unirradiated fuel shipments are also addressed in Table S–4. Accident risks are the product of accident frequency times consequence. Accident frequencies are likely to be lower than they were when WASH-1238 (AEC 1972) was published because traffic accident, injury, and fatality rates have fallen over the past 30 years. Consequences of accidents that are severe enough to result in a release of unirradiated fuel particles are not significantly different for advanced LWRs because the fuel form, cladding, and packaging are similar to those analyzed in WASH-1238. Consequently, the impacts of accidents during transport of unirradiated fuel to advanced LWR sites would be smaller than the WASH-1238 results that formed the basis for Table S–4.

With respect to the advanced gas-cooled reactors, accident rates (accidents per unit distance) and associated accident frequencies (accidents per year) would follow the same trends as for LWRs, i.e., overall reduction relative to the accident rates used in WASH-1238 (AEC 1972). The consequences of accidents involving gas-cooled reactor unirradiated fuel, however, are more uncertain. A literature search was conducted to identify publicly available documents that describe the effects of accidents (i.e., exposure of unirradiated gas-cooled reactor fuel to structural and thermal transients). No definitive references were found. Consequently, it was assumed here that the gas-cooled reactor unirradiated fuel shipments would have the same abilities as LWR unirradiated fuel to maintain functional integrity following a traffic accident. This assumption is judged to be conservative because gas-cooled reactor fuel operates at significantly higher temperatures and thus maintains integrity under more severe thermal conditions than LWR fuel. Detailed information about the behavior of the gas-cooled reactor fuel under impact conditions was not available. However, packaging systems for unirradiated gas-cooled reactor fuel will be required to meet the same requirements as unirradiated LWR fuel packages. Properly designed and manufactured packaging systems are the most effective means of preventing damage and dispersal of the contained materials under accident conditions. Consequently, packaging systems for unirradiated gas-cooled reactor fuels would provide release (i.e., consequence) prevention and mitigation equivalent to those designed for unirradiated LWR fuels. In addition, the fuel forms for the gas-cooled reactors are similar to those for LWRs (i.e., uranium oxide for the PBMR and uranium oxycarbide for the GT-MHR versus uranium oxide for LWRs); thus, the failure resistance provided by unirradiated gas-cooled reactor fuels is not expected to be significantly lower than that for LWRs. Based on the assumption that unirradiated gas-cooled and LWR fuels and associated packaging systems provide equivalent resistance to thermal and impact conditions, it was concluded that the impacts of accidents involving unirradiated gas-cooled reactor fuel are not expected to be significantly different than those for unirradiated LWR fuel.

H.2.2 Spent Fuel Shipping

This section discusses the impact of transporting irradiated or spent advanced reactor fuel from candidate sites to a spent fuel disposal facility located at Yucca Mountain, Nevada. The section is divided into two parts. The first part considers incident-free transportation, and the second part considers transportation accidents.

The analysis is based on shipment of spent fuel by legal-weight trucks in casks with characteristics similar to casks currently available (i.e., massive, heavily shielded, cylindrical metal pressure vessels). Each shipment is assumed to consist of a single shipping cask loaded onto a modified trailer. These assumptions are consistent with assumptions made in the evaluation of the environmental impacts of transportation of spent fuel presented in Addendum I to NUREG-1437 (NRC 1999). As discussed in Addendum I, these assumptions are conservative because the alternative assumptions involve rail transportation or heavy-haul trucks, which would reduce the number of spent-fuel shipments.

Environmental impacts of the transportation of spent fuel were calculated using the RADTRAN 5 computer code (Neuhauser et al. 2003). Routing and population data for input to RADTRAN 5 for shipment by truck were obtained from the TRAGIS routing code (Johnson and Michelhaugh 2000). The population data in the TRAGIS code is based on the 2000 Census.

H.2.2.1 Incident-Free Transportation of Spent Fuel

"Incident-free" transportation refers to transportation activities in which the shipments of radioactive material reach their destination without releasing any radioactive cargo to the environment. The vast majority of radioactive shipments are expected to reach their destination without experiencing an accident or incident or releasing any cargo. The "incident-free" impacts from these normal, routine shipments arise from the low levels of radiation that penetrate the heavily shielded spent fuel shipping cask. Although Federal regulations in 10 CFR Part 71 and

49 CFR Part 173 impose constraints on radioactive material shipments, some radiation penetrates the shipping container and exposes nearby persons to low levels of radiation.

Incident-free legal-weight truck transportation of spent fuel has been evaluated by considering shipments from six representative reactor sites to a repository at Yucca Mountain, Nevada, for disposal. This assumption is conservative because it tends to maximize the shipping distance from the East Coast and Midwest, where most of the reactors are assumed to be located. Therefore, shipment to one or more other potential sites would reduce the impacts.

Environmental impacts from these shipments will occur to persons residing along the transportation corridors between the potential advanced reactor sites and the repository; to persons in vehicles passing the spent-fuel shipment; to persons at vehicle stops for refueling, rest, and vehicle inspections; and to transportation crew members. The impacts to these exposed population groups were quantified using the RADTRAN 5 computer code (Neuhauser et al. 2003).

This analysis addresses the impacts of spent nuclear fuel transport to a high-level waste repository from a generic perspective because Congress has directed the U.S. Department of Energy to study only Yucca Mountain for the proposed repository. The analysis assumes that all spent nuclear fuel would be shipped to that repository.

The characteristics of specific shipping routes (e.g., population densities, shipping distances) influence the normal radiological exposures. To address the differences that arise from the specific reactor site from which the spent fuel shipment originates, each advanced reactor design was assumed to be located at all of the primary and alternative ESP sites. These sites are:

Primary Site	Alternative Sites
North Anna	Savannah River Site (SRS)
Clinton	Portsmouth Gaseous Diffusion Plant (PGDP)
Grand Gulf	FitzPatrick
	Pilgrim
	Zion
	Quad Cities
	Braidwood
	Surry Power Station

Note: Impacts were not calculated for the River Bend site because the analysis is bounded by the impacts calculated for Grand Gulf. Impacts were not calculated for the Dresden and LaSalle sites because they are bounded by the Braidwood analysis.

Input to RADTRAN 5 includes the total shipping distance between the origin and destination sites and the population distributions along the routes. This information was obtained by running the TRAGIS computer code (Johnson and Michelhaugh 2000) for the origin-destination combinations of interest for legal-weight trucks. The resulting route characteristics information is shown in Table H-6. Note that for truck shipments, all the spent fuel is assumed to be shipped to the Yucca Mountain site over designated controlled-quantity highway routes. The routes used here are the same as those used in the Yucca Mountain Environmental Impact Statement (DOE 2002b).

Shipping casks have not been designed for advanced reactor spent fuel. Although some of the advanced reactor fuel designs are similar to current LWR fuel, no attempt has been made to optimize the cargo capacities of shipping casks for advanced LWR fuels. For the non-LWR fuel types (i.e., the GT-MHR and PBMR), there is little information on even a conceptual basis that would provide a defensible technical basis for shipping-cask capacities. The shipping-cask capacity data in the *Early Site Permit Environmental Report Sections and Supporting Information* (INEEL 2003) is summarized as follows:

- ABWR – The ABWR fuel is not significantly different from existing LWR fuel designs; thus, the number of ABWR assemblies that can be transported in a legal-weight truck shipment (i.e., 25-ton shipping cask) is not expected to be different from current cargo capacities.

- ESBWR – The ESBWR fuel is similar to the ABWR fuel.

- The surrogate AP1000 – The surrogate AP1000 fuel assemblies are similar to current-generation PWR fuel. No information was provided in INEEL (2003) on shipping cask capacities for surrogate AP1000 spent nuclear fuel.

- ACR-700 – The ACR-700 fuel is somewhat different from the current and advanced LWR fuel designs. SERI estimated that an ACR-700 rail cask would hold about 10 MTU of spent fuel, similar to the current cask designs. This value is nearly identical to the cargo capacities of current rail cask designs; thus, it was assumed that the truck cask capacity for ACR-700 and current-generation LWRs would also be about the same (i.e., 1.8 MTU/shipment).

- IRIS – The IRIS fuel is similar to current-generation PWR fuel. No information was provided in INEEL (2003) on shipping-cask capacities for IRIS spent nuclear fuel.

- GT-MHR – The GT-MHR fuel is a spherical coated-particle fuel with a uranium oxycarbide fuel kernel loaded into graphite fuel assemblies. This fuel concept is significantly different from current and advanced LWR fuels (sintered UO_2 pellets loaded into zircaloy tubes). According to INEEL (2003), six spent fuel assemblies containing 0.023 MTU of spent fuel is assumed to be transported in a legal weight truck cask.

Table H-6. Transportation Route Information for Shipments from ESP Sites to the Yucca Mountain Spent Fuel Disposal Facility

ESP Site	One-way Shipping Distance, km				Population Density, persons/km²			Stop Time per Trip, hr
	Total	Rural	Suburban	Urban	Rural	Suburban	Urban	
Primary Site								
North Anna	4409.5	3498	812.4	99.1	11.3	319	2310.6	5
Clinton	3076.3	2626.3	398.3	51.7	9.4	306.1	2372.2	3.5
Grand Gulf[(a)]	3718.3	3030.4	581.3	106.6	9.2	339.4	2429.4	4
Alternative Site								
Savannah River Site (SRS)	4263	3260	881	122	11	331.5	2311.2	5
Portsmouth Gaseous Diffusion Plant (PGDP)	3902.2	3166.9	647.2	88.1	10.7	316.4	2339.7	4.5
FitzPatrick	4212.2	3228.6	875.4	108.2	11.4	312.4	2348.7	5
Pilgrim	4682.3	3469.3	1091.7	121.3	11.8	312.3	2377.2	5.5
Zion	3138.9	2629.6	441.3	68	9.5	323.8	2360.3	3.5
Quad Cities	2853.1	2451	352.6	49.5	9.1	310.2	2391.3	3
Braidwood[(b)]	3034.5	2604.4	378.7	51.4	9.4	308.9	2377.2	3.5
Surry Power Station	4555.4	3590.7	863.9	100.8	11.4	317.6	2301.6	5

(a) The River Bend alternative site can be assumed to be bounded by the Grand Gulf values because of the proximity of the sites.
(b) Dresden and LaSalle can be assumed to be bounded by the Braidwood values because of the proximity of the sites.

- PBMR – The PBMR fuel is also a spherical coated-particle fuel with uranium oxide fuel kernels. In INEEL (2003), it is estimated that 0.495 MTU of spent PBMR fuel can be transported in a single legal-weight truck shipment.

The aforementioned shipping cask capacities are approximations based on current shipping cask designs. Actual shipping cask capacities in the future may be significantly different. Applicants must account for this in applications at the construction permit or combined operating license stage.

Incident-free radiation doses are a function of many variables. The most important of these variables are presented in Table H-7. Most of these variables, which are extracted from the literature, are considered to be "standard" values used in many RADTRAN 5 applications, including environmental impact statements, regulatory analyses, and others.

For purposes of this analysis, the transportation crew for spent fuel shipments delivered by truck consisted of two drivers. Escorts were considered, but they were not included because their distance from the shipping cask would reduce the dose rates to levels well below the dose rates

Table H-7. RADTRAN 5 Incident-Free Exposure Parameters

Parameter	RADTRAN 5 Input Value	Source
Vehicle speed – rural, km/hr	88.49	Based on average speed in rural areas given in DOE (2002a). Because most travel is on interstate highways, the same vehicle speed is assumed in rural, suburban, and urban areas. No speed reductions were assumed for travel at rush hour.
Vehicle speed – suburban, km/hr	88.49	
Vehicle speed – urban, km/hr	88.49	
Traffic count – rural, vehicles/hr	530	DOE (2002a)
Traffic count – suburban, vehicles/hr	760	
Traffic count – urban, vehicles/hr	2400	
Dose rate at 1 m from vehicle, mSv/hr	0.14	Approximate dose rate at 1 m (3 ft) that is equivalent to maximum dose rate allowed by Federal regulations (i.e., 0.1 mSv/hr at 2 m (~7 ft) from the side of a transport vehicle) (DOE 2002b)
Packaging dimensions, m	Length – 5.2 Diameter – 1.0	DOE (2002b)
Number of truck crew	2	AEC (1972), NRC (1977), and DOE (2002a)
Stop time, hr/trip	Route-specific	See Table H-6.
Population density at stops, persons/km^2	30,000	Sprung et al. (2000)
Min/max radii of annular area around vehicle at stops, m	1 to 10	Sprung et al. (2000)
Shielding factor applied to annular area surrounding vehicle at stops	1 (no shielding)	Sprung et al. (2000)
Population density surrounding truck stops, persons/km^2	340	Sprung et al. (2000)
Min/max radius of annular area surrounding truck stop, m	10 to 800	Sprung et al. (2000)
Shielding factor applied to annular area surrounding truck stop	0.2	Sprung et al. (2000)

experienced by the drivers. Stop times were assumed to accrue at the rate of 30 minutes per 4-hour driving time. TRAGIS outputs were used to determine the number of stops for each origin-destination.

Doses to the public at truck stops have been significant contributors to the doses calculated in previous RADTRAN 5 analyses. For this analysis, stop doses are the sum of the doses to individuals located in two annular rings centered at the stopped vehicle, as illustrated in Figure H-1. The inner ring represents persons who may be at the truck stop at the same time as a spent fuel shipment and extends 1 to 10 m from the edge of the vehicle. The outer ring represents persons who reside near a truck stop and extends from 10 to 800 m from the vehicle. This scheme is the same as that used in Sprung et al. (2000).

Population densities and shielding factors were also taken from Sprung et al. (2000) and were based on the observations of Griego et al. (1996).

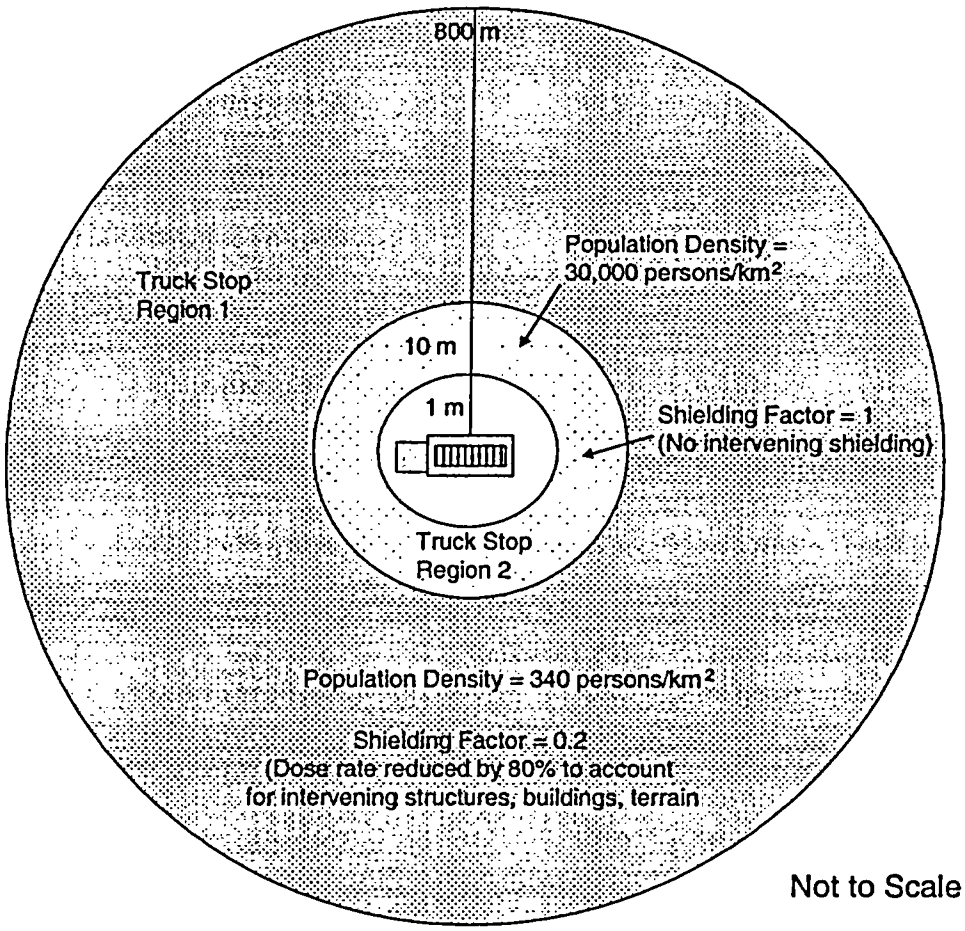

Figure H-1. Illustration of Truck Stop Model (Sprung et al. 2000)

The results of these routine (incident-free) exposure calculations are shown in Table H-8 for spent fuel shipments from all eleven primary and alternative sites to the potential Yucca Mountain repository. Population dose estimates are given for workers (i.e., truck crew members), onlookers (doses to persons at truck stops and persons and on highways exposed to the spent fuel shipments), and along the route (persons living near the highway).

This discussion addresses whether or not the environmental effects of incident-free advanced reactor spent fuel shipments are within the guidelines established in Table S–4. The bounding cumulative doses to the exposed population given in Table S–4 are:

- Transport workers 0.04 person-Sv (4 person-rem) per reference reactor year
- General public (onlookers) 0.03 person-Sv (3 person-rem) per reference reactor year
- General public (along route) 0.03 person-Sv (3 person-rem) per reference reactor year.

Table H-8. Routine (Incident-Free) Radiation Doses to Transport Workers and the Public from Shipping Spent Fuel from Potential ESP Sites to the Yucca Mountain Disposal Facility

	Population Dose, person-Sv/shipment[a]		
Reactor Site	**Crew**	**Onlookers**	**Along Route**
Braidwood[b]	7.1×10^{-4}	2.4×10^{-3}	4.4×10^{-5}
Clinton	7.2×10^{-4}	2.5×10^{-3}	4.5×10^{-5}
FitzPatrick	9.8×10^{-4}	3.5×10^{-3}	9.5×10^{-5}
Grand Gulf[c]	8.7×10^{-4}	2.8×10^{-3}	7.0×10^{-5}
North Anna	1.0×10^{-3}	3.5×10^{-3}	9.2×10^{-5}
Pilgrim	1.1×10^{-3}	3.9×10^{-3}	1.2×10^{-4}
Portsmouth	9.1×10^{-4}	3.2×10^{-3}	7.3×10^{-5}
Quad Cities	6.7×10^{-4}	2.1×10^{-3}	4.1×10^{-5}
Savannah River	9.9×10^{-4}	3.5×10^{-3}	1.0×10^{-4}
Surry Power Station	1.1×10^{-3}	3.5×10^{-3}	9.7×10^{-5}
Zion	7.3×10^{-4}	2.5×10^{-3}	5.2×10^{-5}

(a) Multiply person-Sv/shipment times 100 to obtain doses in person-rem/shipment.
(b) The River Bend alternative site can be assumed to be bounded by the Grand Gulf values because of the proximity of the sites.
(c) Dresden and LaSalle can be assumed to be bounded by the Braidwood values because of the proximity of the sites.

Calculation of the cumulative doses entailed converting the per-shipment risks given in Table H-8 to estimates of environmental effects per reference reactor year of operation. The per-shipment results, which are independent of reactor type (i.e., the doses are dependent on the assumed external radiation dose rate emitted from the cask, which is fixed at the regulatory maximum limit for all of the advanced reactor types), are given in terms of the population dose per shipment of spent fuel. To develop estimates of the annual environmental impacts, the following assumptions were made:

- The basis for the annual number of shipments of spent fuel from the reference LWR in WASH-1238 (AEC 1972) will be used. In WASH-1238, it was assumed that 60 shipments per year will be made, each shipment carrying 0.5 MTU of spent fuel. This equates to shipping 30 MTU of spent fuel per year. This is equivalent to the annual refueling requirements for the reference LWR. It was assumed that the other reactor types will also ship spent fuel at a rate equal to their annual refueling requirements.

- Shipping cask capacities that were used to calculate annual spent fuel shipments for the advanced LWRs were assumed to be the same as the reference LWR, i.e., approximately 0.5 MTU per truck shipment.

- The annual numbers of spent fuel shipments from the advanced gas-cooled reactors were taken directly from INEEL (2003). These estimates were 38 shipments per year from the GT-MHR site and 16 shipments per year from the PBMR site.

Table H-9 provides the estimated annual population doses from routine (incident-free) transportation of spent fuel from ESP sites to the Yucca Mountain disposal facility. The results in Tables H-9 to H-11 have been normalized to the WASH-1238 (AEC 1972) net electrical generation (i.e., 880 MW(e)). Although radiation may cause cancers at high doses and high dose rates, currently there are no data that unequivocally establish the occurrence of cancer following exposure to low doses and dose rates, below about 100 mSv (10,000 mrem). However, radiation protection experts conservatively assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. Simply stated, any increase in dose, no matter how small, results in an incremental increase in health risk. This theory is accepted by the NRC as a conservative model for estimating health risks from radiation exposure, recognizing that the model probably over-estimates those risks.

Based on this model, the staff estimates the risk to the public from radiation exposure using the nominal probability coefficient for total detriment (730 fatal cancers, nonfatal cancers, and severe hereditary effects per 10,000 person-Sv [1,000,000 person-rem]) from International Commission on Radiation Protection (ICRP) Publication 60 (ICRP 1990). All the population doses presented in Table H-9 are less than one person-Sv/yr (100 person-rem/yr); therefore, the total detriment estimates associated with these population doses would all be less than 0.1 fatal cancers, nonfatal cancers, and severe hereditary effects per year. These risks are very small compared to the fatal cancers, nonfatal cancers, and severe hereditary effects that the same population would incur annually from exposure to natural sources of radiation.

As shown in Table H-9, some of the estimated population doses are higher than the Table S–4 conditions. Two key reasons for the higher population doses relative to Table S–4 are the higher number of spent fuel shipments estimated for some of the reactor technologies and the longer shipping distances used in this assessment than were used in WASH-1238 (AEC 1972). WASH-1238 (AEC 1972) used a "typical" distance for a spent fuel shipment of 1600 km (1000 mi), whereas the shipping distances used in this assessment ranged from about 3000 km (1800 mi) to 4700 km (2900 mi). The higher numbers of shipments are based on spent fuel shipping-casks designed to transport short-cooled fuel (150 days out of the reactor). It was assumed in this analysis that the shipping-cask capacities are 0.5 MTU/ shipment, roughly equivalent to one PWR or two BWR spent fuel assemblies per shipment. Newer designs are based on longer-cooled spent fuel (5 years out of reactor) and have larger capacities than those used in this assessment. DOE (2002b) spent fuel shipping-cask capacities were approximately 1.8 MTU/shipment, or up to four PWR or nine BWR fuel assemblies per shipment. Use of the newer shipping-cask designs will reduce the number of spent fuel shipments and the associated environmental impacts. If the population doses are adjusted for the shipping distance (a factor of 2 to 3) and shipping cask capacity (a factor of 4), the routine population doses from spent fuel shipments from all reactor types and all sites fall within the Table S–4 conditions.

Most of the stops made for actual spent fuel shipments are short duration stops (i.e., 10 minutes) for brief visual inspections of the cargo (e.g., checking the cask tie-downs). These stops typically occur in areas devoid of people, such as an overpass or freeway ramp in an unpopulated area. Therefore, doses to residents surrounding these types of stops are negligible. In DOE (2002b), close-proximity exposures (i.e., from 1 to 15.8 m from the cask) were not assumed to occur at the short-duration inspection stops. In this analysis, for the purpose of developing bounding estimates of environmental effects, close-proximity (1 to 10 m from cask) exposures at all truck stops were included in the RADTRAN 5 calculations. Because the numbers of stops in this analysis are effectively doubled relative to DOE (2002b), truck stop doses are also doubled. The doses to residents would also be lower; however, because doses to residents are two to three orders of magnitude (i.e., a factor of 100 to 1000) less than the calculated close-proximity doses, this reduction does not affect the total stop dose.

The number of exposed persons at stops is higher in this analysis by about a factor of 1.5 relative to DOE (2002b) assumptions (6.9 persons in DOE 2002b versus 10 persons assumed in this analysis). Thus, the bounding doses calculated in this analysis are also a factor of 1.5 (10 divided by 6.9) greater than those given in DOE (2002b). Furthermore, empirical data provided in Griego et al. (1996) indicate that a 30-minute stop is toward the high end of the stop time distribution. Average stop times for food and refueling observed by Griego et al. (1996) are on the order of 18 minutes. This amounts to another factor of 1.5 increase in stop doses calculated here relative to DOE (2002b).

Table H-9. Routine (Incident-Free) Population Doses from Spent Fuel Transportation, Normalized to Reference LWR Net Electrical Generation

Reactor Type	Reference LWR (WASH-1238)			ABWR/ESBWR			Surrogate AP1000			ACR-700		
No. Shipments per year	60			41			40			90		
	Environmental Effects, person-Sv per reference reactor year[a]											
Reactor Site	Crew	Onlookers	Along Route	Crew	Onlookers	Along Route	Crew	Onlookers	Along Route	Crew	Onlookers	Along Route
Braidwood[b]	4.2×10^{-2}	1.5×10^{-1}	2.6×10^{-3}	2.9×10^{-2}	1.0×10^{-1}	1.8×10^{-3}	2.8×10^{-2}	9.7×10^{-2}	1.7×10^{-3}	6.3×10^{-2}	2.2×10^{-1}	3.9×10^{-3}
Clinton	4.3×10^{-2}	1.5×10^{-1}	2.7×10^{-3}	2.9×10^{-2}	1.0×10^{-1}	1.8×10^{-3}	2.8×10^{-2}	9.7×10^{-2}	1.8×10^{-3}	6.4×10^{-2}	2.2×10^{-1}	4.1×10^{-3}
FitzPatrick	5.9×10^{-2}	2.1×10^{-1}	5.7×10^{-3}	4.0×10^{-2}	1.4×10^{-1}	3.9×10^{-3}	3.9×10^{-2}	1.4×10^{-1}	3.8×10^{-3}	8.8×10^{-2}	3.1×10^{-1}	8.5×10^{-3}
Grand Gulf[c]	5.2×10^{-2}	1.7×10^{-1}	4.2×10^{-3}	3.5×10^{-2}	1.2×10^{-1}	2.8×10^{-3}	3.4×10^{-2}	1.1×10^{-1}	2.7×10^{-3}	7.8×10^{-2}	2.5×10^{-1}	6.2×10^{-3}
North Anna	6.2×10^{-2}	2.1×10^{-1}	5.5×10^{-3}	4.2×10^{-2}	1.4×10^{-1}	3.7×10^{-3}	4.1×10^{-2}	1.4×10^{-1}	3.6×10^{-3}	9.2×10^{-2}	3.2×10^{-1}	8.2×10^{-3}
Pilgrim	6.5×10^{-2}	2.3×10^{-1}	7.0×10^{-3}	4.4×10^{-2}	1.6×10^{-1}	4.8×10^{-3}	4.3×10^{-2}	1.5×10^{-1}	4.6×10^{-3}	9.8×10^{-2}	3.5×10^{-1}	1.0×10^{-3}
Portsmouth	5.5×10^{-2}	1.9×10^{-1}	4.4×10^{-3}	3.7×10^{-2}	1.3×10^{-1}	3.0×10^{-3}	3.6×10^{-2}	1.2×10^{-1}	2.9×10^{-3}	8.1×10^{-2}	2.8×10^{-1}	6.6×10^{-3}
Quad Cities	4.0×10^{-2}	1.3×10^{-1}	2.4×10^{-3}	2.7×10^{-2}	8.6×10^{-1}	1.7×10^{-3}	2.6×10^{-2}	8.4×10^{-2}	1.6×10^{-3}	6.0×10^{-2}	1.9×10^{-1}	3.6×10^{-3}
Savannah River	6.0×10^{-2}	2.1×10^{-1}	6.0×10^{-3}	4.0×10^{-2}	1.4×10^{-1}	4.1×10^{-3}	3.9×10^{-2}	1.4×10^{-1}	4.0×10^{-3}	8.9×10^{-2}	3.2×10^{-1}	9.0×10^{-3}
Surry Power Station	6.4×10^{-2}	2.1×10^{-1}	5.8×10^{-3}	4.3×10^{-2}	1.4×10^{-1}	3.9×10^{-3}	4.2×10^{-2}	1.4×10^{-1}	3.8×10^{-3}	9.5×10^{-2}	3.2×10^{-1}	8.7×10^{-3}
Zion	4.4×10^{-2}	1.5×10^{-1}	3.1×10^{-3}	3.0×10^{-2}	1.0×10^{-1}	2.1×10^{-3}	2.9×10^{-2}	9.7×10^{-2}	2.0×10^{-3}	6.5×10^{-2}	2.2×10^{-1}	4.6×10^{-3}

Table H-9. (contd)

Reactor Type	IRIS			GT-MHR			PBMR		
No. Shipments per year	35			34			12		
	Environmental Effects, person-rem per reference reactor year								
Reactor Site	**Crew**	**Onlookers**	**Along Route**	**Crew**	**Onlookers**	**Along Route**	**Crew**	**Onlookers**	**Along Route**
Braidwood	2.5×10^{-2}	8.5×10^{-2}	1.5×10^{-3}	2.4×10^{-2}	8.2×10^{-2}	1.5×10^{-3}	7.9×10^{-3}	2.7×10^{-2}	4.9×10^{-4}
Clinton	2.5×10^{-2}	8.5×10^{-2}	1.6×10^{-3}	2.4×10^{-2}	8.2×10^{-2}	1.5×10^{-3}	8.0×10^{-3}	2.8×10^{-2}	5.1×10^{-4}
FitzPatrick	3.4×10^{-2}	1.2×10^{-1}	3.3×10^{-3}	3.3×10^{-2}	1.2×10^{-1}	3.2×10^{-3}	1.1×10^{-2}	3.9×10^{-2}	1.1×10^{-3}
Grand Gulf	3.0×10^{-2}	9.8×10^{-2}	2.4×10^{-3}	2.9×10^{-2}	9.4×10^{-2}	2.3×10^{-3}	9.7×10^{-3}	3.2×10^{-2}	7.8×10^{-4}
North Anna	3.6×10^{-2}	1.2×10^{-1}	3.2×10^{-3}	3.4×10^{-2}	1.2×10^{-1}	3.1×10^{-3}	1.2×10^{-2}	4.0×10^{-2}	1.0×10^{-3}
Pilgrim	3.8×10^{-2}	1.3×10^{-1}	4.0×10^{-3}	3.6×10^{-2}	1.3×10^{-1}	3.9×10^{-3}	1.2×10^{-2}	4.3×10^{-2}	1.3×10^{-3}
Portsmouth	3.1×10^{-2}	1.1×10^{-1}	2.5×10^{-3}	3.0×10^{-2}	1.1×10^{-1}	2.4×10^{-3}	1.0×10^{-2}	3.6×10^{-2}	8.2×10^{-4}
Quad Cities	2.3×10^{-2}	7.4×10^{-2}	1.4×10^{-3}	2.2×10^{-2}	7.1×10^{-2}	1.4×10^{-3}	7.5×10^{-3}	2.4×10^{-2}	4.6×10^{-4}
Savannah River	3.4×10^{-2}	1.2×10^{-1}	3.5×10^{-3}	3.3×10^{-2}	1.2×10^{-1}	3.3×10^{-3}	1.1×10^{-2}	3.9×10^{-2}	1.1×10^{-3}
Surry Power Station	3.7×10^{-2}	1.2×10^{-1}	3.3×10^{-3}	3.5×10^{-2}	1.2×10^{-1}	3.2×10^{-3}	1.2×10^{-2}	4.0×10^{-2}	1.1×10^{-3}
Zion	2.5×10^{-2}	8.5×10^{-2}	1.8×10^{-3}	2.4×10^{-2}	8.2×10^{-2}	1.7×10^{-3}	8.2×10^{-3}	2.8×10^{-2}	5.8×10^{-4}

(a) Multiply person-Sv/yr times 100 to obtain doses in person-rem/yr.
(b) The River Bend alternative site can be assumed to be bounded by the Grand Gulf values because of the proximity of the sites.
(c) Dresden and LaSalle can be assumed to be bounded by the Braidwood values because of the proximity of the sites.

Based on these observations, the staff concluded that the stop model used in this study overestimates public doses at stops by approximately a factor of four (factor of 2 for close-proximity exposure time at stops, a factor of 1.5 for average stop time at food and refueling stops, and a factor of 1.5 for the number of people in proximity to the shipping cask). Coupled with the factor of 2 reduction in shipping cask dose rates that result from fuel aging, the doses to onlookers at stops could be reduced to about one-eighth of the doses shown in Table H-9 [1/(2 x 1.5 x 1.5 x 2) ≈ 0.12] to reflect more realistic truck shipping conditions.

Based on the above, use of more realistic dose rates, shipping cask capacities, and truck stop model assumptions in the RADTRAN 5 calculations could substantially reduce the environmental effects presented in Table H-9.

Table H-10 provides a comparison between the radiological incident-free doses calculated in NUREG-0170 (NRC 1977) and those calculated here. The table also summarizes the key

Table H-10. Comparison of Incident-Free Doses from NUREG-0170 (NRC 1977) Spent Fuel Shipments and Spent Fuel Shipment from Quad-Cities to a Potential Geologic Repository at Yucca Mountain in this Analysis

Incident-Free Exposure Parameter	**NUREG-0170 (NRC 1977)**	**This Study (Quad Cities to Yucca Mountain)[a]**
One-way shipping distance, km	2530	2853
Travel fraction		
Urban	0.05	0.02
Suburban	0.05	0.12
Rural	0.9	0.86
Population density along highway, persons per km^2		
Urban	3861	2391.3
Suburban	719	310.2
Rural	6	9.1
Speed, km/hr		
Urban	24	88
Suburban	40	88
Rural	88	88
Traffic count, vehicles/hr		
Urban	2800	2400
Suburban	780	760
Rural	470	530
Shipment dose Rate, mSv/hr at 2m	0.1	0.1
Crew dose rate, mSv/hr	0.02	Calculated (7.4 m from package)

Table H-10. (contd)

Incident-Free Exposure Parameter	NUREG-0170 (NRC 1977)	This Study (Quad Cities to Yucca Mountain)[a]
Stop time, hr per trip		
Urban	2	3 hours per trip (30 minutes per 4 hours driving time)
Suburban	5	
Rural	1	
Population density at stops (per km^2)		
Urban	3861	Distribution: 1 to 10 m - 30,000; 10 to 800 m - 340 (see Figure H-1)
Suburban	719	
Rural	6	
Person-Sv/shipment		
Crew	1.2×10^{-3}	4.8×10^{-4}
Off-link	1.5×10^{-4}	3.1×10^{-4}
On-link	7.4×10^{-5}	1.7×10^{-4}
Stops	1.9×10^{-4}	1.7×10^{-4}[b]
Total	1.6×10^{-3}	8.5×10^{-4}
Handlers + Storage	2.1×10^{-3}	Not calculated
Grand Total	3.7×10^{-3}	8.5×10^{-4}

(a) Tables H-7 and H-8 provide the bases for these input parameters.
(b) Stop doses have been adjusted as described in the text to reflect more realistic assumptions than were used in the bounding analysis (Table H-9).

incident-free input parameters that were used in NUREG-0170 and this study. Comparisons are also made between the doses for spent fuel shipments in NUREG-0170 and doses calculated for a shipment from the Quad Cities to a potential geologic repository at Yucca Mountain because the shipping distances are comparable (2530 km in NUREG-0170 versus 2853 km for Quad Cities to Yucca Mountain). As shown in the table, many parameters have changed over the years and the technical bases for them have improved. For example, the work of Griego et al. (1996) has improved the basis for assumptions about stop times and persons exposed at truck stops, and the TRAGIS computer code has improved the basis for shipping distances and population distributions along highway routes.

The incident-free impacts at truck stops shown in the table have been adjusted, as discussed above, to reflect more realistic conditions than assumed in the bounding analysis. Adjustments were not made to the onlookers, along route, and crew doses shown in Table H-9. As shown, the adjusted doses in Table H-10 for spent fuel shipments from the Quad Cities to potential geologic repository at the potential Yucca Mountain site are about a factor of 2 lower than the per-shipment doses from NUREG-0170 when the doses to and doses associated with in-transit storage from NUREG-0170 are excluded. Storage doses were excluded from this analysis because spent fuel shipments proceed directly from the reactor site to Yucca Mountain with no intermediate storage involved. Handler doses were excluded from this analysis because doses to workers that load the spent fuel cask at reactors and unload them at the potential repository are treated as facility doses, not transportation doses, in recent National Environmental Policy Act of 1969 (NEPA) documents.

H.2.2.2 Transportation Accident Impacts

RADTRAN 5 assesses accident risk by multiplying the probabilities times consequences of accidents to produce a risk value. RADTRAN 5 considers a spectrum of potential transportation accidents, ranging from those with high frequencies and low consequences (for example, fender-benders) to those with low frequencies and high consequences (accidents in which the shipping container is exposed to severe mechanical and thermal conditions).

Radionuclide inventories are important parameters in the calculation of accident risks. The radionuclide inventories used in this analysis were taken directly from the *Early Site Permit Environmental Report Sections and Supporting Data* (INEEL 2003). The report included hundreds of radionuclides for each advanced reactor type. A screening analysis was conducted to select the dominant contributors to accident risks to simplify the RADTRAN 5 calculations. The screening identifies the radionuclides that will contribute more than 99.999 percent of the dose from inhalation. A sum-of-fractions approach was used for this screening. First, the inventory of each radionuclide was multiplied by its respective inhalation dose conversion factor, taken from Federal Guidance Report 13 (EPA 2002). These values were then summed. Then, each inventory-conversion factor product was divided by the sum of the products to obtain the fraction of the total inhalation dose for each radionuclide. The resulting fractions were then sorted from largest to smallest, their cumulative contributions were calculated, and those that contributed to 99.999 percent of the inhalation-dose potential were selected. Several gases, including hydrogen-3, krypton-85, and iodine-129, were added to the list because they are more easily released than the solid and semi-volatile species contained in the fuel. The inventories of radionuclides used in this study are shown in Table H-11. Note that the dominant radionuclides are approximately the same regardless of fuel type. Also note that adequate radionuclide inventory data were not given in INEEL (2003) for the ACR-700 and IRIS advanced reactors nor are such data provided in WASH-1238 (AEC 1972) for the reference LWR. Consequently, accident risks were not quantified for these plant types.

Robust shipping casks are used to transport spent fuel because of the heavy radiation shielding and accident resistance required by 10 CFR Part 71. Spent fuel shipping casks must be certified Type B packaging systems, which means they must withstand a series of severe hypothetical accident conditions with essentially no loss of containment or shielding capability. The tests include a 9-m (30-ft) free drop onto an unyielding surface, a drop onto a puncture

Table H-11. Radionuclide Inventories Used in the Transportation Accident Risk Calculations for Each Advanced Reactor Type

Radionuclide	ABWR and ESBWR Inventory, Bq/MTU[(a)]	Surrogate AP1000 Inventory, Bq/MTU	GT-MHR Inventory, Bq/MTU	PBMR Inventory, Bq/MTU
Am-241	4.96×10^{13}	2.69×10^{13}	8.18×10^{13}	7.55×10^{13}
Am-242m	1.24×10^{12}	4.85×10^{11}	5.03×10^{11}	8.51×10^{11}
Am-243	1.20×10^{12}	1.24×10^{12}	5.14×10^{11}	4.77×10^{12}
Ce-144	4.22×10^{14}	3.28×10^{14}	2.15×10^{15}	1.19×10^{15}
Cm-242	2.04×10^{12}	1.05×10^{12}	1.51×10^{12}	2.78×10^{12}
Cm-243	1.37×10^{12}	1.14×10^{12}	2.02×10^{11}	1.96×10^{12}
Cm-244	1.80×10^{14}	2.87×10^{14}	2.83×10^{13}	5.48×10^{14}
Cm-245	2.43×10^{10}	4.48×10^{10}	1.65×10^{8}	5.29×10^{10}
Co-60	1.01×10^{14}	(b)	(b)	(b)
Cs-134	1.78×10^{15}	1.78×10^{15}	2.21×10^{15}	4.03×10^{15}
Cs-137	4.59×10^{15}	3.44×10^{15}	1.08×10^{16}	1.41×10^{16}
Eu-154	3.81×10^{14}	3.38×10^{14}	3.23×10^{14}	3.74×10^{14}
Eu-155	1.93×10^{14}	1.71×10^{14}	8.77×10^{13}	1.08×10^{14}
Pm-147	1.25×10^{15}	6.51×10^{14}	6.92×10^{15}	5.07×10^{15}
Pu-238	2.27×10^{14}	2.25×10^{14}	1.17×10^{14}	4.55×10^{14}
Pu-239	1.43×10^{13}	9.44×10^{12}	2.25×10^{13}	1.11×10^{13}
Pu-240	2.28×10^{13}	2.01×10^{13}	3.96×10^{13}	3.32×10^{13}
Pu-241	4.51×10^{15}	2.58×10^{15}	8.33×10^{15}	7.18×10^{15}
Pu-242	8.29×10^{10}	6.73×10^{10}	1.56×10^{11}	4.51×10^{11}
Ru-106	6.07×10^{14}	5.74×10^{14}	1.48×10^{15}	1.68×10^{15}
Sb-125	1.99×10^{14}	1.42×10^{14}	2.21×10^{14}	2.51×10^{14}
Sr-90	3.27×10^{15}	2.29×10^{15}	8.95×10^{15}	1.08×10^{16}
Y-90	3.27×10^{15}	2.29×10^{15}	8.95×10^{15}	1.08×10^{16}

(a) To convert Bq/MTU to Ci/MTU, divide the value by 3.7×10^{10}.
(b) Co-60 is an activation product. Only the ABWR/ESBWR submittal in INEEL (2003) provided inventory data for activation products.

probe, an exposure to an engulfing 800°C fire for 30 minutes, and an underwater immersion. According to Sprung et al. (2000), the probability of encountering accident conditions more severe than these tests that could lead to shipping cask failure are less than 0.01 percent of all accidents (that is, more than 99.99 percent of all accidents would not result in a release of radioactive material from the shipping cask). It was assumed that shipping casks for advanced reactor spent fuels will provide equivalent mechanical and thermal protection of the spent fuel cargo.

The RADTRAN 5 accident risk calculations were performed using unit radionuclide inventories (Bq/MTU) for the spent fuel shipments from the various reactor types. The resulting risk estimates were then multiplied by assumed annual spent fuel shipments (MTU/yr) to derive estimates of the annual accident risks associated with spent fuel shipments from each potential ESP site. As was done for routine exposures, it was assumed that the numbers of shipments of spent fuel per year are equivalent to the annual discharge quantities: 32.76 MTU/yr for the ABWR and ESBWR; 24.4 MTU/yr for a single surrogate AP1000 site; 6.8 MTU/yr for the four-reactor GT MHR site; and 8.3 MTU/yr for the eight-reactor PBMR site. These data were taken from INEEL (2003) and have not been normalized to the reference LWR net electrical generation.

Route-specific accident rates (accidents per km) were derived for the RADTRAN 5 accident risk analysis. The approach used to develop accident rates for spent fuel shipments is as follows. The TRAGIS data provide estimates of the distance traveled in each state along a route and the type of highway (interstate, state highway, or other). Saricks and Tompkins (1999) provide accident rates for each state that are a function of highway type. The approach taken to estimate route-specific accident rates was to multiply the state-level accident or fatality rates by the distances traveled in each state on the corresponding highway type and then sum over all the states on each route. For example, for interstate highways, the interstate distances and interstate accident rates were used. For non-interstate highway travel, either the "Primary" or "Other" accident rates given by Saricks and Tompkins (1999) were used. This allowed computation of route-specific accident rates.

Transportation accident risk analysis in RADTRAN 5 is performed using an accident severity and package release model. The user can define up to 30 severity categories, with each category increasing in magnitude. Severity categories are related to fire, puncture, crush, and immersion environments created in vehicular accidents. For this analysis, the 19 severity categories defined in NUREG/CR-6672 (Sprung et al. 2000) were adopted.

Each severity category has an assigned conditional probability (or the probability, given an accident occurs, that it will be of the specified severity). The accident scenarios are further defined by allowing the user to input release fractions and aerosol and respirable fractions for each severity category. These fractions are a function of the physical-chemical properties of the materials being transported as well as the mechanical and thermal accident conditions that define the severity categories. The severity and release fractions used here are presented in Table H-12.

The severity categories and release fractions in Sprung et al. (2000) were designed specifically to address accidents involving current generation LWR fuel and the current generation of spent fuel shipping casks. While some of the advanced reactor fuel designs are similar to the current generation (e.g., the ABWR, ESBWR, surrogate AP1000, ACR-700, and IRIS), others are significantly different, including the GT-MHR and PBMR. Extrapolating the current generation of LWR fuel and shipping casks to advanced LWR fuels and shipping casks is relatively straightforward because the fuel form, cladding, and physical and mechanical properties are similar.

Table H-12. Severity and Release Fractions Used to Model Spent Fuel Transportation Accidents (Sprung et al. 2000)

Severity Category	Severity Fraction[a]	Release Fractions[b] Gas	Cesium	Ruthenium	Particulates	Corrosion Products
1	1.53×10^{-8}	0.8	2.4×10^{-8}	6.0×10^{-7}	6.0×10^{-7}	2.0×10^{-3}
2	5.88×10^{-5}	0.14	4.1×10^{-9}	1.0×10^{-7}	1.0×10^{-7}	1.4×10^{-3}
3	1.81×10^{-6}	0.18	5.4×10^{-9}	1.3×10^{-7}	1.3×10^{-7}	1.8×10^{-3}
4	7.49×10^{-8}	0.84	3.6×10^{-5}	3.8×10^{-6}	3.8×10^{-6}	3.2×10^{-3}
5	4.65×10^{-7}	0.43	1.3×10^{-8}	3.2×10^{-7}	3.2×10^{-7}	1.8×10^{-3}
6	3.31×10^{-9}	0.49	1.5×10^{-8}	3.7×10^{-7}	3.7×10^{-7}	2.1×10^{-3}
7	0	0.85	2.7×10^{-5}	2.1×10^{-6}	2.1×10^{-6}	3.1×10^{-3}
8	1.13×10^{-8}	0.82	2.4×10^{-8}	6.1×10^{-7}	6.1×10^{-7}	2.0×10^{-2}
9	8.03×10^{-11}	0.89	2.7×10^{-8}	6.7×10^{-7}	6.7×10^{-7}	2.2×10^{-3}
10	0	0.91	5.9×10^{-6}	6.8×10^{-7}	6.8×10^{-7}	2.5×10^{-3}
11	1.44×10^{-10}	0.82	2.4×10^{-8}	6.1×10^{-7}	6.1×10^{-7}	2.0×10^{-3}
12	1.02×10^{-12}	0.89	2.7×10^{-8}	6.7×10^{-7}	6.7×10^{-7}	2.2×10^{-3}
13	0	0.91	5.9×10^{-6}	6.8×10^{-7}	6.8×10^{-7}	2.5×10^{-3}
14	7.49×10^{-11}	0.84	9.6×10^{-5}	8.4×10^{-5}	1.8×10^{-5}	6.4×10^{-3}
15	0	0.85	5.5×10^{-5}	5.0×10^{-5}	9.0×10^{-6}	5.9×10^{-3}
16	0	0.91	5.9×10^{-6}	6.4×10^{-6}	6.8×10^{-7}	3.3×10^{-3}
17	0	0.91	5.9×10^{-6}	6.4×10^{-6}	6.8×10^{-7}	3.3×10^{-3}
18	5.86×10^{-6}	0.84	1.7×10^{-5}	6.7×10^{-8}	6.7×10^{-8}	2.5×10^{-3}
19	0.99993	0	0	0	0	0

(a) Severity fractions are the conditional probabilities, given the occurrence of an accident, that the mechanical and thermal conditions experienced by a spent fuel shipping cask are within the conditions defined by the Severity Category. See Sprung et al. (2000) for detailed information about the derivation of these data.
(b) RADTRAN 5 also models the fraction of the released material that is of small enough particle size to be dispersible in prevailing wind conditions and the fraction that is respirable. For this analysis, these parameters were set to 1.0 (i.e., 100 percent dispersible and 100 percent respirable).

Furthermore, substantial experimental data exist to develop technically defensible release fractions for various radionuclide groups (e.g., gases, semi-volatiles such as cesium and ruthenium, and particulates). However, because detailed experimental studies of releases from GT-MHR and PBMR fuels have not been conducted, there are significant uncertainties about potential release quantities from these fuels. For this assessment, release fractions for current generation LWR fuels were used to approximate the impacts from the advanced reactor spent fuel shipments. This essentially assumes the fuel materials and containment systems (i.e., cladding, fuel coatings) behave similarly to current LWR fuel under applied mechanical and thermal conditions. Due to the lack of experimental data on gas-cooled reactor fuels, it is currently not known if this approach is bounding. However, gas-cooled reactors operate at much higher temperatures than LWRs; thus, high-temperature conditions anticipated in transportation accident fires are expected to have less effect on radionuclide releases than they would for LWR fuels. Smaller release fractions are consequently anticipated for advanced gas-cooled reactor fuels than for LWR fuels subjected to thermal transients.

For accidents that result in a release of radioactive material, RADTRAN 5 assumes the material is dispersed into the environment according to standard Gaussian diffusion models. The code allows the user to choose two different methods for modeling the atmospheric transport of radionuclides after a potential accident. The user can input either Pasquill atmospheric-stability category data or averaged time-integrated concentrations. In this analysis, the default standard cloud option (using time-integrated concentrations) was used.

RADTRAN 5 calculates the population dose from the released radioactive material for five possible exposure pathways:

- external dose from exposure to the passing cloud of radioactive material

- external dose from radionuclides deposited on the ground by the passing plume – The analysis included the radiation exposures from this pathway even though the area surrounding a potential accidental release would be evacuated and decontaminated, thus preventing long-term exposures from this pathway.

- internal dose from inhalation of airborne radioactive contaminants

- internal dose from radioactive materials that were deposited on the ground and the resuspended – The analysis included the radiation exposures from this pathway even though evacuation and decontamination of the area surrounding a potential accidental release would prevent long-term exposures.

- internal dose from ingestion of contaminated food – Because the analysis assumed interdiction of foodstuffs and evacuation after an accident, no internal dose due to ingestion of contaminated foods was calculated.

A sixth pathway, external doses arising from increased radiation fields surrounding a shipping cask with damaged shielding, was considered but not included in the analysis. It is possible that shielding materials incorporated into the cask structures could become damaged as a result of an accident. For example, casks with lead shielding could undergo a slumping phenomenon in which impact or fire causes gaps to form in the lead. Radiation would penetrate through the gaps in the shielding at higher intensities, leading to higher radiation dose rates. These are commonly referred to as loss of shielding events. They were not included in this assessment because their contribution to spent fuel transportation risks is much smaller than the dispersal accident risks.

Standard radionuclide uptake and dosimetry models are incorporated into RADTRAN 5. The computer code combines the accident consequences and frequencies of each severity category, sums up the severity categories, and then integrates across all the shipments. Accident-risk impacts that are provided in the form of a collective population dose (person-rem over the entire shipping campaign).

The shipping distances and population distribution information for the routes used for the evaluation of the impacts of incident-free transportation (see Table H-6) were also used to calculate transportation impacts. Representative shipping casks described above were assumed.

Table H-13 presents unit (per MTU) accident risks associated with transportation of spent fuel from each potential ESP site to the Yucca Mountain high-level waste repository.

Table H-13. Unit Spent Fuel Transportation Accident Risks for Advanced Reactors

	Advanced Reactor Type			
Site	**ABWR/ ESBWR**	**Surrogate AP1000**	**GT-MHR**	**PBMR**
	Population Dose, person-Sv/MTU[(a)]			
Braidwood[(b)]	1.1×10^{-7}	1.0×10^{-8}	1.5×10^{-8}	2.5×10^{-8}
Clinton	5.1×10^{-7}	1.0×10^{-8}	1.5×10^{-8}	2.6×10^{-8}
FitzPatrick	1.9×10^{-7}	1.7×10^{-8}	2.5×10^{-8}	4.3×10^{-8}
Grand Gulf[(c)]	2.1×10^{-7}	1.9×10^{-8}	2.8×10^{-8}	4.7×10^{-8}
North Anna	2.3×10^{-7}	2.1×10^{-8}	3.2×10^{-8}	5.4×10^{-8}
Pilgrim	4.0×10^{-7}	3.7×10^{-8}	5.8×10^{-8}	9.3×10^{-8}
Portsmouth	2.6×10^{-7}	2.1×10^{-8}	3.1×10^{-8}	5.2×10^{-8}
Quad Cities	1.0×10^{-7}	9.4×10^{-9}	1.4×10^{-8}	1.4×10^{-8}
Savannah River	2.6×10^{-7}	2.4×10^{-8}	3.6×10^{-8}	6.1×10^{-8}
Surry Power Station	2.4×10^{-7}	2.2×10^{-8}	3.3×10^{-8}	5.6×10^{-8}
Zion	1.5×10^{-7}	1.4×10^{-8}	2.1×10^{-8}	3.5×10^{-8}

(a) To convert to person-rem, multiply person-Sv by 100.
(b) The River Bend alternative site can be assumed to bounded by the Grand Gulf values because of the proximity of the sites.
(c) Dresden and LaSalle can be assumed to be bounded by the Braidwood values because of the proximity of the sites.

Projected annual accident risks, normalized to the WASH-1238 (AEC 1972) reference LWR net electrical generation (i.e., 880 MW(e)) are presented in Table H-13. As expected, accident risks are highest for the longest shipments. Also, consistent with past spent fuel transportation risk assessments, the routine impacts are several orders of magnitude greater than accident impacts.

Considering the uncertainties in the data and computational methods, the overall transportation accident risks associated with ABWR, ESBWR, surrogate AP1000, GT-MHR, and PBMR spent fuel shipments are judged to be small. Although likely to also be small, accident risks associated with IRIS and ACR-700 spent fuel shipments could not be analyzed due to lack of radionuclide source-term data. Additional analyses are necessary to quantify the impacts of IRIS and ACR-700 spent fuel shipments.

Table H-14 presents the environmental consequences of transportation accidents when shipping spent fuel from the proposed ESP sites and alternative sites to a spent fuel repository

Table H-14. Annual Spent Fuel Transportation Accident Impacts for Advanced Reactors, Normalized to Reference LWR Net Electrical Generation

	Advanced Reactor Type			
MTU/reference reactor year	ABWR/ESBWR	Surrogate AP1000	GT-MHR	PBMR
	20.3	19.7	6.0	5.8
	Population Dose, person-Sv/per reference reactor year[a]			
Braidwood[b]	2.2×10^{-6}	2.0×10^{-7}	8.9×10^{-8}	1.5×10^{-7}
Clinton	1.0×10^{-5}	2.0×10^{-7}	9.0×10^{-8}	1.5×10^{-7}
FitzPatrick	3.8×10^{-6}	3.3×10^{-7}	1.5×10^{-7}	2.5×10^{-7}
Grand Gulf[c]	4.2×10^{-6}	3.7×10^{-7}	1.7×10^{-7}	2.7×10^{-7}
North Anna	4.7×10^{-6}	4.2×10^{-7}	1.9×10^{-7}	3.1×10^{-7}
Pilgrim	8.1×10^{-6}	7.2×10^{-7}	3.5×10^{-7}	5.4×10^{-7}
Portsmouth	5.2×10^{-6}	4.0×10^{-7}	1.8×10^{-7}	3.0×10^{-7}
Quad Cities	2.1×10^{-6}	1.8×10^{-7}	8.4×10^{-8}	8.2×10^{-8}
Savannah River	5.3×10^{-6}	4.7×10^{-7}	2.1×10^{-7}	3.5×10^{-7}
Surry Power Station	4.8×10^{-6}	4.3×10^{-7}	2.0×10^{-7}	3.2×10^{-7}
Zion	3.0×10^{-6}	2.7×10^{-7}	1.2×10^{-7}	2.0×10^{-7}

(a) Multiply person-Sv/reference reactor year times 100 to obtain doses in person-rem/reference reactor year.
(b) The River Bend alternative site can be assumed to be bounded by the Grand Gulf values because of the proximity of the sites.
(c) Dresden and LaSalle can be assumed to be bounded by the Braidwood values because of the proximity of the sites.

Furthermore, substantial experimental data exist to develop technically defensible release fractions for various radionuclide groups (e.g., gases, semi-volatiles such as cesium and ruthenium, and particulates). However, because detailed experimental studies of releases assumed to be at Yucca Mountain, Nevada. The shipping distances and population distribution information for the routes were the same as those used for the normal "incident-free" conditions. The table presents estimates of population dose (person-Sv/reference reactor year) for several of the advanced reactor designs. These values are normalized to the WASH-1238 reference reactor (880-MW(e) net electrical generation, 1100-MW(e) reactor operating at 80 percent capacity).

Although radiation may cause cancers at high doses and high dose rates, currently there are no data that unequivocally establish the occurrence of cancer following exposure to low doses and dose rates, below about 100 mSv (10,000 mrem). However, radiation protection experts conservatively assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. Simply stated, any increase in dose, no matter how small, results in an incremental increase in health risk. This theory is accepted by the NRC as a conservative model for estimating health risks from radiation exposure, recognizing that the model probably over-estimates those risks.

Based on this model, the staff estimates the risk to the public from radiation exposure using the nominal probability coefficient for total detriment (730 fatal cancers, nonfatal cancers, and severe hereditary effects per 10,000 person-Sv [1,000,000 person-rem]) from International Commission on Radiation Protection (ICRP) Publication 60 (ICRP 1990). All the population doses presented in Table H-14 are less than 1.0×10^{-5} person-Sv (1.0×10^{-3} person-rem) per reference reactor year (100 person-rem/yr); therefore, the total detriment estimates associated with these population doses would all be less than 1.0×10^{-6} fatal cancers, nonfatal cancers, and severe hereditary effects per reference reactor year. These risks are quite small compared to the fatal cancers, nonfatal cancers, and severe hereditary effects that the same population would incur annually from exposure to natural sources of radiation.

H.2.3 Shipment of Radioactive Waste

This section discusses the environmental effects of transporting radioactive waste from advanced reactor sites. The environmental conditions listed in 10 CFR 51.52 that apply to shipments of radioactive waste are as follows:

- Radioactive waste (except spent fuel) is packaged and in a solid form.
- Radioactive waste (except spent fuel) is shipped from the reactor by truck or rail.

INEEL (2003) indicates that all of the advanced reactors will transport their radioactive waste by truck. Furthermore, INEEL (2003) indicates that all of the advanced reactors plan to solidify and package their radioactive waste. In addition, all of the advanced reactors will be subject to NRC (10 CFR Part 71) and Department of Transportation regulations for the shipment of radioactive material (49 CFR Parts 173 and 178).

Table S–4 also specifies the following conditions that apply to shipments of radioactive waste:

- weight – less than 33,000 kg (73,000 lb) per truck or 100 tons per cask per railcar
- traffic density – less than one truck shipment per day or three railcars per month.

The advanced reactors would be capable of shipping their radioactive wastes in compliance with Federal or State weight restrictions. With respect to the traffic density, all of the advanced reactor vendors provided radioactive waste generation estimates. Table H-15 provides these estimates, in addition to the radioactive waste generation estimates for the reference LWR in WASH-1238 (AEC 1972).

As shown in the table, only the PBMR generates a larger volume of radioactive waste than the reference LWR in WASH-1238. However, the GT-MHR and PBMR information in INEEL (2003) assumed these advanced reactors would ship wastes using two different packaging systems: one that hauls 28.3 m^3/shipment (1000 ft^3 per shipment) and one that hauls 5.7 m^3/shipment (200 ft^3/per shipment). Under those conditions, the number of shipments of radioactive waste per year, normalized to 1100 MW(e) electric generation capacity, would be about six shipments /year per 1100 MW(e) (880 net MW(e)) for the GT-MHR and seven shipments/ year per 1100 MW(e) for the PBMR. These estimates are well below the reference LWR (42 shipments/yr per 1100 MW(e)). In any event, all the estimates are well below the one truck shipment per day condition given in 10 CFR 51.52, Table S–4. Doubling the shipment estimates to account for empty return shipments is still well below the one shipment per day condition.

H.3 Support Information for Environmental Impacts of Transportation

The support information for the potential environmental effects of transportation of reactor fuel and radioactive waste to and from potential ESP sites includes the effects of transportation of fresh fuel to ESP sites, the effects of transportation of spent fuel from ESP sites to a spent fuel disposal facility, the effects of both incident-free transportation and transportation accidents, and the environmental effects of radioactive waste shipments.

H.3.1 Fresh Fuel Shipping

This section addresses the number and characteristics of shipments of fresh fuel to ESP sites relative to the conditions in 10 CFR 51.52. Comparisons are also made against Table S—4 and WASH-1238 (NRC 1972) which provided the data that supports Table S—4. Section H.3.1.1 presents the basic fresh fuel shipping requirements for each advanced reactor design. These data were extracted from INEEL (2003). Section H.3.1.2 presents the comparisons to 10 CFR 51.52 conditions.

Table H-15. Summary of Radioactive Waste Shipments for Advanced Reactors

Reactor Type	DOE (2003) Waste Generation Information	Annual Waste Volume, m^3/yr per Site	Electrical Output, MW(e) per Site	Normalized Rate, m^3/1100 MW(e) Reactor (880 MW(e) Net)[a]	Shipments/ 1100 MW(e) (880 MW(e) Net) Electrical Output[b]
Reference LWR (WASH-1238)	100 m^3/yr per reactor	108	1100	108	46
ABWR	100 m^3/yr per reactor	100	1500[c]	62	27
ESBWR	100 m^3/yr per reactor	100	1500[c]	62	27
Surrogate AP1000	55 m^3/yr per reactor	56	1150[c]	45	20
ACR-700	47.5 m^3/yr per reactor	95	1462[d]	64	28
IRIS	25 m^3/yr per reactor	74	1005[e]	67	29
GT-MHR	98 m^3/yr (4-reactor site)	98	1140[f]	86	37[h]
PBMR	100 drums/yr per reactor	168	1320[g]	118	51[h]

Conversions: 1 m^3 = 35.31 ft^3. Drum volume = 210 liters (0.21 m^3).

(a) Capacity factors used to normalize the waste generation rates to an equivalent electrical generation output are given in Table 6-3 for each reactor type. All are normalized to 880 MW(e) net electrical output (1100-MW(e) plant with an 80 percent capacity factor).

(b) The number of shipments per 1100 MW(e) was calculated assuming the WASH-1238 average waste shipment capacity of 2.34 m^3 per shipment (108 m^3/yr divided by 46 shipments/yr).

(c) The ABWR and ESBWR sites include one reactor at 1500 MW(e) and the surrogate AP1000 site includes one reactor at 1150 MW(e).

(d) The ACR-700 site includes two reactors at 731 MW(e) per reactor.

(e) The IRIS site includes three reactors at 335 MW(e) per reactor.

(f) The GT-MHR site includes four reactors at 285 MW(e) per reactor.

(g) The PBMR site includes eight reactors at 165 MW(e) per reactor.

(h) SERI states in INEEL (2003) that 90 percent of the waste could be shipped on trucks carrying 28 m^3 (1000 ft^3) of waste and the remaining 10 percent in shipments carrying 5.7 m^3 (200 ft^3) of radioactive waste. This would result in six to seven shipments per year after normalization to the reference LWR electrical output.

H.3.1.1 Advanced Reactor Fresh Fuel Shipping Data

In WASH-1238, a reference boiling water reactor (BWR) and pressurized water reactor (PWR) were used to formulate the basic numbers of fresh fuel shipments required for initial core loading and refueling. The reference BWR and PWR plants were 1100 MW(e) plants. The reference BWR assumed an initial core loading of 150 MTU and the reference PWR assumed 100 MTU. Both reactor types resulted in 18 truck shipments of fresh fuel per nuclear power plant. Annual reload quantities were assumed to be 30 MTU/yr for both reactor types, which resulted in an additional 6 truck shipments per year per nuclear power plant. In total, about 252 truck shipments of fresh fuel are required over a 40-year plant life, including the initial core and 39 years of reloads, for both reactor types.

The initial fuel loading and annual reload quantities for the Advanced Boiling Water Reactor (ABWR), a 1500 MW(e) plant, and the Economic Simplified Boiling Water Reactor (ESBWR) are approximately the same; 156.96 MTU per plant initial core loading and 32.76 MTU/yr per plant reload quantities (INEEL 2003). This equates to about 872 fresh fuel elements in the initial core and 213 elements per year for refueling. Truck shipment capacities were stated in INEEL (2003) to be 28 to 30 fresh fuel elements per truck shipment. Assuming 30 fuel elements per truck shipment results in about 30 shipments of fresh fuel to load the initial core and 6.1 truck shipments per year for refueling. If 28 fuel elements per truck shipment are used, the initial core load requires about 32 shipments of fresh fuel and annual refueling requires about 6.5 truck shipments per year.

The surrogate AP1000 is a 1150 MW(e) advanced PWR power plant. The initial core load was estimated to be 84.5 MTU per plant and annual reload requirements were estimated at 24.4 MTU/yr per plant. The data in INEEL (2003) also indicated that the average uranium mass in a fresh surrogate AP1000 fuel assembly was 0.583 MTU and that 12 fuel elements per truck shipment would be transported. This resulted in about 14 truck shipments to supply the initial core and about 3.8 truck shipments/year to support refueling.

The ACR-700 is an advanced design CANDU reactor assumed to generate 731 MW(e). It was stated in INEEL (2003) that the initial core load for the ACR-700 included 61.3 MTU per plant and the annual refueling requirements are 33.1 MTU/yr per plant. Each fuel element contains 18 kgU (INEEL 2003). This corresponds to 3406 fuel elements in the initial core loading and 1839 fuel elements per year for refueling. A range of truck shipment capacities was given in INEEL (2003) to be 180 to 240 fuel elements per truck shipment. This equates to 15 to 19 truck shipments to supply the initial core load and from 7.7 to 10.2 annual refueling shipments.

The International Reactor Innovative and Secure (IRIS) design is a 335 MW(e) advanced PWR. It requires an initial core load of 48.67 MTU or 89 fuel elements per unit (546.9 kgU per fuel element) (INEEL 2003). For refueling, the IRIS reactor was assumed to require an additional 6.26 MTU/yr of fresh fuel per unit or about 40 fresh fuel elements every 3.5 years. INEEL (2003) indicates a "typical" site may contain three units. Assuming each truck shipment carries eight fuel elements, the initial core load requires 34 truck shipments per three-unit site and annual refueling requires an additional 4.3 truck shipments per year per three-unit site.

The Gas Turbine-Modular Helium Reactor (GT-MHR) is a gas-cooled reactor that uses a substantially different fuel design than current and advanced LWRs. The reactor's thermal power level is rated at 600 MWt per unit and electric generation capacity is rated at 285 MW(e) per unit. A standard GT-MHR plant is assumed to be composed of four reactor units.

INEEL (2003) states that the initial core load for a single unit is about 1020 fuel elements. Annual average reload requirements are 510 fuel elements per unit. INEEL (2003) also indicates that each truck shipment can carry 80 fuel elements so it will require about 51 truck shipments to transport the initial core load for all 4 units and about 20 truck shipments per year for the annual reload requirements for all four units.

The Pebble Bed Modular Reactor (PBMR) is a gas-cooled reactor that is rated at 400 MW(t) (165 MW(e)) per unit. A typical PBMR plant is assumed to consist of eight units. The PBMR uses a substantially different fuel design than a typical LWR. INEEL (2003) states that each unit requires 260,000 fuel spheres per unit for its initial core load; 120,000 fuel spheres per unit are required for annual average reloads. A total of 48,000 fuel spheres is assumed to be transported in a typical truck shipment. As a result, it will take about 44 shipments of fuel spheres to transport the initial core load for all eight units and about 20 shipments per year to transport the annual reload quantity for all eight units.

H.3.1.2 Analysis of the Environmental Impacts of Fresh Fuel Shipments

As required by 10 CFR 51.52, applicants are required to submit a statement that the reactor and the transportation of fuel and waste to and from the reactor meet all the conditions specified in 10 CFR 51.52(a) or fulfil the requirements set forth in 10 CFR 51.52(b). The conditions specified in 10 CFR 51.52(a) that apply to fresh fuel include the following:

(1) Reactor core has thermal loading less than 3800 MW.

(2) Reactor fuel is in the form of sintered UO_2 pellets not exceeding 4 percent U-235 by weight and the pellets are encapsulated in zircaloy rods.

(3) Unirradiated fuel is shipped to the reactor by truck.

(4) The environmental impacts of transportation of fuel as set forth in Summary Table S—4 in 10 CFR 51.52(c).

Fresh fuel shipment information for the advanced reactors is discussed below for each of these criteria.

H.3.2 Reactor Core Thermal Loading

The thermal output ratings of the seven advanced reactor types as given in INEEL (2003) are as follows:

(1) ABWR – 4300 MW(t) (single unit)
(2) ESBWR – 4000 MW(t) (single unit)

(2) Surrogate AP1000 – 3400 MW(t) (single unit)
(4) ACR-700 – 1982 MW(t)/unit x 2 units/site = 3964 MW(t)/site
(5) IRIS – 1000 MW(t)/unit x 3 units/site = 3000 MW(t)/site
(6) GT-MHR – 600 MW(t)/unit x 4 units/site = 2400 MW(t)/site
(7) PBMR – 400 MW(t)/unit x 8 units/site = 3200 MW(t)/site.

As shown above, single-unit ABWR and ESBWR plants would exceed the 3800 MW(t) guideline in 10 CFR 51.52(a)(1). In addition, a twin-unit ACR-700 plant would exceed the core thermal power guideline.

H.3.3 Reactor Fuel Form

All of the advanced LWRs (such as the ABWR, ESBWR, surrogate AP1000, IRIS, and ACR-700) use sintered UO_2 fuel pellets encapsulated in zircaloy rods. The average enrichment for the ACR-700 fuel is about 2 percent, which is well within the 10 CFR 51.52(a)(2) condition. The average enrichments for the other advanced LWR fuels exceed the 4 percent U-235 by weight condition in 10 CFR 51.52(a)(2).

The gas-cooled reactors (such as the GT-MHR and PBMR) have a substantially different fuel form than described in 10 CFR 51.52(a)(2). The fuel forms for these reactors are coated uranium oxycarbide fuel kernels (GT-MHR) or coated UO_2 fuel kernels (PBMR). The fuel kernels are coated with layers of pyrolitic carbon and silicone carbide. Thus, these fuel forms are not the same as the conditions specified in 10 CFR 51.52(a)(2). Furthermore, the equilibrium enrichments for these fuels are 12.9 percent (PBMR) and 19.8 percent (GT-MHR). Therefore, the advanced gas-cooled reactor fuel forms do not meet the conditions specified in 10 CFR 51.52(a)(2).

H.3.4 Shipping Mode

All four reactor types were stated in INEEL (2003) to use trucks to ship fresh fuel to the various ESP sites.

H.3.5 WASH-1238 and Table S–4

The Table S–4 condition that is applicable to shipment of fresh fuel is that the number of shipments of fuel and waste to and from a commercial nuclear power plant must be less than 1 per day. Table H-16 summarizes the number of truck shipments of fresh fuel required for each reactor type. The table also normalizes the numbers of shipments to the net electrical generation output for the reference reactor in WASH-1238, or 880 MW(e) (1100 MW(e) plant operating at 80 percent annual capacity factor).

Table H-16. Number of Truck Shipments of Fresh Fuel for Each Advanced Reactor Type

Reactor Type	Number of Shipments per Reactor Site			Site Electric Generation, MW(e)[c]	Capacity Factor[d]	Normalized, Shipments per 1100 MW(e)[e]
	Initial Core[a]	Annual Reload	Total[b]			
Reference LWR (WASH-1238)	18	6.0	252	1100	0.8	252
ABWR/ESBWR[d]	30	6.1	267	1500	0.95	165
Surrogate AP1000	14	3.8	161	1150	0.95	130
ACR-700	15	7.7	314	731	0.9	420
IRIS	34	4.3	201	1005[f]	0.96	184
GT-MHR	51	20.0	831	1140[g]	0.88	729
PBMR	44	20.0	824	1320[h]	0.95	579

NOTE: The reference LWR shipment values have all been normalized to 880 MW(e) net electrical generation.

(a) Shipments of the initial core have been rounded up to the next highest whole number.
(b) Total shipments of fresh fuel over 40-year plant lifetime (initial core load plus 39 years of average annual reload quantities).
(c) Unit capacities and capacity factors were taken from INEEL (2003).
(d) Ranges of capacities are given in INEEL (2003) for these reactor fresh fuel shipments. The fresh fuel shipment data for these reactors were derived using the upper limit of the ranges.
(e) Normalized to net electric output for WASH-1238 reference plant (1100 MW(e)) plant at 80 percent or net electrical output of 880 MW(e)).
(f) The IRIS site includes three units at 335 MW(e) per unit.
(g) The GT-MHR site includes four reactor units at 285 MW(e) per unit.
(h) The PBMR site includes eight reactor units at 165 MW(e) per unit.

As shown, the ACR-700, PBMR, and GT-MHR advanced reactor types exceed the number of truck shipments estimated for the reference LWR in WASH-1238. The largest number of shipments, in excess of 700 shipments over 40 years, is for the GT-MHR. However, this equates to far less than one truck shipment per day. Consequently, the numbers of shipments for all the advanced reactor types are within the relevant condition specified in Table S–4.

Table S–4 includes a condition that the truck shipments not exceed 33,000 kg (73,000 lb) as governed by Federal or State gross vehicle weight restrictions. All of the advanced reactors were indicated in INEEL (2003) to be capable of meeting this restriction for fresh fuel shipments.

Finally, Table S–4 includes conditions related to radiological doses to transport workers and members of the public along transport routes. These doses are a function of the radiation dose rate emitted from the fresh fuel shipments, the number of exposed individuals and their locations relative to the shipment, the time in transit (including travel time and stop time), and number of shipments to which the individuals are exposed. The radiological dose impact of the transportation of fresh fuel was calculated using the RADTRAN 5 computer code (Neuhauser et al. 2003). The RADTRAN 5 calculations were performed to develop estimates of the worker and public doses associated with annual fresh fuel shipments to the ESP sites.

One of the key assumptions in WASH-1238 for the reference LWR fresh fuel shipments is that the radiation dose rate at 1 m (3 ft) from the transport vehicle is about 0.001 mSv/hr (0.1 mrem/hr). This assumption was also used in the analysis of advanced reactor fresh fuel shipments. This assumption is reasonable for all of the advanced reactor fuel types because the fuel materials will all be low dose rate uranium radionuclides and will be packaged similarly (inside a metal container that provides little radiation shielding). The numbers of shipments per year were obtained by dividing the normalized shipments in Table H-16 by 40 years of operation. Other key input parameters used in the radiation dose analysis for fresh fuel are shown in Table H-17.

The RADTRAN 5 results for this "generic" fresh fuel shipment are as follows:

- Transport workers: 1.71×10^{-5} person-Sv/shipment (1.71×10^{-3} person-rem/shipment)

- General public (Onlookers – persons at stops and sharing the highway): 6.65×10^{-5} person-Sv/shipment (6.65×10^{-3} person-rem/shipment)

- General public (Along Route – persons living near a highway): 1.61×10^{-6} person-Sv/shipment (1.61×10^{-4} person-rem/shipment).

These values were combined with the average annual shipments of fresh fuel for each advanced reactor type (see Table H-16) normalized to the WASH-1238 reference LWR electric output (880 MW(e)) to calculate annual doses to the public and workers that can be compared to Table S–4 conditions. The results are shown in Table H-18. As shown, the calculated radiation doses for shipping fresh fuel to ESP sites are within the Table S–4 conditions.

H.3.6 Transportation Accidents

Accidents involving fresh fuel shipments are also addressed in Table S–4. Accident risks are a combination of accident frequency and consequence. Accident frequencies are likely to be lower than they were when WASH-1238 was published because traffic accident, injury, and

Table H-17. RADTRAN 5 Input Parameters for Fresh Fuel Shipments

Parameter	RADTRAN 5 Input Value	Source
Shipping distance, km	3,200	NRC (1972)[a]
Travel Fraction – Rural	0.90	NRC (1977)
Travel Fraction – Suburban	0.05	
Travel Fraction – Urban	0.05	
Population Density – Rural, persons/km^2	10	DOE (2002a)
Population Density – Suburban, persons/km^2	349	
Population Density – Urban, persons/km^2	2,260	
Vehicle speed – Rural, km/hr	88.49	Based on average speed in rural areas given in DOE (2002a)
Vehicle speed – Suburban, km/hr	88.49	
Vehicle speed – Urban, km/hr	88.49	
Traffic count – Rural, vehicles/hr	530	DOE (2002a)
Traffic count – Suburban, vehicles/hr	760	
Traffic count – Urban, vehicles/hr	2,400	
Dose rate at 1 m from vehicle, mrem/hr	0.1	NRC (1972)
Packaging length, m	7.3	Approximate length of 2 LWR fuel element packages placed on end
Number of truck crew	2	NRC (1972), NRC (1977), and DOE (2002a)
Stop time, hr/trip	4.5	Based on 0.0014 hr stop time per km (Hostick et al. 1992)
Population density at stops, persons/km^2	64,300	Based on 20 people in annular ring extending from 1 to 10 m from vehicle

(a) NRC (1972) have a range of shipping distances between 40 km (25 mi) and 4800 km (3000 mi) for fresh fuel shipments. A 3200-km (2000-mi) "average" shipping distance was assumed.

Table H-18. Radiological Impacts of Transporting Fresh Fuel to ESP Sites

Plant Type	Normalized Average Annual Shipments	Cumulative Annual dose, person-rem/yr per 1100 MW(e)		
		Workers	Public – Onlookers	Public – Along Route
Reference LWR (WASH-1238)	6.3	1.1E-02	4.2E-02	1.0E-03
ABWR/ESBWR	4.1	7.1E-03	2.7E-02	6.6E-04
Surrogate AP1000	3.3	5.6E-03	2.2E-02	5.2E-04
ACR-700	10.5	1.8E-02	7.0E-02	1.7E-03
IRIS	4.6	7.9E-03	3.1E-02	7.4E-04
GT-MHR	18.2	3.1E-02	1.2E-01	2.9E-03
PBMR	14.5	2.5E-02	9.6E-02	2.3E-03
10 CFR 51.52 Table S–4 Condition	<1 per day	4	3	3

fatality rates have fallen over the past 30 years. Consequences of accidents that are severe enough to result in a release of fresh fuel particles are not significantly different for advanced LWRs because the fuel form, cladding, and packaging are similar to those analyzed in WASH-1238. Consequently, the impact of accidents during transport of fresh fuel to advanced LWR sites would be smaller than the WASH-1238 results that formed the basis for Table S–4.

With respect to the advanced gas-cooled reactors, accident rates (accidents per unit distance) and associated accident frequencies (accidents per year) would follow the same trends as LWRs (overall reduction relative to the accident rates used in WASH-1238 [AEC 1972]). The consequences of accidents involving gas-cooled reactor fresh fuel, however, are more uncertain. A literature search was conducted to identify publicly available documents that describe the effects of accidents (exposure of fresh gas-cooled reactor fuel to structural and thermal transients). No definitive references were found. Consequently, it was assumed here that the gas-cooled reactor fresh fuel shipments would have the same abilities as LWR fresh fuel to maintain its functional integrity following a traffic accident. This assumption is judged to be conservative because gas-cooled reactor fuel operates at significantly higher temperatures, and thus maintains integrity under more severe thermal conditions than LWR fuel. Detailed information about the behavior of the gas-cooled reactor fuel under impact conditions was not found. However, packaging systems for fresh gas-cooled reactor fuel will be required to meet the same requirements as fresh LWR fuel packages. Properly designed and manufactured packaging systems are the most effective means of preventing damage and dispersal of the contained materials under accident conditions. Consequently, packaging systems for fresh gas-cooled reactor fuels would provide equivalent release (consequence) prevention and mitigation to those designed for fresh LWR fuels. In addition, the fuel forms for the gas-cooled reactors are similar to LWRs (uranium oxide for the PBMR and uranium oxycarbide for the GT-MHR versus uranium oxide for LWRs), so the failure resistance provided by fresh gas-cooled reactor fuels should not be significantly lower than LWRs. Based on the assumption, which will need to be verified at the CP/COL stage, that fresh gas-cooled and LWR fuels and associated packaging systems provide equivalent resistance to thermal and impact conditions, it was concluded that the impact of accidents involving gas-cooled reactor fresh fuel would not be significantly different than for LWR fresh fuel.

H.3.7 Spent Fuel Shipping

This section discusses the impact of transporting spent advanced reactor fuel from candidate sites to a potential spent fuel disposal facility located at Yucca Mountain, Nevada. The section is divided into two parts. The first part considers incident-free transportation, and the second part considers transportation accidents.

The analysis is based on shipment of spent fuel by legal-weight trucks in casks with characteristics similar to casks currently available (massive, heavily-shielded, cylindrical metal pressure vessels). Each shipment is assumed to consist of a single shipping cask loaded onto a modified trailer. These assumptions are consistent with assumptions made in the evaluation of the environmental impact of transportation of spent fuel presented in Addendum I to NUREG-1437 (NRC 1999a). As discussed in Addendum I, these assumptions are conservative because the alternative assumptions involve rail transportation or heavy-haul trucks, which would reduce the number of spent-fuel shipments.

Environmental impact of the transportation of spent fuel was calculated using the RADTRAN 5 computer code (Neuhauser et al. 2003). Routing and population data for input to RADTRAN for shipment by truck were obtained from the TRAGIS routing code (Johnson and Michelhaugh 2000). The population data in the TRAGIS code is based on the 2000 census.

H.3.8 Incident-Free Transportation of Spent Fuel

"Incident-free" transportation refers to transportation activities in which the shipments of radioactive material reach their destination without releasing any radioactive cargo to the environment. The vast majority of radioactive shipments are expected to reach their destination without experiencing an accident or incident or releasing any cargo. The "incident-free" impact from these normal, routine shipments arise from the low levels of radiation that penetrate the heavily-shielded spent fuel shipping cask. Although Federal regulations in 10 CFR Part 71 and

49 CFR Part 173 impose constraints on radioactive material shipments, some radiation penetrates the shipping container and exposes nearby persons to low levels of radiation.

Incident-free, legal-weight truck transportation of spent fuel has been evaluated by considering shipments from six representative reactor sites to a repository at Yucca Mountain, Nevada, for disposal. This assumption is conservative because it tends to maximize the shipping distance from the east coast and the Midwest where most of the reactors are assumed to be located. Therefore, shipment to one or more other potential sites would reduce the impact.

Environmental impact from these shipments will occur to persons residing along the transportation corridors between potential ESP sites and the repository; to persons in vehicles passing the spent-fuel shipment; to persons at vehicle stops for refueling, rest, and vehicle inspections; and to transportation crew members. The impact to these exposed population groups were quantified using the RADTRAN 5 computer code (Neuhauser et al. 2003).

This analysis addressed the impact of spent nuclear fuel transport to a high level waste repository from a generic perspective because the Congress has directed the U.S. Department of Energy to study only Yucca Mountain for the potential proposed repository. The analysis assumed that all spent nuclear fuel would be shipped to that potential repository.

The characteristics of specific shipping routes (for example, population densities, shipping distances) influence the normal radiological exposures. To address the differences that arise from the specific reactor site from which the spent-fuel shipment originates, each advanced reactor design was assumed to be located at all the primary and alternative early site permit sites.

These sites are:

Primary Site	Alternative Site
North Anna	Savannah River Site (SRS)
Clinton	Portsmouth Gaseous Diffusion Plant (PGDP)
Grand Gulf	FitzPatrick
	Pilgrim
	Zion
	Quad Cities
	Braidwood
	Surry Power Station

Input to RADTRAN 5 includes the total shipping distance between the origin and destination sites and the population distributions along the routes. This information was obtained by running the TRAGIS computer code (Johnson and Michelhaugh 2000) for the origin-destination combinations of interest for legal weight trucks. The resulting route characteristics information is shown in Table H-19. Note that for truck shipments, all the spent fuel is assumed to be shipped to the potential Yucca Mountain site over designated highway-route controlled quantity (HRCQ) routes. The routes used here are the same as those used in the Yucca Mountain Environmental Impact Statement (DOE 2002b).

Table H-19. Transportation Route Information for Shipments from ESP Sites to the Potential Yucca Mountain Spent Fuel Disposal Facility

Advance Reactor Site	One-Way Shipping Distance, km				Population Density, persons/km²			Stop time per trip, hr
	Total	Rural	Suburban	Urban	Rural	Suburban	Urban	
Primary Site								
North Anna	4409.5	3498	812.4	99.1	11.3	319	2310.6	5
Clinton	3076.3	2626.3	398.3	51.7	9.4	306.1	2372.2	3.5
Grand Gulf	3718.3	3030.4	581.3	106.6	9.2	339.4	2429.4	4
Alternative Site								
Savannah River Site	4263	3260	881	122	11	331.5	2311.2	5
Portsmouth	3902.2	3166.9	647.2	88.1	10.7	316.4	2339.7	4.5
FitzPatrick	4212.2	3228.6	875.4	108.2	11.4	312.4	2348.7	5
Pilgrim	4682.3	3469.3	1091.7	121.3	11.8	312.3	2377.2	5.5
Zion	3138.9	2629.6	441.3	68	9.5	323.8	2360.3	3.5
Quad Cities	2853.1	2451	352.6	49.5	9.1	310.2	2391.3	3
Braidwood	3034.5	2604.4	378.7	51.4	9.4	308.9	2377.2	3.5
Surry	4555.4	3590.7	863.9	100.8	11.4	317.6	2301.6	5

Shipping casks have not been designed for advanced reactor spent fuel. Although some of the advanced reactor fuel designs are similar to current LWR fuel, no attempt has been made to optimize the cargo capacities of shipping casks for advanced LWR fuels. For the non-LWR fuel types (that is, the GT-MHR, and PBMR), there is little information on even a conceptual basis that would provide a defensible technical basis for shipping cask capacities. The shipping cask capacity data in the report *Early Site Permit Environmental Report Sections and Supporting Documentation* (INEEL 2003) are summarized as follows:

- ABWR – ABWR fuel is not significantly different than existing LWR fuel designs so the number of ABWR assemblies that can be transported in a legal weight truck shipment (25 ton shipping cask) should not be different than current cargo capacities.

- ESBWR – The ESBWR fuel is similar to the ABWR fuel.

- Surrogate AP1000 – Surrogate AP1000 fuel assemblies are similar to current generation PWR fuel. No information was provided in INEEL (2003) on shipping cask capacities for surrogate AP1000 spent nuclear fuel.

- ACR-700 – The ACR-700 fuel is somewhat different than the current and advanced LWR fuel designs. SERI estimated that an ACR-700 rail cask would hold about 10 MTU of spent fuel, similar to the current cask designs. This value is nearly identical to the cargo capacities of current rail cask designs so it was assumed that the truck cask capacity for ACR-700 and current generation LWRs would also be about the same (1.8 MTU/shipment).

- IRIS – The IRIS fuel is similar to current generation PWR fuel. No information was provided in INEEL (2003) on shipping cask capacities for IRIS spent nuclear fuel.

- GT-MHR – The GT-MHR fuel is a spherical coated particle fuel with a uranium oxycarbide fuel kernel loaded into graphite fuel elements. This fuel concept is significantly different than current and advanced LWR fuels (sintered UO2 pellets loaded into zircaloy tubes). According to INEEL (2003), six spent fuel elements containing 0.023 MTU of spent fuel are assumed to be transported in a legal weight truck cask.

- PBMR – The PBMR fuel is also a spherical coated particle fuel with uranium oxide fuel kernels. In INEEL (2003), it is estimated that 0.495 MTU of spent PBMR fuel can be transported in a single legal weight truck shipment.

The aforementioned shipping cask capacities are approximations based on current shipping cask designs. Actual shipping cask capacities in the future may be significantly different. Applicants must account for this in their applications at the CP/COL stage.

Incident-free radiation doses are a function of many variables. The most important of these variables are presented in Table H-20. Most of these variables were extracted from the literature are considered to be "standard" values used in many RADTRAN applications, including environmental impact statements, and regulatory analyses.

For purposes of this analysis, the transportation crew for truck spent fuel shipments consisted of two drivers. Escorts were considered, but they were not included because their distance from the shipping cask would reduce the dose rates to levels well below the dose rates experienced by the drivers. Stop times were assumed to accrue at the rate of 30 minutes per 4 hours driving time. TRAGIS outputs were used to determine the number of stops for each origin-destination.

Table H-20. RADTRAN 5 Incident-free Exposure Parameters

Parameter	RADTRAN 5 Input Value	Source
Vehicle speed – Rural, km/hr	88.49	Based on average speed in rural areas given in DOE (2002a). Because most travel is on interstate highways, the same vehicle speed is assumed in rural, suburban, and urban areas. No speed reductions were assumed for travel at rush hour.
Vehicle speed – Suburban, km/hr	88.49	
Vehicle speed – Urban, km/hr	88.49	
Traffic count – Rural, vehicles/hr	530	DOE 2002a
Traffic count – Suburban, vehicles/hr	760	
Traffic count – Urban, vehicles/hr	2400	
Dose rate at 1 m from vehicle, mrem/hr	14	DOE 2002b – approximate dose rate at 1 m that is equivalent to maximum dose rate allowed by Federal regulations (10 mrem/hr at 2 m from the side of a transport vehicle).
Packaging dimensions, m	Length 5.2 Diameter 1.0	DOE 2002b
Number of truck crew	2	NRC 1972, NRC 1977, and DOE 2002a
Stop time, hr/trip	Route-specific	See Table H-19.
Population Density at Stops, persons/km^2	30,000	Sprung et al. (2000)
Min/Max Radii of Annular Area Around Vehicle at Stops, m	1 to 10	Sprung et al. (2000)
Shielding Factor Applied to Annular Area Surrounding Vehicle at Stops	1 (no shielding)	Sprung et al. (2000)
Population Density Surrounding truck stops, persons/km^2	340	Sprung et al. (2000)
Min/Max Radius of Annular Area Surrounding Truck Stop, m	10 to 800	Sprung et al. (2000)
Shielding Factor Applied to Annular Area Surrounding Truck Stop	0.2	Sprung et al. (2000)

Doses to the public at truck stops have been significant contributors to the doses calculated in previous RADTRAN analyses. For this analysis, stop doses are the sum of the doses to individuals located in two annular rings centered at the stopped vehicle, as illustrated in Figure H-2. The inner ring represents persons who may be at the truck stop at the same time as a spent fuel shipment and extends 1 to 10 m from the edge of the vehicle. The outer ring represents persons who reside near a truck stop and extends from 10 to 800 m from the vehicle. This scheme is the same as that used in NRC (2000). Population densities and shielding factors were also taken from NRC (2000), which were based on the observations of Griego et al. (1996).

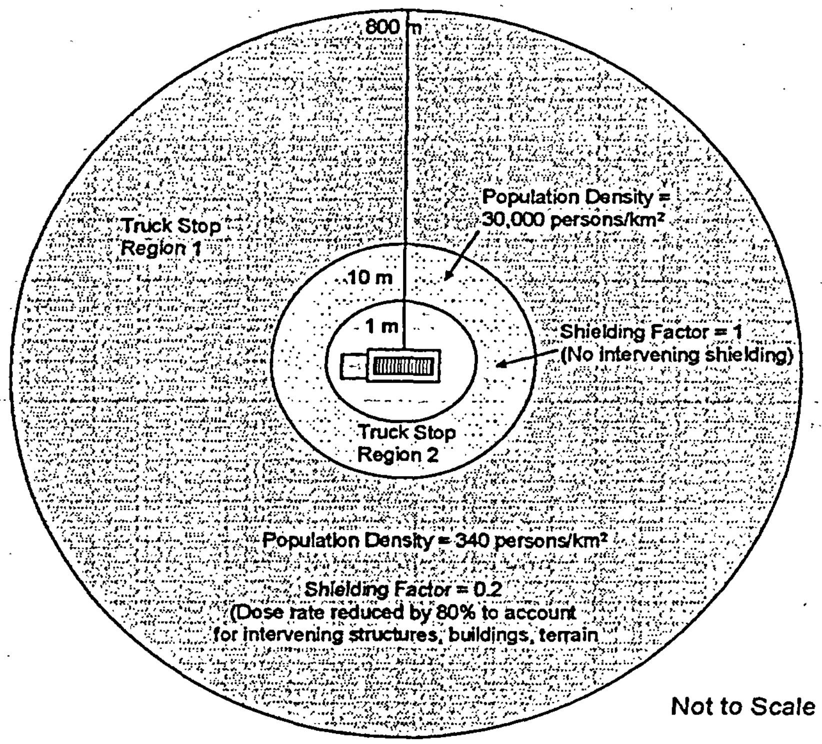

Figure H-2. Illustration of Truck Stop Model (NRC 2000)

The results of these routine (incident-free) exposure calculations are shown in Table H-21 for spent-fuel shipments from all 11 primary and alternative sites to the potential Yucca Mountain repository. Population dose estimates are given for workers (such as, truck crew members), onlookers (doses to persons at truck stops and persons on highways exposed to the spent fuel shipments), and along the route (persons living near the highway).

This discussion addresses whether or not the environmental effects of incident-free advanced reactor spent-fuel shipments are within the guidelines established in Table S–4 of 10 CFR 51.52. The bounding cumulative doses to the exposed population given in Table S–4 are:

- Transport workers: 0.04 person-Sv/reactor-year (4 person-rem/reactor-year)
- General public (onlookers): 0.03 person-Sv/reactor-year (3 person-rem/reactor-year)
- General public (along route): 0.03 person-Sv/reactor-year (3 person-rem/reactor-year).

Calculation of the cumulative doses entailed converting the per-shipment risks given in Table H-21 to estimates of environmental effects per reactor-year of operation. The per-shipment results, which are independent of reactor technology (in other words, the doses

Table H-21. Routine (Incident-Free) Radiation Doses to Transport Workers and the Public from Shipping Spent Fuel from Potential Advanced Reactor Sites to the Potential Yucca Mountain Disposal Facility

	Population Dose (person-rem/shipment)[a]		
Reactor Site	**Crew**	**Public (Onlookers)**	**Public (Along Route)**
Braidwood	7.1E-02	2.4E-01	4.4E-03
Clinton	7.2E-02	2.5E-01	4.5E-03
FitzPatrick	9.8E-02	3.5E-01	9.5E-03
Grand Gulf	8.7E-02	2.8E-01	7.0E-03
North Anna	1.0E-01	3.5E-01	9.2E-03
Pilgrim	1.1E-01	3.9E-01	1.2E-02
Portsmouth	9.1E-02	3.2E-01	7.3E-03
Quad Cities	6.7E-02	2.1E-01	4.1E-03
Savannah River	9.9E-02	3.5E-01	1.0E-02
Surry	1.1E-01	3.5E-01	9.7E-03
Zion	7.3E-02	2.5E-01	5.2E-03

(a) To convert person-rem to person-Sv, divide the number by 100.

are dependent on the assumed external radiation dose rate emitted from the cask, which is fixed at the regulatory maximum limit for all of the advanced reactor technologies), are given in terms of the population dose per shipment of spent fuel. To develop estimates of the annual environmental impact, the following assumptions were made:

- The basis for the annual number of shipments of spent fuel from the reference LWR in WASH-1238 will be used. In WASH-1238, it was assumed that 60 shipments per year will be made, each shipment carrying 0.5 MTU of spent fuel. This equates to shipping 30 MTU of spent fuel per year. This is equivalent to the annual refueling requirements for the reference LWR. It was assumed that spent fuel will be shipped from other reactor types at a rate equal to their annual refueling requirements.

- Shipping cask capacities used to calculate annual spent fuel shipments for the advanced LWRs were assumed to be the same as the reference LWR (approximately 0.5 MTU per truck shipment).

- The annual numbers of spent fuel shipments from the advanced gas-cooled reactors were taken directly from INEEL (2003). These estimates were 38 shipments/yr from the GT-MHR site and 16 shipments/yr from the PBMR site.

Table H-22 provides the estimated annual population doses from routine (incident-free) transportation of spent fuel from ESP sites to the potential Yucca Mountain disposal facility. The collective population doses (person-rem) were converted to population risk using health-effects conversion factors. The dose to risk factors, which were taken from Federal Guidance Report 13 (Eckerman et al. 2002), assume 6.0×10^{-4} latent cancer fatalities (LCFs) per person-rem and 8.5×10^{-4} total detrimental health effects per person-rem for workers and the general public. Total detriment includes fatal and non-fatal cancers and severe hereditary effects. The annual LCF and total detriment estimates are presented in Tables H-23 and H-24, respectively, for each reactor site/reactor type combination. The results in Tables H-22 to H-24 have been normalized to the WASH-1238 net electrical generation (880 MW(e)).

As shown in Table H-22, some of the estimated population doses are higher than the Table S–4 conditions. Two key reasons for the higher population doses relative to Table S–4 are the higher number of spent fuel shipments estimated for some of the reactor technologies and the longer shipping distances used in this assessment than were used in WASH-1238. WASH-1238 used a "typical" distance for a spent fuel shipment of 1600 km (1000 mi) whereas the shipping distances used in this assessment ranged from about 3000 km (1800 mi) to 4700 km (2900 mi). The higher numbers of shipments are based on spent fuel shipping casks designed to transport short-cooled fuel (150 days out of the reactor). It was assumed in this analysis that the shipping cask capacities are 0.5 MTU/shipment, roughly equivalent to one PWR or two BWR spent fuel assemblies per shipment. Newer designs are based on longer-cooled spent fuel (5 years out of reactor) and have larger capacities than those used in this assessment. DOE (2002b) spent fuel shipping cask capacities were approximately 1.8 MTU/ shipment, or up to four PWR or nine BWR fuel assemblies per shipment. Use of the newer shipping cask designs will reduce the number of spent fuel shipments and the associated environmental impact. If the population doses are adjusted for the shipping distance (factor of 2 to 3) and shipping cask capacity (factor of 4), the routine population doses from spent fuel shipments from all reactor types and all sites fall within the Table S–4 conditions.

Table H-22. Routine (Incident free) Population Doses From Spent Fuel Transportation, Normalized to Reference Light Water Reactor Net Electrical Generation

Reactor Type	Reference LWR (WASH-1238)			ABWR/ESBWR			Surrogate AP1000			ACR-700		
No. Shipments per yr	60			41			40			90		
	Environmental Effects, person-rem per reactor year(a)											
Reactor Site	Crew	On-lookers	Along Route	Crew	On-lookers	Along Route	Crew	On-lookers	Along Route	Crew	On-lookers	Along Route
Braidwood	4.2E+00	1.5E+01	2.6E-01	2.9E+00	1.0E+01	1.8E-01	2.8E+00	9.7E+00	1.7E-01	6.3E+00	2.2E+01	3.9E-01
Clinton	4.3E+00	1.5E+01	2.7E-01	2.9E+00	1.0E+01	1.8E-01	2.8E+00	9.7E+00	1.8E-01	6.4E+00	2.2E+01	4.1E-01
FitzPatrick	5.9E+00	2.1E+01	5.7E-01	4.0E+00	1.4E+01	3.9E-01	3.9E+00	1.4E+01	3.8E-01	8.8E+00	3.1E+01	8.5E-01
Grand Gulf	5.2E+00	1.7E+01	4.2E-01	3.5E+00	1.2E+01	2.8E-01	3.4E+00	1.1E+01	2.7E-01	7.8E+00	2.5E+01	6.2E-01
North Anna	6.2E+00	2.1E+01	5.5E-01	4.2E+00	1.4E+01	3.7E-01	4.1E+00	1.4E+01	3.6E-01	9.2E+00	3.2E+01	8.2E-01
Pilgrim	6.5E+00	2.3E+01	7.0E-01	4.4E+00	1.6E+01	4.8E-01	4.3E+00	1.5E+01	4.6E-01	9.8E+00	3.5E+01	1.0E+00
Portsmouth	5.5E+00	1.9E+01	4.4E-01	3.7E+00	1.3E+01	3.0E-01	3.6E+00	1.2E+01	2.9E-01	8.1E+00	2.8E+01	6.6E-01
Quad Cities	4.0E+00	1.3E+01	2.4E-01	2.7E+00	8.6E+00	1.7E-01	2.6E+00	8.4E+00	1.6E-01	6.0E+00	1.9E+01	3.6E-01
Savannah River	6.0E+00	2.1E+01	6.0E-01	4.0E+00	1.4E-01	4.1E-01	3.9E+00	1.4E+01	4.0E-01	8.9E+00	3.2E+01	9.0E-01
Surry	6.4E+00	2.1E+01	5.8E-01	4.3E+00	1.4E+01	3.9E-01	4.2E+00	1.4E+01	3.8E-01	9.5E+00	3.2E+01	8.7E-01
Zion	4.4E+00	1.5E+01	3.1E-01	3.0E+00	1.0E+01	2.1E-01	2.9E+00	9.7E+00	2.0E-01	6.5E+00	2.2E+01	4.6E-01

(a) To convert person-rem to person-Sv, divide the number by 100.

Table H-22. (contd)

Reactor Type	IRIS			GT MHR			PBMR		
No. Shipments per yr	35			34			12		
	Environmental Effects, person-rem per reactor year[(a)]								
Reactor Site	Crew	On-lookers	Along Route	Crew	On-lookers	Along Route	Crew	On-lookers	Along Route
Braidwood	2.5E+00	8.5E+00	1.5E-01	2.4E+00	8.2E+00	1.5E-01	7.9E-01	2.7E+00	4.9E-02
Clinton	2.5E+00	8.5E+00	1.6E-01	2.4E+00	8.2E+00	1.5E-01	8.0E-01	2.8E+00	5.1E-02
FitzPatrick	3.4E+00	1.2E+01	3.3E-01	3.3E+00	1.2E+01	3.2E-01	1.1E+00	3.9E+00	1.1E-01
Grand Gulf	3.0E+00	9.8E+00	2.4E-01	2.9E+00	9.4E+00	2.3E-01	9.7E-01	3.2E+00	7.8E-02
North Anna	3.6E+00	1.2E+01	3.2E-01	3.4E+00	1.2E+01	3.1E-01	1.2E+00	4.0E+00	1.0E-01
Pilgrim	3.8E+00	1.3E+01	4.0E-01	3.6E+00	1.3E+01	3.9E-01	1.2E+00	4.3E+00	1.3E-01
Portsmouth	3.1E+00	1.1E+01	2.5E-01	3.0E+00	1.1E+01	2.4E-01	1.0E+00	3.6E+00	8.2E-02
Quad Cities	2.3E+00	7.4E+00	1.4E-01	2.2E+00	7.1E+00	1.4E-01	7.5E-01	2.4E+00	4.6E-02
Savannah River	3.4E+00	1.2E+01	3.5E-01	3.3E+00	1.2E+01	3.3E-01	1.1E+00	3.9E+00	1.1E-01
Surry	3.7E+00	1.2E+01	3.3E-01	3.5E+00	1.2E+01	3.2E-01	1.2E+00	4.0E+00	1.1E-01
Zion	2.5E+00	8.5E+00	1.8E-01	2.4E+00	8.2E+00	1.7E-01	8.2E-01	2.8E+00	5.8E-02

(a) To convert person-rem to person-Sv, divide the number by 100.

Table H-23. Latent Cancer Fatality Impacts From Routine Spent Fuel Transportation, Normalized to Reference Light Water Reactor Net Electrical Generation

Reactor Type	Environmental Effects, Latent Cancer Fatalities Per Reactor Year											
	Reference LWR (WASH-1238)			ABWR/ESBWR			Surrogate AP1000			ACR-700		
Reactor Site	**Crew**	**Onlookers**	**Along Route**	**Crew**	**Onlookers**	**Along Route**	**Crew**	**Onlookers**	**Along Route**	**Crew**	**Onlookers**	**Along Route**
Braidwood	2.5E-03	8.8E-03	1.6E-04	1.7E-03	6.0E-03	1.1E-04	1.7E-03	5.8E-03	1.0E-04	3.8E-03	1.3E-02	2.3E-04
Clinton	2.6E-03	8.8E-03	1.6E-04	1.8E-03	6.0E-03	1.1E-04	1.7E-03	5.8E-03	1.1E-04	3.9E-03	1.3E-02	2.4E-04
FitzPatrick	3.5E-03	1.3E-02	3.4E-04	2.4E-03	8.6E-03	2.3E-04	2.3E-03	8.3E-03	2.3E-04	5.3E-03	1.9E-02	5.1E-04
Grand Gulf	3.1E-03	1.0E-02	2.5E-04	2.1E-03	6.9E-03	1.7E-04	2.1E-03	6.7E-03	1.6E-04	4.7E-03	1.5E-02	3.7E-04
North Anna	3.7E-03	1.3E-02	3.3E-04	2.5E-03	8.6E-03	2.2E-04	2.4E-03	8.3E-03	2.2E-04	5.5E-03	1.9E-02	4.9E-04
Pilgrim	3.9E-03	1.4E-02	4.2E-04	2.7E-03	9.4E-03	2.9E-04	2.6E-03	9.1E-03	2.8E-04	5.9E-03	2.1E-02	6.3E-04
Portsmouth	3.3E-03	1.1E-02	2.6E-04	2.2E-03	7.7E-03	1.8E-04	2.2E-03	7.5E-03	1.7E-04	4.9E-03	1.7E-02	3.9E-04
Quad Cities	2.4E-03	7.6E-03	1.5E-04	1.6E-03	5.2E-03	1.0E-04	1.6E-03	5.0E-03	9.6E-05	3.6E-03	1.1E-02	2.2E-04
Savannah River	3.6E-03	1.3E-02	3.6E-04	2.4E-03	8.6E-03	2.5E-04	2.4E-03	8.3E-03	2.4E-04	5.3E-03	1.9E-02	5.4E-04
Surry	3.8E-03	1.3E-02	3.5E-04	2.6E-03	8.6E-03	2.4E-04	2.5E-03	8.4E-03	2.3E-04	5.7E-03	1.9E-02	5.2E-04
Zion	2.6E-03	8.9E-03	1.9E-04	1.8E-03	6.0E-03	1.3E-04	1.7E-03	5.8E-03	1.2E-04	3.9E-03	1.3E-02	2.8E-04

Table H-23. (contd)

Reactor Type	IRIS			GT MHR			PBMR		
	Environmental Effects, Latent Cancer Fatalities Per Reactor Year								
Reactor Site	Crew	Onlookers	Along Route	Crew	Onlookers	Along Route	Crew	Onlookers	Along Route
Braidwood	1.5E-03	5.1E-03	9.1E-05	1.4E-03	4.9E-03	8.7E-05	4.8E-04	1.6E-03	2.9E-05
Clinton	1.5E-03	5.1E-03	9.4E-05	1.4E-03	4.9E-03	9.0E-05	4.8E-04	1.7E-03	3.0E-05
FitzPatrick	2.0E-03	7.3E-03	2.0E-04	2.0E-03	7.0E-03	1.9E-04	6.6E-04	2.4E-03	6.4E-05
Grand Gulf	1.8E-03	5.9E-03	1.4E-04	1.7E-03	5.7E-03	1.4E-04	5.8E-04	1.9E-03	4.7E-05
North Anna	2.1E-03	7.3E-03	1.9E-04	2.1E-03	7.0E-03	1.8E-04	6.9E-04	2.4E-03	6.2E-05
Pilgrim	2.3E-03	8.0E-03	2.4E-04	2.2E-03	7.7E-03	2.3E-04	7.3E-04	2.6E-03	7.9E-05
Portsmouth	1.9E-03	6.6E-03	1.5E-04	1.8E-03	6.3E-03	1.5E-04	6.1E-04	2.1E-03	4.9E-05
Quad Cities	1.4E-03	4.4E-03	8.5E-05	1.3E-03	4.2E-03	8.1E-05	4.5E-04	1.4E-03	2.7E-05
Savannah River	2.1E-03	7.3E-03	2.1E-04	2.0E-03	7.0E-03	2.0E-04	6.7E-04	2.4E-03	6.8E-05
Surry	2.2E-03	7.3E-03	2.0E-04	2.1E-03	7.1E-03	1.9E-04	7.1E-04	2.4E-03	6.5E-05
Zion	1.5E-03	5.1E-03	1.1E-04	1.5E-03	4.9E-03	1.0E-04	4.9E-04	1.7E-03	3.5E-05

Table H-24. Total Detrimental Health Effects From Routine Spent Fuel Transportation, Normalized to Reference Light Water Reactor Net Electrical Generation

	Environmental Effects, Total Detrimental Health Effects per reactor year											
Reactor Type	Reference LWR (WASH-1238)			ABWR/ESBWR			Surrogate AP1000			ACR-700		
Reactor Site	Crew	On-lookers	Along Route	Crew	On-lookers	Along Route	Crew	On-lookers	Along Route	Crew	On-lookers	Along Route
Braidwood	3.6E-03	1.2E-02	2.2E-04	2.4E-03	8.5E-03	1.5E-04	2.4E-03	8.2E-03	1.5E-04	5.4E-03	1.9E-02	3.3E-04
Clinton	3.7E-03	1.3E-02	2.3E-04	2.5E-03	8.5E-03	1.6E-04	2.4E-03	8.2E-03	1.5E-04	5.5E-03	1.9E-02	3.4E-04
FitzPatrick	5.0E-03	1.8E-02	4.8E-04	3.4E-03	1.2E-02	3.3E-04	3.3E-03	1.2E-02	3.2E-04	7.5E-03	2.7E-02	7.2E-04
Grand Gulf	4.4E-03	1.4E-02	3.5E-04	3.0E-03	9.8E-03	2.4E-04	2.9E-03	9.5E-03	2.3E-04	6.6E-03	2.2E-02	5.3E-04
North Anna	5.2E-03	1.8E-02	4.7E-04	3.6E-03	1.2E-02	3.2E-04	3.4E-03	1.2E-02	3.1E-04	7.8E-03	2.7E-02	7.0E-04
Pilgrim	5.6E-03	2.0E-02	6.0E-04	3.8E-03	1.3E-02	4.0E-04	3.7E-03	1.3E-02	3.9E-04	8.3E-03	2.9E-02	8.9E-04
Portsmouth	4.6E-03	1.6E-02	3.7E-04	3.1E-03	1.1E-02	2.5E-04	3.0E-03	1.1E-02	2.5E-04	6.9E-03	2.4E-02	5.6E-04
Quad Cities	3.4E-03	1.1E-02	2.1E-04	2.3E-03	7.4E-03	1.4E-04	2.2E-03	7.1E-03	1.4E-04	5.1E-03	1.6E-02	3.1E-04
Savannah River	5.1E-03	1.8E-02	5.1E-04	3.4E-03	1.2E-02	3.5E-04	3.3E-03	1.2E-02	3.4E-04	7.6E-03	2.7E-02	7.7E-04
Surry	5.4E-03	1.8E-02	4.9E-04	3.7E-03	1.2E-02	3.3E-04	3.6E-03	1.2E-02	3.2E-04	8.1E-03	2.7E-02	7.4E-04
Zion	3.7E-03	1.3E-02	2.6E-04	2.5E-03	8.5E-03	1.8E-04	2.5E-03	8.3E-03	1.7E-04	5.6E-03	1.9E-02	4.0E-04

Table H-24. (contd)

	Environmental Effects, Total Detrimental Health Effects per reactor year								
Reactor Type	IRIS			GT MHR			PBMR		
Reactor Site	Crew	Onlookers	Along Route	Crew	Onlookers	Along Route	Crew	Onlookers	Along Route
Braidwood	2.1E-03	7.2E-03	1.3E-04	2.0E-03	6.9E-03	1.2E-04	6.7E-04	2.3E-03	4.2E-05
Clinton	2.1E-03	7.2E-03	1.3E-04	2.0E-03	6.9E-03	1.3E-04	6.8E-04	2.3E-03	4.3E-05
FitzPatrick	2.9E-03	1.0E-02	2.8E-04	2.8E-03	9.9E-03	2.7E-04	9.4E-04	3.3E-03	9.1E-05
Grand Gulf	2.6E-03	8.3E-03	2.0E-04	2.5E-03	8.0E-03	2.0E-04	8.3E-04	2.7E-03	6.6E-05
North Anna	3.0E-03	1.0E-02	2.7E-04	2.9E-03	1.0E-02	2.6E-04	9.8E-04	3.4E-03	8.7E-05
Pilgrim	3.2E-03	1.1E-02	3.4E-04	3.1E-03	1.1E-02	3.3E-04	1.0E-03	3.7E-03	1.1E-04
Portsmouth	2.7E-03	9.3E-03	2.2E-04	2.6E-03	9.0E-03	2.1E-04	8.7E-04	3.0E-03	7.0E-05
Quad Cities	2.0E-03	6.3E-03	1.2E-04	1.9E-03	6.0E-03	1.2E-04	6.3E-04	2.0E-03	3.9E-05
Savannah River	2.9E-03	1.0E-02	3.0E-04	2.8E-03	1.0E-02	2.8E-04	9.5E-04	3.4E-03	9.6E-05
Surry	3.1E-03	1.0E-02	2.8E-04	3.0E-03	1.0E-02	2.7E-04	1.0E-03	3.4E-03	9.2E-05
Zion	2.2E-03	7.3E-03	1.5E-04	2.1E-03	7.0E-03	1.5E-04	7.0E-04	2.3E-03	5.0E-05

The results in Tables H-22 to H-24 are highly sensitive to the assumed dose rate emitted from the shipping cask. For conservatism, the regulatory maximum dose rate (10 mrem/hr at 2 m) was assumed in the RADTRAN 5 calculations (the dose rate can be no greater than that value). The shipping casks assumed in the Yucca Mountain EIS (DOE 2002b) were designed to transport spent fuel that has cooled for 5 years. In reality, most spent fuel will have cooled for much longer than 5 years before it is shipped to a geologic repository. Sprung et al. (2000) developed a probabilistic distribution of dose rates based on fuel cooling times that indicates that approximately three-fourths of the spent fuel to be transported to a geologic repository will have dose rates less than half of the regulatory limit. Consequently, the estimated population doses in Table H-22 could be divided in half if realistic dose rate projections are used.

Doses at truck stops have been found in many studies to be important contributors to public dose estimates. RADTRAN 5 parameters that are used to calculate doses at stops include the amount of stop time per trip, number of exposed people, and the dose rate (see Table H-20). The RADTRAN 5 stop model used here assumes that a 30-minute stop is made approximately every 4 hours for food, rest, refueling, and inspections. This assumption is conservative relative to the stop assumptions used in the Yucca Mountain EIS (DOE 2002), in which a 30-minute stop is assumed to occur every 845 km (approximately every 8 to 10 hours) and short duration (10 minutes) stops are made every 161 km (approximately every 2 hours). This equates to an approximate doubling of the number of truck stops for food and refueling relative to DOE (2002b).

Most of the stops made for actual spent fuel shipments are short duration stops (10 minutes) for brief visual inspections of the cargo (for example, checking the cask tie-downs). These stops typically occur in areas devoid of people, such as an overpass or freeway ramp in an unpopulated area. Therefore, doses to residents surrounding these types of stops are negligible. In DOE (2002b), close-proximity exposures (from 1 to 15.8 m from the cask) were not assumed to occur at the short-duration inspection stops. In this analysis, for the purpose of developing bounding estimates of environmental effects, close-proximity (1 to 10 m from cask) exposures at all truck stops were included in the RADTRAN 5 calculations. Since the numbers of stops in this analysis are effectively doubled relative to DOE (2002b), truck stop doses are also doubled. The doses to residents would also be lower; however, since doses to residents are two to three orders of magnitude (that is, a factor of 100 to 1000) less than the calculated close-proximity doses, this reduction does not affect the total stop dose.

The number of exposed persons at stops is higher in this analysis by about a factor of 1.5 relative to DOE (2002b) assumptions (6.9 persons in DOE 2002b versus 10 persons assumed in this analysis). Thus, the bounding doses calculated in this analysis are also a factor of 1.5 (10 divided by 6.9) greater than those given in DOE (2002b). Furthermore, empirical data provided in Griego et al. (1996) indicates that a 30-minute stop is toward the high end of the stop time distribution. Average stop times for food and refueling observed by Griego et al.

(1996) are on the order of 18 minutes. This amounts to another factor of 1.5 increase in stop doses calculated here relative to DOE (2002b).

Based on these observations, the staff concluded that the stop model used in this study over-estimates public doses at stops by at approximately a factor of four (factor of 2 for close-proximity exposure time at stops, factor of 1.5 for average stop time at food and refueling stops, and factor of 1.5 for the number of people in close-proximity to the shipping cask). Coupled with the factor of 2 reduction in shipping cask dose rates that result from fuel aging, the doses to onlookers at stops could be reduced to about one-eighth of the doses shown in Tables H-22 to H-24 [1/(2 x 1.5 x 1.5 x 2) ≈ 0.12] to reflect more realistic truck shipping conditions.

Based on the above, use of more realistic dose rates, shipping cask capacities, and truck stop model assumptions in the RADTRAN 5 calculations could substantially reduce the environmental effects presented in Tables H-22 to H-24.

Table H-25 provides a comparison between the radiological incident-free doses calculated in NUREG-0170 (NRC 1977) and those calculated here. The table also summarizes the key incident-free input parameters that were used in NUREG-0170 and this study. Comparisons are also made between the doses for spent fuel shipments in NUREG-0170 and doses calculated for a shipment from Quad Cities to a potential geologic repository at Yucca Mountain because the shipping distances are comparable (2530 km in NUREG-0170 versus 2853 km for Quad Cities to Yucca Mountain). As shown in the table, many parameters have changed over the years and the technical bases for them have improved. For example, the work of Griego et al. (1996) has improved the basis for assumptions about stop times and persons exposed at truck stops, and the TRAGIS computer code has improved the basis for shipping distances and population distributions along highway routes.

The incident-free impact at truck stops shown in the table has been adjusted as discussed above to reflect more realistic conditions than assumed in the bounding analysis. Adjustments were not made to the on-link, off-link, and crew doses shown in Table H-22. As shown, the adjusted doses in Table H-25 for spent fuel shipments from Quad Cities to potential geologic repository at the potential Yucca Mountain site are about a factor of 2 lower than the per-shipment doses from NUREG-0170 when the doses to and doses associated with in-transit storage from NUREG-0170 are excluded. Storage doses were excluded from this analysis because spent fuel shipments proceed directly from the reactor site to the potential Yucca Mountain site with no intermediate storage involved. Handler doses were excluded from this analysis because doses to workers that load the spent fuel cask at reactors and unload them at the potential repository the are treated as facility doses, not transportation doses, in recent National Environmental Policy Act of 1969 (NEPA) documents.

Table H-25. Comparison of Incident Free Doses from NUREG-0170 Spent Fuel Shipments and Spent Fuel Shipment from Quad-Cities to a Potential Geologic Repository at Yucca Mountain in this Analysis

Incident-Free Exposure Parameter	NUREG-0170 (NRC 1977)	This Study (Quad Cities to Yucca Mountain)[a]
One-Way Shipping Distance, km	2530	2853
Travel Fraction		
Urban	0.05	0.02
Suburban	0.05	0.12
Rural	0.9	0.86
Population Density along Highway, persons per km^2		
Urban	3861	2391.3
Suburban	719	310.2
Rural	6	9.1
Speed, km/hr		
Urban	24	88
Suburban	40	88
Rural	88	88
Traffic Count, vehicles/hr		
Urban	2800	2400
Suburban	780	760
Rural	470	530
Shipment Dose Rate, mrem/hr at 2 m	10	10
Crew Dose Rate, mrem/hr	2	Calculated (7.4 m from package)
Stop time, hr per trip		
Urban	2	3 hours per trip (30 minutes per 4 hours driving time)
Suburban	5	
Rural	1	

Table H-25. (contd)

Incident-Free Exposure Parameter	NUREG-0170 (NRC 1977)	This Study (Quad Cities to Yucca Mountain)[a]
Population Density at Stops (per km^2)		
Urban	3861	Distribution: 1 to 10 m - 30,000; 10 to 800 m - 340 (see Figure H-2)
Suburban	719	
Rural	6	
Person-rem/Shipment		
Crew	1.2E-01	4.8E-02
Off-link	1.5E-02	3.1E-03
On-link	7.4E-03	1.7E-02
Stops	1.9E-02	1.7E-02[b]
Total	1.6E-01	8.5E-02
Handlers + Storage	2.1E-01	Not Calculated
Grand Total	3.7E-01	8.5E-02

(a) Tables H-20 and H-21 provide the bases for these input parameters.
(b) Stop doses have been adjusted as described in the text to reflect more realistic assumptions than were used in the bounding analysis (Table H-22).

H.3.9 Transportation Accident Impacts

RADTRAN 5 assesses accident risk by combining the probabilities and consequences of accidents to produce a risk value. RADTRAN 5 considers a spectrum of potential transportation accidents, ranging from those with high frequencies and low consequences (for example, "fender benders") to those with low frequencies and high consequences (such as accidents in which the shipping container is exposed to severe mechanical and thermal conditions).

Radionuclide inventories are important parameters in the calculation of accident risks. The radionuclide inventories used in this analysis were taken directly from the Early Site Permit Environmental Report Sections and Supporting Data (DOE 2003). The report included hundreds of radionuclides for each advanced reactor type. A screening analysis was conducted to select the dominant contributors to accident risks to simplify the RADTRAN 5 calculations. The screening identifies the radionuclides that will contribute more than 99.999 percent of the dose from inhalation. A "sum-of-fractions" approach was used for this screening. First, the inventory of each radionuclide was multiplied by its respective inhalation dose conversion factor taken from FGR-13 (Eckerman et al. 2002). These values were then summed. Then, each inventory-conversion factor product was divided by the sum of the products to obtain the fraction of the total inhalation dose for each radionuclide. The resulting fractions were then sorted from largest to smallest, their cumulative contributions were calculated, and those that contributed to 99.999 percent of the inhalation dose potential were selected. Several gases, including H-3, Kr-85, and I-129, were added to the list because they are more easily released than the solid and semi-volatile species contained in the fuel. The inventories of radionuclides used in this study are shown in Table H-26. Note that the dominant radionuclides are approximately the same regardless of fuel type. Also note that adequate radionuclide inventory data was not given in INEEL (2003) for the ACR-700 and IRIS advanced reactors. It was also not provided in WASH-1238 for the reference LWR. Consequently, accident risks were not quantified for these plant types.

Massive shipping casks are used to transport spent fuel because of the heavy radiation shielding and accident resistance required by 10 CFR Part 71. Spent fuel shipping casks must be certified Type B packaging systems, meaning they must withstand a series of severe hypothetical accident conditions with essentially no loss of containment or shielding capability. The tests include a 9 m (30 ft) free drop onto an unyielding surface, drop onto a puncture probe, exposure to an engulfing 800°C fire for 30 minutes, and underwater immersion. According to Sprung et al. (2000), the probability of encountering accident conditions more severe than these tests that could lead to shipping cask failure are less than 0.01 percent of all accidents (that is, more than 99.99 percent of all accidents would not result in a release of radioactive material from the shipping cask). It was assumed that shipping casks for advanced reactor spent fuels will provide equivalent mechanical and thermal protection of the spent fuel cargo.

The RADTRAN 5 accident risk calculations were performed using unit radionuclide inventories (Ci/MTU) for the spent fuel shipments from the various reactor types. The resulting risk estimates were then multiplied by assumed annual spent fuel shipments (MTU/yr) to derive estimates of the annual accident risks associated with spent fuel shipments from each potential advanced reactor site. As was done for routine exposures, it was assumed that the numbers of shipments of spent fuel per year are equivalent to the annual discharge quantities. These are 32.76 MTU/yr for the ABWR and ESBWR, 24.4 MTU/yr for the surrogate AP1000, 6.8 MTU/yr for the four-module GT-MHR, and 8.3 MTU/yr for the eight-module PBMR. These data were taken from INEEL (2003) and have not been normalized to the reference LWR net electrical generation.

Route-specific accident rates (accidents per km) were derived for the RADTRAN 5 accident risk analysis. The approach used to develop accident rates for spent fuel shipments is as follows. The TRAGIS data provides estimates of the distance traveled in each state along a route and the type of highway (interstate, state highway, or other). Saricks and Tompkins (1999) provide accident rates for each state that are a function of highway type. The approach taken to estimate route-specific accident rates was to multiply the state-level accident or fatality rates by the distances traveled in each state on the corresponding highway type and then sum over all the states on each route. For example, for interstate highways, the interstate distances and interstate accident rates were used. For non-interstate highway travel, either the "Primary" or "Other" rates given by Saricks and Tompkins (1999) were used. This allowed computation of route-specific accident rates.

Table H-26. Radionuclide Inventories Used in the Transportation Accident Risk Calculations for Each Advanced Reactor Type

ABWR and ESBWR		Surrogate AP1000		GT-MHR		PBMR	
Radio-nuclide	Inventory, Ci/MTU	Radio-nuclide	Inventory, Ci/MTU	Radio-nuclide	Inventory, Ci/MTU	Radio-nuclide	Inventory, Ci/MTU
Am-241	1.34E+03	Am-241	7.27E+02	Am-241	2.21E+03	Am-241	2.04E+03
Am-242m	3.34E+01	Am-242m	1.31E+01	Am-242m	1.36E+01	Am-242m	2.30E+01
Am-243	3.24E+01	Am-243	3.34E+01	Am-243	1.39E+01	Am-243	1.29E+02
Ce-144	1.14E+04	Ce-144	8.87E+03	Ce-144	5.82E+04	Ce-144	3.22E+04
Cm-242	5.51E+01	Cm-242	2.83E+01	Cm-242	4.08E+01	Cm-242	7.52E+01
Cm-243	3.69E+01	Cm-243	3.07E+01	Cm-243	5.45E+00	Cm-243	5.29E+01
Cm-244	4.86E+03	Cm-244	7.75E+03	Cm-244	7.64E+02	Cm-244	1.48E+04
Cm-245	6.56E-01	Cm-245	1.21E+00	Cm-245	4.46E-03	Cm-245	1.43E+00
Co-60[(a)]	2.73E+03	Co-60	0.00E+00	Co-60	0.00E+00	Co-60	0.00E+00
Cs-134	4.81E+04	Cs-134	4.80E+04	Cs-134	5.98E+04	Cs-134	1.09E+05
Cs-137	1.24E+05	Cs-137	9.31E+04	Cs-137	2.93E+05	Cs-137	3.82E+05
Eu-154	1.03E+04	Eu-154	9.13E+03	Eu-154	8.72E+03	Eu-154	1.01E+04
Eu-155	5.22E+03	Eu-155	4.62E+03	Eu-155	2.37E+03	Eu-155	2.93E+03
Pm-147	3.37E+04	Pm-147	1.76E+04	Pm-147	1.87E+05	Pm-147	1.37E+05
Pu-238	6.14E+03	Pu-238	6.07E+03	Pu-238	3.17E+03	Pu-238	1.23E+04
Pu-239	3.87E+02	Pu-239	2.55E+02	Pu-239	6.07E+02	Pu-239	2.99E+02
Pu-240	6.15E+02	Pu-240	5.43E+02	Pu-240	1.07E+03	Pu-240	8.98E+02
Pu-241	1.22E+05	Pu-241	6.96E+04	Pu-241	2.25E+05	Pu-241	1.94E+05
Pu-242	2.24E+00	Pu-242	1.82E+00	Pu-242	4.21E+00	Pu-242	1.22E+01
Ru-106	1.64E+04	Ru-106	1.55E+04	Ru-106	4.01E+04	Ru-106	4.53E+04
Sb-125	5.37E+03	Sb-125	3.83E+03	Sb-125	5.96E+03	Sb-125	6.79E+03
Sr-90	8.85E+04	Sr-90	6.19E+04	Sr-90	2.42E+05	Sr-90	2.92E+05
Y-90	8.85E+04	Y-90	6.19E+04	Y-90	2.42E+05	Y-90	2.92E+05

(a) Co-60 is an activation product. Only the ABWR/ESBWR submittal in INEEL (2003) provided inventory data for activation products.

Transportation accident risk analysis in RADTRAN 5 is performed using an accident severity and package release model. The user can define up to 30 severity categories, with each category increasing in magnitude. Severity categories are related to fire, puncture, crush, and immersion environments created in vehicular accidents. For this analysis, the 19 severity categories defined in NUREG/CR-6672 (Sprung et al. 2000) were adopted.

Each severity category has an assigned conditional probability (or the probability, given an accident occurs that it will be of the specified severity). The accident scenarios are further defined by allowing the user to input release fractions and aerosol and respirable fractions for each severity category. These fractions are a function of the physical-chemical properties of the materials being transported as well as the mechanical and thermal accident conditions that define the severity categories. The severity and release fractions used here are presented in Table H-27.

The severity categories and release fractions in Sprung et al. (2000) were designed specifically to address accidents involving current generation LWR fuel and the current generation of spent fuel shipping casks. While some of the advanced reactor fuel designs are similar to the current generation (for example, the ABWR, ESBWR, surrogate AP1000, ACR-700, and IRIS), others are significantly different, including the GT-MHR, and PBMR. Extrapolating the current generation of fuel and shipping casks to advanced reactor fuels and shipping casks is relatively straightforward since the fuel form, cladding, physical and mechanical properties, are similar. Furthermore, substantial experimental data exists to develop technically defensible release fractions for various radionuclide groups (for example, gases, semi-volatiles such as cesium and ruthenium, and particulates). However, detailed experimental studies of releases from GT-MHR, and PBMR fuels have not been conducted, so there are significant uncertainties about potential release quantities from these fuels. For this assessment, release fractions for current generation LWR fuels were used to approximate the impact from the advanced reactor spent fuel shipments. This essentially assumes that the fuel materials and containment systems (cladding, fuel coatings) behave similarly to current LWR fuel under applied mechanical and thermal conditions. Due to the lack of data on gas-cooled reactor fuels, it is currently not known if this approach is bounding. This approach will have to be evaluated at the construction permit/ combined license stage. However, gas-cooled reactors are designed to operate at much higher temperatures than LWRs and thus high temperature conditions anticipated in transportation accident fires should have less of an effect on radionuclide releases than they do for LWR fuels. Thus, smaller release fractions are anticipated for advanced gas-cooled reactor fuels than for LWR fuels subjected to thermal transients.

For accidents that result in a release of radioactive material, RADTRAN 5 assumes the material is dispersed into the environment according to standard Gaussian diffusion models. The code allows the user to choose two different methods for modeling the atmospheric transport of radionuclides after a potential accident. The user can either input Pasquill atmospheric-stability category data or averaged time-integrated concentrations. In this analysis, the default standard cloud option (using time-integrated concentrations) was used.

RADTRAN 5 calculates the population dose from the released radioactive material for five possible exposure pathways. These pathways are:

- External dose from exposure to the passing cloud of radioactive material.

Table H-27. Severity and Release Fractions Used to Model Spent Fuel Transportation Accidents (Sprung et al. 2000)

Severity Category	Severity Fraction[a]	Release Fractions[b]				
		Gas	Cesium	Ruthenium	Particulates	Crud
1	1.53E-08	0.8	2.4E-08	6.0E-07	6.0E-07	2.0E-03
2	5.88E-05	0.14	4.1E-09	1.0E-07	1.0E-07	1.4E-03
3	1.81E-06	0.18	5.4E-09	1.3E-07	1.3E-07	1.8E-03
4	7.49E-08	0.84	3.6E-05	3.8E-06	3.8E-06	3.2E-03
5	4.65E-07	0.43	1.3E-08	3.2E-07	3.2E-07	1.8E-03
6	3.31E-09	0.49	1.5E-08	3.7E-07	3.7E-07	2.1E-03
7	0	0.85	2.7E-05	2.1E-06	2.1E-06	3.1E-03
8	1.13E-08	0.82	2.4E-08	6.1E-07	6.1E-07	2.0E-02
9	8.03E-11	0.89	2.7E-08	6.7E-07	6.7E-07	2.2E-03
10	0	0.91	5.9E-06	6.8E-07	6.8E-07	2.5E-03
11	1.44E-10	0.82	2.4E-08	6.1E-07	6.1E-07	2.0E-03
12	1.02E-12	0.89	2.7E-08	6.7E-07	6.7E-07	2.2E-03
13	0	0.91	5.9E-06	6.8E-07	6.8E-07	2.5E-03
14	7.49E-11	0.84	9.6E-05	8.4E-05	1.8E-05	6.4E-03
15	0	0.85	5.5E-05	5.0E-05	9.0E-06	5.9E-03
16	0	0.91	5.9E-06	6.4E-06	6.8E-07	3.3E-03
17	0	0.91	5.9E-06	6.4E-06	6.8E-07	3.3E-03
18	5.86E-06	0.84	1.7E-05	6.7E-08	6.7E-08	2.5E-03
19	0.99993	0	0	0	0	0

(a) Severity fractions are the conditional probabilities, given the occurrence of an accident, that the mechanical and thermal conditions experienced by a spent fuel shipping cask are within the conditions defined by the Severity Category. See Sprung et al. (2000) for detailed information about the derivation of these data.
(b) RADTRAN5 also models the fraction of the released material that is of small enough particle size to be dispersible in prevailing wind conditions and the fraction that is respirable. For this analysis, these parameters were set to 1.0 (100 percent dispersible and 100 percent respirable).

- External dose from radionuclides deposited on the ground by the passing plume. The analysis included the radiation exposures from this pathway even though the area surrounding a potential accidental release would be evacuated and decontaminated, thus preventing long-term exposures from this pathway.

- Internal dose from inhalation of airborne radioactive contaminants.

- Internal dose from radioactive materials that were deposited on the ground and the resuspended. The analysis included the radiation exposures from this pathway even though evacuation and decontamination of the area surrounding a potential accidental release would prevent long-term exposures.

- Internal dose from ingestion of contaminated food. The analysis assumed interdiction of foodstuffs and evacuation after an accident so no internal dose due to ingestion of contaminated foods was calculated.

A sixth pathway, external doses arising from increased radiation fields surrounding a shipping cask with damaged shielding, was considered, but not included in the analysis. It is possible that shielding materials incorporated into the cask structures could become damaged as a result of an accident. For example, casks with lead shielding could undergo a slumping phenomenon in which impact or fire causes gaps to form in the lead. Radiation would penetrate through the gaps in the shielding at higher intensities, leading to higher radiation dose rates. These are commonly referred to as Loss of Shielding (LOS) events. They were not included in this assessment because their contribution to spent fuel transportation risks is much smaller than the dispersal accident risks.

Standard radionuclide uptake and dosimetry models are incorporated into RADTRAN 5. The computer code combines the accident consequences and frequencies of each severity category, sums up the severity categories, and then integrates across all the shipments. Accident-risk impact that is provided in the form of a collective population dose (person-rem over the entire shipping campaign) is then converted to population risk using health-effects conversion factors. The dose to risk factors, which were taken from Federal Guidance Report 13 (Eckerman et al. 2002), assume 6.0E-04 LCFs per person-rem and 8.5E-04 total detrimental health effects per person-rem for workers and the general public. Total detriment includes fatal and non-fatal cancers and severe hereditary effects.

The shipping distances and population distribution information for the routes used for the evaluation of the impact of incident-free transportation (see Table H-19) was also used to calculate transportation impact. Representative shipping casks described above were assumed.

Table H-28 presents unit (per MTU) accident risks associated with transportation of spent fuel from each potential advanced reactor site to the potential Yucca Mountain HLW repository. Projected annual accident risks, normalized to the WASH-1238 reference LWR net electrical generation (880 MW(e)) are presented in Table H-29. As expected, accident risks are highest for the longest shipments. Also, consistent with past spent fuel transportation risk assessments, the human health impact associated with routine (incident-free) transportation is several orders of magnitude greater than accident risks.

Table H-28. Unit Spent Fuel Transportation Accident Risks for Advanced Reactors

	Advanced Reactor Type			
Site	**ABWR/ESBWR**	**Surrogate AP1000**	**GT-MHR**	**PBMR**
Population Dose, person-rem/MTU				
Braidwood	1.1E-05	1.0E-06	1.5E-06	2.5E-06
Clinton	5.1E-05	1.0E-06	1.5E-06	2.6E-06
FitzPatrick	1.9E-05	1.7E-06	2.5E-06	4.3E-06
Grand Gulf	2.1E-05	1.9E-06	2.8E-06	4.7E-06
North Anna	2.3E-05	2.1E-06	3.2E-06	5.4E-06
Pilgrim	4.0E-05	3.7E-06	5.8E-06	9.3E-06
Portsmouth	2.6E-05	2.1E-06	3.1E-06	5.2E-06
Quad Cities	1.0E-05	9.4E-07	1.4E-06	1.4E-06
Savannah River	2.6E-05	2.4E-06	3.6E-06	6.1E-06
Surry	2.4E-05	2.2E-06	3.3E-06	5.6E-06
Zion	1.5E-05	1.4E-06	2.1E-06	3.5E-06
Latent Cancer Fatalities per MTU				
Braidwood	6.7E-09	6.0E-10	8.9E-10	1.5E-09
Clinton	3.1E-08	6.1E-10	9.1E-10	1.5E-09
FitzPatrick	1.1E-08	1.0E-09	1.5E-09	2.6E-09
Grand Gulf	1.2E-08	1.1E-09	1.7E-09	2.8E-09
North Anna	1.4E-08	1.3E-09	1.9E-09	3.2E-09
Pilgrim	2.4E-08	2.2E-09	3.5E-09	5.6E-09
Portsmouth	1.5E-08	1.2E-09	1.8E-09	3.1E-09
Quad Cities	6.2E-09	5.6E-10	8.4E-10	8.4E-10
Savannah River	1.6E-08	1.4E-09	2.2E-09	3.7E-09
Surry	1.4E-08	1.3E-09	2.0E-09	3.3E-09
Zion	9.0E-09	8.2E-10	1.2E-09	2.1E-09
Total Detrimental Health Effects per MTU				
Braidwood	9.4E-09	8.5E-10	1.3E-09	2.2E-09
Clinton	4.3E-08	8.6E-10	1.3E-09	2.2E-09
FitzPatrick	1.6E-08	1.4E-09	2.2E-09	3.7E-09
Grand Gulf	1.7E-08	1.6E-09	2.4E-09	4.0E-09

Table H-28. (contd)

	Advanced Reactor Type			
Site	**ABWR/ESBWR**	**Surrogate AP1000**	**GT-MHR**	**PBMR**
North Anna	2.0E-08	1.8E-09	2.7E-09	4.6E-09
Pilgrim	3.4E-08	3.1E-09	5.0E-09	7.9E-09
Portsmouth	2.2E-08	1.7E-09	2.6E-09	4.4E-09
Quad Cities	8.8E-09	8.0E-10	1.2E-09	1.2E-09
Savannah River	2.2E-08	2.0E-09	3.1E-09	5.2E-09
Surry	2.0E-08	1.9E-09	2.8E-09	4.7E-09
Zion	1.3E-08	1.2E-09	1.7E-09	3.0E-09

Considering the uncertainties in the data and computational methods, the overall transportation accident risks associated with ABWR, ESBWR, surrogate AP1000, GT-MHR, and PBMR spent fuel shipments are judged to be small. Although likely to also be small, accident risks associated with IRIS and ACR-700 spent fuel shipments could not be analyzed due to lack of radionuclide source term data. Additional analyses are necessary to quantify the impact of IRIS and ACR-700 spent fuel shipments.

For perspective, there are approximately 725,000 persons that live within 800 m of the route between the North Anna ESP site and the potential Yucca Mountain (800 m is the distance on either side of the route used by RADTRAN 5 to compute the routine repository site doses to the population along the route). According to the U.S. Centers for Disease Control and Prevention, the cancer mortality rate in the United States in 2001 was 194.4 fatalities per 100,000 persons (NCHS 2004). Using this rate, one would expect there to be about 1400 cancer fatalities per year from among the 725,000 people along the route between the North Anna ESP site and the potential Yucca Mountain repository site. This is many orders of magnitude greater than the annual accident risk values presented in Table H-29. Therefore, no increase in environmental effects of spent-fuel transportation accidents are expected as a result of shipping spent fuel from ESP sites to the potential Yucca Mountain spent fuel disposal facility.

Table H-29. Annual Spent Fuel Transportation Accident Impacts for Advanced Reactors, Normalized to Reference Light Water Reactor Net Electrical Generation

	Advanced Reactor Type			
	ABWR/ESBWR	Surrogate AP1000	GT-MHR	PBMR
MTU/yr	20.3	19.7	6.0	5.8
Population Dose, person-rem/yr				
Braidwood	2.2E-04	2.0E-05	8.9E-06	1.5E-05
Clinton	1.0E-03	2.0E-05	9.0E-06	1.5E-05
FitzPatrick	3.8E-04	3.3E-05	1.5E-05	2.5E-05
Grand Gulf	4.2E-04	3.7E-05	1.7E-05	2.7E-05
North Anna	4.7E-04	4.2E-05	1.9E-05	3.1E-05
Pilgrim	8.1E-04	7.2E-05	3.5E-05	5.4E-05
Portsmouth	5.2E-04	4.0E-05	1.8E-05	3.0E-05
Quad Cities	2.1E-04	1.8E-05	8.4E-06	8.2E-06
Savannah River	5.3E-04	4.7E-05	2.1E-05	3.5E-05
Surry	4.8E-04	4.3E-05	2.0E-05	3.2E-05
Zion	3.0E-04	2.7E-05	1.2E-05	2.0E-05
Latent Cancer Fatalities per Year				
Braidwood	1.3E-07	1.2E-08	5.3E-09	8.8E-09
Clinton	6.2E-07	1.2E-08	5.4E-09	8.9E-09
FitzPatrick	2.3E-07	2.0E-08	9.1E-09	1.5E-08
Grand Gulf	2.5E-07	2.2E-08	1.0E-08	1.6E-08
North Anna	2.8E-07	2.5E-08	1.1E-08	1.9E-08
Pilgrim	4.9E-07	4.3E-08	2.1E-08	3.3E-08
Portsmouth	3.1E-07	2.4E-08	1.1E-08	1.8E-08
Quad Cities	1.3E-07	1.1E-08	5.0E-09	4.9E-09
Savannah River	3.2E-07	2.8E-08	1.3E-08	2.1E-08
Surry	2.9E-07	2.6E-08	1.2E-08	1.9E-08
Zion	1.8E-07	1.6E-08	7.3E-09	1.2E-08
Total Detrimental Health Effects per Year				
Braidwood	1.9E-07	1.7E-08	7.6E-09	1.3E-08

Table H-29. (contd)

	Advanced Reactor Type			
	ABWR/ESBWR	Surrogate AP1000	GT-MHR	PBMR
Clinton	8.8E-07	1.7E-08	7.7E-09	1.3E-08
FitzPatrick	3.2E-07	2.8E-08	1.3E-08	2.1E-08
Grand Gulf	3.5E-07	3.1E-08	1.4E-08	2.3E-08
North Anna	4.0E-07	3.6E-08	1.6E-08	2.7E-08
Pilgrim	6.9E-07	6.1E-08	3.0E-08	4.6E-08
Portsmouth	4.4E-07	3.4E-08	1.6E-08	2.6E-08
Quad Cities	1.8E-07	1.6E-08	7.1E-09	6.9E-09
Savannah River	4.5E-07	4.0E-08	1.8E-08	3.0E-08
Surry	4.1E-07	3.7E-08	1.7E-08	2.7E-08
Zion	2.6E-07	2.3E-08	1.0E-08	1.7E-08

H.3.10 Shipment of Radioactive Waste

This section discusses the environmental effects of transporting radioactive waste from ESP sites. The environmental conditions listed in 10 CFR 51.52 that apply to shipments of radioactive waste are:

- Radioactive waste (except spent fuel) is packaged and in a solid form.
- Radioactive waste (except spent fuel) is shipped from the reactor by truck or rail.

INEEL (2003) indicates that all of the advanced reactor technologies will transport their radioactive waste by truck. Furthermore, INEEL (2003) indicates that all of the advanced reactor technologies plan to solidify and package their radioactive waste. In addition, all of the advanced reactor technologies will be subject to NRC (10 CFR Part 71) and Department of Transportation (DOT, 49 CFR Parts 173 and 178) regulations for the shipment of radioactive material.

Table S–4 also specifies the following limits that apply to shipment of radioactive waste:

- Weight – less than 73,000 lbs. per truck or 100 tons per cask per railcar
- Traffic density – less than one truck shipment per day or 3 railcars per month.

The advanced reactor technologies would be capable of shipping their radioactive wastes in compliance with Federal or State weight restrictions. With respect to the traffic density, all of the advanced reactor vendors provided radioactive waste generation estimates. Table H-30 provides these estimates, in addition to the radioactive waste generation estimates for the reference LWR in WASH-1238.

Table H-30. Summary of Radioactive Waste Shipments for Advanced Reactors

Reactor Type	INEEL (2003) Waste Generation Information	Annual Waste Volume, m^3/yr per site	Electrical Output, MW(e)/site	Normalized Rate, m^3/ 1100 MW(e) Plant (880 MW(e) net)[(a)]	Shipments/ 1100 MW(e) (880 MW(e) net) Electrical Output[(b)]
Reference LWR (WASH-1238)	3800 ft^3/yr per unit	108	1100	108	46
ABWR	100 m^3/yr per unit	100	1500	62	27
ESBWR	100 m^3/yr per unit	100	1500	62	27
Surrogate AP1000	1964 ft^3/yr per unit	56	1150	45	20
ACR-700	47.5 m^3/yr per unit	47.5	731	64	28
IRIS	870 ft^3/yr per unit	74(3 units)	1005 (3 units)	67	29
GT-MHR	98 m^3/yr (4 unit plant)	98 (4 units)	1140 (4 units)	86	37[(c)]
PBMR	100 drums/yr per unit	168 (8 units)	1320 (8 units)	118	51[(c)]

Conversions: 1 m^3 = 35.31 ft^3. Drum volume = 210 liters (0.21 m^3).

(a) Capacity factors used to normalize the waste generations rates to an equivalent electrical generation output are given in Table H-16 for each reactor type. All are normalized to 880 MW(e) net electrical output (1100 MW(e) plant with an 80 percent capacity factor).

(b) The number of shipments per 1100 MW(e) was calculated assuming the WASH-1238 average waste shipment capacity of 2.34 m^3 per shipment (108 m^3/yr divided by 46 shipments/yr).

(c) INEEL (2003) states that 90 percent of the waste could be shipped on trucks carrying 28 m^3 (1000 ft^3) of waste and the remaining 10 percent in shipments carrying 5.7 m^3 (200 ft^3) of radioactive waste. This would result in 6 to 7 shipments per year after normalization to the reference LWR electrical output.

As shown in the table, only the PBMR generates a larger volume of radioactive waste than the reference LWR in WASH-1238. However, the GT-MHR and PBMR information in INEEL (2003) assumed the wastes generated from those designs would be shipped using two different packaging systems: one that hauls 28.3 m^3/shipment (1000 ft^3 per shipment) and one that hauls

5.7 m^3/shipment (200 ft^3 per shipment). Under those conditions, the number of shipments of radioactive waste per year, normalized to 1100 MW(e) electric generation capacity, would be about six shipments/year per 1100 MW(e) (880 net MW(e)) for the GT-MHR and seven shipments/year per 1100 MW(e) for the PBMR. These estimates are well below the reference LWR (42 shipments/yr per 1100 MW(e)). In any event, all the estimates are well below the 1 truck shipment per day condition given in 10 CFR 51.52 Table S–4. Doubling the shipment estimates to account for empty return shipments is still well below the 1 shipment per day condition.

H.4 References

10 CFR Part 51. Code of Federal Regulations, Title 10, Energy, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 71. Code of Federal Regulations, Title 10, Energy, Part 71, "Packaging and Transportation of Radioactive Material."

49 CFR Part 173. Code of Federal Regulations. Title 49, *Transportation,* Part 173, "Shippers - General Requirements for Shipments and Packages."

49 CFR Part 178. Code of Federal Regulations. Title 49, *Transportation,* Part 178, "Specifications for Packages."

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Appendix I

Plant Parameter Envelope (PPE) Values

Appendix I

Plant Parameter Envelope (PPE) Values

This appendix contains the System Energy Resources, Inc. (SERI), Plant Parameter Envelope (PPE) for the proposed Grand Gulf early site permit site as submitted in the *Site Safety Analysis Report* as Table 1.3-1 and reproduced here as Table I-1.

Table I-1. PPE for the Grand Gulf Early Site Permit (ESP) Facility

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TABLE 1.3-1

PLANT PARAMETERS ENVELOPE (PPE)

PPE Section	Composite Value[1]	Comments	Value[2]
2. Normal Plant Heat Sink			
2.3 Condenser			
2.3.2 Condenser / Heat Exchanger Duty	10.7 E9 Btu/hr		US
2.4 NHS Cooling Towers – Mechanical Draft (Natural Draft) (See Note 3)			
2.4.6 (2.5.6) Cycles of Concentration	4		US
2.4.8 (2.5.8) Height	60 ft (475 ft)		US
2.4.9 (2.5.9) Makeup Flow Rate	47,900 gpm expected (78,000 gpm max)		TP
2.4.12 (2.5.12) Cooling Water Flow Rate	865,000 gpm		US
5. Potable Water/Sanitary Waste System			
5.2 Raw Water Requirements			
5.2.1 Maximum Use	240 gpm		TP
5.2.2 Monthly Average Use	180 gpm		TP
6 Demineralized Water System			
6.2 Raw Water Requirements			
6.2.1 Maximum Use	1440 gpm		TP
6.2.2 Monthly Average Use	1100 gpm		TP
7 Fire Protection System			
7.1 Raw Water Requirements			
7.1.1 Maximum Use	1890 gpm		TP
7.1.2 Monthly Average Use	(30 gpm)		TP
9. Unit Vent/Airborne Effluent Release Point			
9.4 Release Point			
9.4.2 Elevation (Normal)	Ground level		US
9.4.3 Elevation (Post Accident)	Ground level		US
9.4.4 Minimum Distance to Site Boundary	0.52 mi (841 m) exclusion area		US

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TABLE 1.3-2

NORMAL OPERATIONS GASEOUS RELEASE SOURCE TERM[1]

Radionuclide	Composite Normal Release[2] (Ci/yr)	Radionuclide	Composite Normal Release[2] (Ci/yr)
Kr-83m	1.68E-03	Rb-89	8.65E-05
Kr-85m	7.20E+01	Sr-89	1.14E-02
Kr-85	8.20E+03	Sr-90	3.60E-03
Kr-87	5.03E+01	Y-90	9.19E-05
Kr-88	9.20E+01	Sr-91	2.00E-03
Kr-89	4.81E+02	Sr-92	1.57E-03
Kr-90	6.49E-04	Y-91	4.81E-04
Xe-131m	3.60E+03	Y-92	1.24E-03
Xe-133m	1.74E+02	Y-93	2.22E-03
Xe-133	9.20E+03	Zr-95	3.19E-03
Xe-135m	8.11E+02	Nb-95	1.68E-02
Xe-135	9.19E+02	Mo-99	1.19E-01
Xe-137	1.03E+03	Tc-99m	5.95E-04
Xe-138	8.65E+02	Ru-103	7.03E-03
Xe-139	8.11E-04	Rh-103m	2.22E-04
I-131	5.19E-01	Ru-106	2.34E-04
I-132	4.38E+00	Rh-106	3.78E-05
I-133	3.41E+00	Ag-110m	4.00E-06
I-134	7.57E+00	Sb-124	3.62E-04
I-135	4.81E+00	Sb-125	1.83E-04
C-14	2.19E+01	Te-129m	4.38E-04
Na-24	8.11E-03	Te-131m	1.51E-04
P-32	1.84E-03	Te-132	3.78E-05
Ar-41	1.02E+02	Cs-134	1.24E-02
Cr-51	7.03E-02	Cs-136	1.19E-03
Mn-54	1.08E-02	Cs-137	1.89E-02
Mn-56	7.03E-03	Cs-138	3.41E-04
Fe-55	1.30E-02	Ba-140	5.41E-02
Co-57	2.46E-05	La-140	3.62E-03
Co-58	6.90E-02	Ce-141	1.84E-02
Fe-59	1.62E-03	Ce-144	3.78E-05
Co-60	2.61E-02	Pr-144	3.78E-05
Ni-63	1.30E-05	W-187	3.78E-04
Cu-64	2.00E-02	Np-239	2.38E-02
Zn-65	2.22E-02		
		Total without Tritium	25,639
		Tritium (H-3)	7.06E+03
		Total with Tritium	32,699

NOTES:

1. See PPE Table 1.3-1, Section 9.5.
2. Composite source term based on highest radionuclide release for all plant types considered.

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TABLE 1.3-1 (Continued)

PPE Section		Composite Value[1]	Comments	Value[2]
9.5	Source Term			
9.5.1	Gaseous (Normal)	32,699 Ci/yr	See TABLE 1.3-2	TP
9.5.2	Gaseous (Post-Accident)	Based on limiting DBAs	See Note 4	US
9.5.3	Tritium	7060 Ci/yr		TP
17.	Plant Characteristics			
17.3	Megawatts Thermal	4300 MWt	Includes allowance for ~10% uprate from 3926 MWt.	US
18.	Construction			
18.4	Plant Population			
18.4.1	Construction	3150 people max		US

NOTES:

1. The "Composite Value" provides an envelope (bounding values) for design parameters for the various plant designs considered for the site. See Site Safety Analysis Report Section 1.3 for a discussion of the basis for parameter values.
2. "Value" pertains to the "Composite Value" for each parameter listed. In this table, a value designated "US" represents a "unit specific" value, meaning that it is applied per unit, or group of units or modules. A designation of "TP" is given to a value that represents total facility requirements. See Site Safety Analysis Report Section 1.3 for a discussion of the basis for parameter values.
3. Several main condenser cooling system alternatives were considered (i.e., mechanical and natural draft cooling towers, cooling ponds, and once-through cooling).
   - The once through cooling option was eliminated due to significant environmental impact.
   - The cooling pond option was eliminated due to insufficient GGNS site acreage to accommodate pond.
4. In general, source terms for any given accident are those used by the vendors in their safety analyses. The methodologies used by the Vendors for establishing source terms include those established in TID-14844 and Regulatory Guide 1.183. See SSAR Sections 3.3.2 and 3.3.3 for additional detail on accident selection and source term methods.

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TABLE 1.4-1

CONFORMANCE WITH NRC REGULATORY GUIDES AND GUIDANCE

Regulatory Guide No.	Title	Rev.	Date	SSAR Para. Reference
1.3	Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Boiling Water Reactors	2	6/74	2.3.2.3, 3.3.4.10
1.23	Onsite Meteorological Programs	-	2/72	2.3.2, 2.3.3, 2.3.4.2
1.25	Assumptions Used for Evaluating the Potential Radiological Consequences of a Fuel Handling Accident in the Fuel Handling and Storage Facility for Boiling and Pressurized Water Reactors	-	3/72	3.3.4.13
1.59	Design Basis Flood for Nuclear Power Plants	2	8/77[1]	2.4.2.2, 2.4.2.3, 2.4.2.3.3.2.1.2, 2.4.3
1.70	Standard format and Content of Safety Analysis Reports for Nuclear Power Plants	3	11/78	1.1, 1.4
1.76	Design Basis Tornado for Nuclear Power Plants	-	4/74	2.3.1.4[2]
1.77	Assumptions Used for Evaluating a Control Rod Ejection Accident for Pressurized Water Reactors	-	5/74	3.3.4.3
1.78	Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release	-	6/74[3]	2.2.3.1.2
1.91	Evaluations of Explosions Postulated To Occur on Transportation Routes Near Nuclear Power Plants	1	2/78	2.2.3.1.1, 3.1.5
1.95	Protection of Nuclear Power Plant Control Room Operators Against An Accidental Chlorine Release	1	1/77[4]	2.2.3.1.2

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TABLE 1.3-3 (Continued)

Parameter	Units	Definition	Bounding Value (Notes)
9.4.3 Elevation (Post Accident)	Feet	The elevation above finished grade of the release point for accident sequence releases.	3
9.4.4 Minimum Distance to Site Boundary	Feet	The minimum lateral distance from the release point to the site boundary	3
9.5 Source Term			
9.5.1 Gaseous (Normal)	Curies per year	The annual activity, by isotope, contained in routine plant airborne effluent streams.	2
9.5.2 Gaseous (Post-Accident)	Curies	The activity, by isotope, activity contained in post-accident airborne effluents.	1
9.5.3 Tritium	Curies per year	The annual activity of tritium contained in routine plant airborne effluent streams.	2
17. Plant Characteristics			
17.3 Megawatts Thermal	Mega-watts	The maximum thermal power generated by a single unit or group of units/modules of a specific reactor plant type	2
18. Construction			
18.4 Plant Population			
18.4.1 Construction	Persons	The number of people required to construct the plant.	2

NOTES:

1. The Bounding Value is the maximum value for any of the plant designs being considered for the site.
2. The Bounding Value is the maximum value for any of the plant design/number of unit combinations being considered for the site.
3. The Bounding Value is the minimum value for any of the plant designs being considered for the site.

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TABLE 1.3-3

PLANT PARAMETERS DEFINITIONS

Parameter	Units	Definition	Bounding Value (Notes)
2. Normal Plant Heat Sink			
2.3 Condenser			
2.3.2 Condenser / Heat Exchanger Duty	BTU per hour	Design value for the waste heat rejected to the circulating water system across the normal heat sink condensers.	2
2.4 (2.5) NHS Cooling Towers (Mechanical Draft or Natural Draft)			
2.4.6 (2.5.6) Cycles of Concentration	Number of cycles	The ratio of total dissolved solids in the cooling water blowdown streams to the total dissolved solids in the makeup water streams.	1
2.4.8 (2.5.8) Height	Feet	The vertical height above finished grade of either natural draft or mechanical draft cooling towers associated with the cooling water systems.	1
2.4.9 (2.5.9) Makeup Flow Rate	Gallons per minute	The expected (and maximum) rate of removal of water from a natural source to replace water losses from closed cooling water systems.	2
2.4.12 (2.5.12) Cooling Water Flow Rate	Gallons per minute	The total cooling water flow rate through the normal heat sink condensers/heat exchangers.	1
5. Potable Water/Sanitary Waste System **5.2 Raw Water Requirements**			
5.2.1 Maximum Use	Gallons per minute	The maximum short-term rate of withdrawal from the water source for the potable and sanitary waste water systems.	2
5.2.2 Monthly Average Use	Gallons per minute	The average rate of withdrawal from the water source for the potable and sanitary waste water systems.	2
6. Demineralized Water System **6.2 Raw Water Requirements**			
6.2.1 Maximum Use	Gallons per minute	The maximum short-term rate of withdrawal from the water source for the demineralized water system.	2
6.2.2 Monthly Average Use	Gallons per minute	The average rate of withdrawal from the water source for the demineralized water system.	2
7. Fire Protection System			
7.1 Raw Water Requirements			
7.1.1 Maximum Use	Gallons per minute	The maximum short-term rate of withdrawal from the water source for the fire protection water system.	2
7.1.2 Monthly Average Use	Gallons per minute	The average rate of withdrawal from the water source for the fire protection water system.	2
9. Unit Vent/Airborne Effluent Release Point			
9.4 Release Point			
9.4.2 Elevation (Normal Operation)	Feet	The elevation above finished grade of the release point for routine operational releases.	3

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TABLE 1.4-1 (Continued)

Regulatory Guide No.	Title	Rev.	Date	SSAR Para. Reference
1.109	Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I	1	10/77	3.2.1, 3.2.2, 3.2.3
1.111	Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors	1	7/77	2.3.5.2, 3.2.1
1.132	Site Investigation for Foundations of Nuclear Power Plants	1	3/79[3]	2.5.1, 2.5.4
1.138	Laboratory Investigations of Soils for Engineering Analyses and Design of Nuclear Power Plants	-	4/78[4]	2.5.1
1.145	Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants	1	11/82[*]	2.3.4
1.165	Identification and Characterization of Seismic Sources and Determination Safe Shutdown Earthquake Ground Motion	-	3/97	2.5.1
1.183	Alternative Radiological Source Terms For Evaluating Design Basis Accidents At Nuclear Power Reactors	-	7/00	3.3.1, 3.3.2, 3.3.3
DG-1105	Procedures and Criteria for Assessing Seismic Soil Liquefaction at Nuclear Power Plant Sites	-	3/01	2.5.1

NOTES:

[1] As updated by the errata published July 30, 1980.

[2] Using later data from the National Severe Storms Forecast Center, and Regulatory Guide 1.76 methodology, the NRC developed an interim position, establishing an update to the design basis tornado characteristics. The NRC's updated criteria were described in its safety evaluation, dated March 25, 1988. The design basis tornado characteristics defined for this project, as listed in Section 2.3.1.4, are based on the NRC's interim position.

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TABLE 1.4-1 (Continued)

3 Regulatory Guide 1.78 (June 1974) is the licensing basis for GGNS Unit 1 and is listed here as a matter of completeness since this guide is discussed in SSAR Section 2.2.3.1.2 involving analyses performed for Unit 1. Subsequent analyses performed for the proposed facility, once the design is established at COL, will address the latest applicable guidance for control room habitability with regards to postulated hazardous chemical releases.

4 The NRC withdrew Regulatory Guide 1.95 in January 2002. Toxic gas analyses described in the GGNS UFSAR and in SSAR 2.2.3.1.2 utilized Reg. Guide 1.95 (Rev. 1). As in the case of Regulatory Guide 1.78, Regulatory Guide 1.95 (Rev. 1) is listed here as a matter of completeness. Subsequent analyses performed for the proposed facility, once the design is established at COL, will address the latest applicable guidance for control room habitability with regards to postulated chlorine releases.

5 Draft guidance contained in the proposed revision to Regulatory Guide 1.132 (DG-1101, February 2002) was also followed. See Sections 2.5.1 and 2.5.4.

6 Draft guidance contained in the proposed revision to Regulatory Guide 1.138 (DG-1109, August 2001) was also followed. See Section 2.5.1.

7 As corrected, per the reissued guide (February 1983) to correct page 1.145-7.

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Appendix J

System Energy Resources, Inc. (SERI) Commitments and Assumptions Relevant to the Analysis of Impact

Appendix J

System Energy Resources, Inc. (SERI) Commitments and Assumptions Relevant to the Analysis of Impact

Throughout the environmental report supporting the Grand Gulf Early Site Permit (ESP) application (SERI 2003c), System Energy Resources, Inc. (SERI) provides:

(1) commitments to address certain issues in the design, construction, and operation of the facility

(2) statements of planned compliance with current laws, regulations, and requirements

(3) commitments to future activities and actions that it will take should it decide to apply for a construction permit (CP) or combined operating license (COL)

(4) descriptions of SERI's estimate of the environmental impacts resulting from the construction and operation of a new nuclear unit or units on the Grand Gulf ESP site

(5) descriptions of SERI's estimates of future activities and actions of others and the likely environmental impacts of those activities and actions that would be expected should SERI decide to apply for a CP or COL.

Those statements are discussed throughout this environmental impact statement (EIS) and are listed in this Appendix.[a] Some of those statements considered by the staff in determining the level of impacts to a resource are related to matters that are within SERI's control. Table J-1 lists those matters that were considered in the staff's evaluation of the environmental impacts related to the construction and operation of a new nuclear unit or units at the Grand Gulf ESP site. The table shows the technical area where the matter is addressed in the EIS, and SERI's statement that addresses the matter. Table J-2 lists statements related to likely activities and actions of others that were considered by the staff.

In some cases the same statement or similar statements are made in more than one place in the environmental report. Where statements contain essentially the same information, the location of the more comprehensive statements are listed first in the table, and the text provided is the text from that location.

(a) The listings are not intended to be a complete list of the commitments described in the SERI environmental report.

Table J-1. Statements Made in the Environmental Report Related to Future Actions and Activities by SERI and the Impacts of Those Activities Considered in the Staff's Analysis

Technical Area	Environmental Report Statement
Land Use	System Energy Resources, Inc. (SERI) has acquired and will maintain surface ownership of all the land within the GGNS plant site property boundary, with the following exceptions.
Land Use	This portion of the switchyard would be used, with modifications.
Land Use	The existing transmission lines would be utilized for a new facility.
Land Use	The power transmission and distribution (T&D) system existing at the time of the new facility startup and operation will be relied upon to distribute the electricity generated by a new facility at Grand Gulf.
Land Use	Construction of the new facility will result in some alterations. Some of these alterations are unavoidable and irreversible; others are unavoidable but subject to improvement.
Land Use	Once the facility design is finalized, appropriate analyses of transmission and distribution system adequacy will be made.
Land Use	To support transport of heavy materials and equipment to the site, new rail service will likely be required.
Land Use	It is anticipated that operation of a new facility will have minimal impact on land use at the site or in the vicinity of the site.
Land Use	There will be no new impacts created as a result of operation of a new facility with regards to maintenance of transmission corridors rights-of-way.
Land Use	The Normal Plant Heat Sink (NHS) that will be used to dissipate heat from the turbine cycle for the new facility will utilize cooling towers to dissipate the heat directly to the atmosphere.
Land Use	The heat dissipation system for the NHS for the new facility will use either natural draft cooling towers (NDCTs) or linear mechanical draft cooling towers (LMDCTs).
Land Use	The towers will use drift eliminators to minimize the amount of water lost from the towers via drift.
Land Use	Road improvement and construction projects...planned... will help ameliorate traffic problems associated with the proposed facility.

Table J-1. (contd)

Technical Area	Environmental Report Statement
Meteorology and Air Quality	The Normal Plant Heat Sink (NHS) that will be used to dissipate heat from the turbine cycle for the new facility will utilize cooling towers to dissipate the heat directly to the atmosphere.
Meteorology and Air Quality	The heat dissipation system for the NHS for the new facility will use either natural draft cooling towers (NDCTs) or linear mechanical draft cooling towers (LMDCTs).
Meteorology and Air Quality	The cycles of concentration for the NHS circulating water is expected to be a maximum of 4, which will result in the concentrations in the circulating water being 4 times that of river water.
Meteorology and Air Quality	SACTI model predicts that the majority of the fogging due to the operation of the LMDCTs will be confined to within about ½ mile (800 m) to the south to southeast of the towers with occasional fogging (approximately 2 hrs/yr) up to about ¾ mile (1200 m) to the south to southeast of the towers (this area is entirely within the property boundary of the site). Therefore, it is predicted that the operation of the LMDCTs will result in limited increased fogging at the site.
Meteorology and Air Quality	The towers will use drift eliminators to minimize the amount of water lost from the towers via drifts.
Meteorology and Air Quality	Two types of cooling systems will be considered for a new facility at the GGNS ESP Site
Meteorology and Air Quality	A closed cooling system with cooling towers will likely be utilized for the normal heat sink.
Meteorology and Air Quality	Gaseous emissions will be within regulatory guidelines set by Federal and State agencies.
Meteorology and Air Quality	The meteorological monitoring program will be the same throughout the pre-construction and operational phases of the project. The monitoring program will simply be a continuation of the ongoing meteorological monitoring program for the GGNS Unit 1 facility.
Ecology	It will be required to coordinate with the Corps of Engineers and/or other appropriate regulatory agencies and obtain permits for construction of the embayment and intake structure when the final design of the intake structure and its exact location are defined. The design and placement of the embayment and intake structure will be in accordance with the Corps guidance, MDEQ and EPA requirements, and good engineering practice.

Table J-1. (contd)

	Technical Area	Environmental Report Statement
1	Ecology	The normal heat sink circulating water system for the new facility will be a closed-cycle type system using either hyperbolic natural draft cooling towers or mechanical draft cooling towers.
2	Ecology	The design and placement of the embayment and intake structure will be in accordance with the Corps of Engineers guidance, MDEQ and EPA requirements, and good engineering practice.
3	Ecology	The Corps of Engineers has completed revetments along the east and west river banks... It is expected that these measures will stabilize the Mississippi River shoreline near the site.
4	Ecology	This portion of the switchyard would be used, with modifications.
5	Ecology	The existing transmission lines would be utilized for a new facility.
6	Ecology	Plant makeup (cooling tower makeup and other raw water needs) for a new facility would be supplied from the Mississippi River via an intake structure located on the east bank of the river.
7	Ecology	The Corps of Engineers continues to evaluate the need for additional shoreline work, and would be expected to make improvements as considered appropriate. However, those actions would not be expected to impact site suitability.
8	Ecology	Makeup to the normal heat sink cooling towers, balance of plant cooling systems (e.g., plant service water), and other raw water makeup needs for a new facility would be supplied by an intake structure located on the east bank of the Mississippi River.
9	Ecology	The new facility owner would be required to coordinate with the Corps of Engineers and obtain permits from appropriate regulatory agencies for construction of the embayment and intake structure when the final design of the embayment and intake structure and its exact location are defined.
10	Ecology	Makeup (cooling tower makeup and other raw water needs) for a new facility would be supplied from the Mississippi River
11	Ecology	Eagles nesting on site would be largely protected from shooting, development and habitat alteration, and other human disturbance that usually accounts for mortality and reduced breeding success elsewhere.
12	Ecology	Other than the installation of additional revetments along the east bank, no significant changes to the river channel or banks which would be expected to alter the ecological characteristics of this riparian habitat have occurred.

Table J-1. (contd)

	Technical Area	Environmental Report Statement
1	Ecology	Makeup water to the cooling tower(s) and supply or makeup water for the SWS will be withdrawn directly from the Mississippi River through an intake structure on the river shore.
2	Ecology	The power transmission and distribution (T&D) system existing at the time of the new facility startup and operation will be relied upon to distribute the electricity generated by a new facility at Grand Gulf.
3	Ecology	When the specific facility design, the expected electrical output, the need for power, and primary market location(s) are established, the adequacy of the existing (at that time) T&D system to support the new facility will be determined.
4	Ecology	Construction activities to be conducted within a floodplain on the site would be the water intake structure and embayment along with other items that are a part of that water intake facility. This water intake will be located at or near the existing barge slip area.
5	Ecology	Once the facility design is finalized, appropriate analyses of transmission and distribution system adequacy will be made.
6	Ecology	Traffic on Grand Gulf Road will increase substantially during the peak construction period, and will be at its peak during the morning and evening shift changes. Noise in the general area will increase from this increased traffic but the increases will be temporary, and will only occur as indicated twice per day, during the week.
7	Ecology	The new facility will require a small amount of water withdrawal relative to normal river flow; makeup flow requirements are estimated at approximately 85,000 gpm.
8	Ecology	There is little potential that operation of the cooling system intake for a new facility at the GGNS ESP Site will impact any such areas. (wildlife)
9	Ecology	The Normal Plant Heat Sink (NHS) that will be used to dissipate heat from the turbine cycle for the new facility will utilize cooling towers to dissipate the heat directly to the atmosphere.
10	Ecology	The heat dissipation system for the NHS for the new facility will use either natural draft cooling towers (NDCTs) or linear mechanical draft cooling towers (LMDCTs).
11	Ecology	Two types of cooling systems will be considered for a new facility at the GGNS ESP Site: natural draft cooling towers and mechanical draft cooling towers.

Table J-1. (contd)

	Technical Area	Environmental Report Statement
1	Ecology	Environmental measurements and monitoring of terrestrial and aquatic ecology at the Grand Gulf Nuclear Station (GGNS) site will be divided into four phases: • Pre-application (CP/COL) Monitoring • Site Preparation and Construction Monitoring • Pre-operational Monitoring • Operational Monitoring
2	Ecology	GGNS ESP Site will not be substantially different from the acceptable environmental impacts identified for the previously analyzed sites.
3	Ecology	SMALL - Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
4	Ecology	(Coal) Additional ecological impact will occur due to land use related to mining of coal and limestone. Substantially greater impacts expected, relative to that required for uranium mining and reprocessing.
5	Socioeconomics	(Combined Cycle Natural Gas) Additional ecological impact will occur due to land use related to gas wells and collection stations; expected to be proportionally higher than that related to uranium mining and reprocessing.
6	Socioeconomics	Emergency planning responsibilities are assigned to a number of departments and agencies. Federal, state and local officials will implement appropriate protective actions in case of an emergency.
7	Socioeconomics	A highway construction plan to extend the present path of Highway 18 is in the early planning stages. This proposed extension will connect Highway 18 to Grand Gulf Road, providing additional access to the GGNS site.
8	Socioeconomics	Plant makeup (cooling tower makeup and other raw water needs) for a new facility would be supplied from the Mississippi River via an intake structure located on the east bank of the river.
9	Socioeconomics	Emergency cooling water (ultimate heat sink) for a new facility would be provided from closed-cooling systems which utilizes enclosed basins with mechanical draft cooling towers, or similar heat removal mechanisms, and would not be reliant on the source of water from the river intake, with the possible exception of normal.
10	Socioeconomics	Depending on the type of plant (merchant plant which would be unregulated, or a regulated – by the Public Service Commissions (PSC) of Mississippi and Louisiana - plant) the tax structure may be similar to the above for GGNS Unit 1 (for a regulated plant), or be some mutually agreeable amount for an unregulated merchant plant.
11	Socioeconomics	The actual mode of shipment will be determined by DOE and may include either rail or truck shipments. (Socio assumed no rail).

Table J-1. (contd)

	Technical Area	Environmental Report Statement
1	Socioeconomics	Construction of the cooling towers will have minimal impact on the surroundings. Based on the previous survey and the above calculations, construction noise levels during construction of a new facility at the GGNS ESP site will have minimal impacts on the surrounding populace.
2	Socioeconomics	Complying with applicable OSHA noise regulations will ensure that the impact on construction workers is considered to be small.
3	Socioeconomics	Provide required mitigative measures for noise which may, on a short term basis, exceed this guidance.
4	Socioeconomics	Traffic on Grand Gulf Road will increase substantially during the peak construction period, and will be at its peak during the morning and evening shift changes. Noise in the general area will increase from this increased traffic but the increases will be increase from this increased traffic but the increases will be temporary, and will only occur as indicated twice per day, during the week.
5	Socioeconomics	Many of the short-term employees will likely travel to the area unaccompanied by family members.
6	Socioeconomics	Rural setting of the site and the premise that the majority of the work force will emanate from the surrounding more populated areas and communities away from the site, it is likely a large portion of these new business and jobs would be temporary.
7	Socioeconomics	Location of a new facility will be several hundred feet or more away from the protected area boundary, and about 1000 feet from the Unit 1 Turbine Building, the radiation levels due to N-16 skyshine are expected to be essentially background levels, similar to those readings obtained at TLDs located on the west/northwest side of the plant protected area boundary.
8	Socioeconomics	U.S. 61 S is two-lane improved roadway - will be 4-lane, divided freeway within 2 years like U.S. 61 N from Port Gibson
9	Socioeconomics	SACTI model predicts that the majority of the fogging due to the operation of the LMDCTs will be confined to within about ½ mile (800 m) to the south to southeast of the towers with occasional fogging (approximately 2 hrs/yr) up to about ¾ mile (1200 m) to occasional fogging (approximately 2 hrs/yr) up to about ¾ mile (1200 m) to the south to southeast of the towers (this area is entirely within the property boundary of the site). Therefore, it is predicted that the operation of the LMDCTs will result in limited increased fogging at the site.

Table J-1. (contd)

	Technical Area	Environmental Report Statement
1	Socioeconomics	Road improvement and construction projects...planned... will help ameliorate traffic problems associated with the proposed facility.
2	Socioeconomics	While the proposed project's workforce and construction time period are greater than that of the gas plant, the impacts will be short term and mitigated by dispersion over several relatively populous counties and improved transportation routes.
3	Human Health	(under unavoidable adverse impacts) Facility workforce will add to road network traffic load with an associated increase in traffic accidents. Road improvements and flexible work schedules will mitigate this impact to a certain extent.
4	Human Health	(Potential Mitigation Measures) Several road improvement and construction projects have been accomplished or planned for GGNS area. These projects will help ameliorate traffic problems associated with the proposed new facility.
5	Human Health	Liquid radwaste system design will be such that water which is discharged to the environment shall result in radioactive releases which conform to the "as low as reasonably achievable" requirements of 10 CFR 50.34a.
6	Human Health	Gaseous radwaste system design, including ventilation systems exhaust systems, will be such that radioactive gases which are discharged to the environment from these systems shall result in radioactive releases which conform to the "as low as reasonably achievable" requirements of 10 CFR 50.34a.
7	Human Health	The LWR technologies being considered will solidify and package their radioactive waste.
8	Human Health	In all likelihood, the decay time will be at least ten years and probably even longer.
9	Human Health	The actual mode of shipment will be determined by DOE and may include either rail or truck shipments.
10	Human Health	The gas-cooled technologies being considered will solidify and package their radioactive waste.
11	Human Health	The gascooled reactor technologies will make far fewer shipments. The GT-MHR will need only 6 shipments while the PBMR will require 9 shipments annually.

Table J-1. (contd)

Technical Area	Environmental Report Statement
Human Health	In the case of decay heat, both of the gas-cooled reactor technologies will generate fewer watts per MTU at time of shipment, and fewer kW per truck cask at time of shipment. The fuel inventory will be discussed as part of the remaining two characteristics that were exceeded: actinide inventory and krypton-85 inventory.
Human Health	Location of a new facility will be several hundred feet or more away from the protected area boundary, and about 1000 feet from the Unit 1 Turbine Building, the radiation levels due to N-16 skyshine are expected to be essentially background levels, similar skyshine are expected to be essentially background levels, similar to those readings obtained at TLDs located on the west/northwest side of the plant protected area boundary.
Human Health	These areas are several hundred feet from the protected area boundary, which will result in a substantial reduction in the dose rate due to distance from the source of the radiation.
Human Health	It is expected that the dose rates in these two constructions areas will be at or very near background levels.
Human Health	The doses they receive from background radiation will be more significant than N-16 shine doses.
Human Health	Implementation of a radiation environmental monitoring program for the new facility, compliance with requirements for maintaining dose ALARA, and attention to design of plant shielding to ensure dose is ALARA, will result in doses to the public and to construction workers due to direct radiation being minimal.

Table J-2. Key Assumptions Used by the Staff in Assessing Environmental Impacts at the Grand Gulf Early Site Permit Site

Technical Area	Assumption
Alternatives	Alternative coal and natural gas fired plants would be located at the ESP site
Alternatives	For a combined energy alternatives option, the staff assessed 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.
Historic and Cultural Resources	Applicant will develop a procedure for reviewing ground disturbing activities for potential impacts to cultural resources.
Historic and Cultural Resources	Applicant will follow procedure.
Historic and Cultural Resources	Applicant will perform surveys of areas identified by SHPO Office, if those areas are selected for construction.
Water	If the groundwater source proves inadequate then the plant could treat water from the Mississippi River instead of groundwater.
Water	Applicant will do the tests to prove the aquifer is suitable.
Land Use	ESP Site wholly contained within GGNS Site.
Land Use	The construction footprint will align with ER Figure 2.1-2.
Land Use	FERC will study the land use impacts of any potential transmission upgrade request.
Land Use	Transmission corridors are 200 feet in width.
Land Use	Transmission upgrades would utilize only existing corridors and rights-of-way.
Land Use	No comprehensive or land-use plans currently exist to guide development in Claiborne County, Mississippi.
Land Use	No significant agriculture, crops, or dairy production are located at or immediately near the GGNS site.

Table J-2. (contd)

Technical Area	Assumption
Land Use	GGNS barge slip would require dredging.
Land Use	Dredge spoils and other fill would be disposed of or utilized within the GGNS site.
Land Use	GGNS heavy haul road would require repair and reconditioning.
Land Use	No 3rd party mining activities would ever be possible at the ESP site.
Land Use	No rail transportation would be developed or reactivated in support of construction activities.
Land Use	Salt drift from any cooling tower design will be localized and well below NRC guidance thresholds.
Land Use	Induced housing effects of construction and operations would be dispersed across urbanized areas of southwestern and central Mississippi.
Land Use	Applicant would abide by all relevant regulations pertaining to ground disturbing activities, wetlands protection, etc.
Land Use	The ESP facility center point is E684017.28 m and N3543266.06 m (UTM Zone 15N, NAD83).
Meteorology and Air Quality	Meteorological data from the site presented in various tables in the ER and RAI responses are reasonably representative of the site (except for wind data). Only the wind data for 2001-2003 are assumed to be representative.
Meteorology and Air Quality	Meteorological data for Vicksburg and Jackson are representative of the region.
Meteorology and Air Quality	Air quality in the vicinity of GGNS is better than that in more urban areas in the region (e.g., Jackson).
Meteorology and Air Quality	Air emissions from the ESP facility would be bounded by those listed in the ER.
Meteorology and Air Quality	Meteorological monitoring will continue with appropriate maintenance and quality assurance.
Meteorology and Air Quality	The ESP facility, if built, would have greater generating capacity than can be handled by the existing transmission system.
Meteorology and Air Quality	New transmission lines would follow existing corridors and rights-of-way.

Table J-2. (contd)

Technical Area	Assumption
Meteorology and Air Quality	SERI would use aggressive dust control measures during construction and operation.
Meteorology and Air Quality	If transportation impacts occur during construction, SERI would take mitigative measures to minimize the impacts.
Meteorology and Air Quality	Various measures outlined in the ER would be followed to limit air quality impacts of construction.
Meteorology and Air Quality	Cooling towers would have drift eliminators that are comparable in effectiveness to the drift eliminators in current generation cooling towers.
Meteorology and Air Quality	New transmission lines would be built to current industry and regulatory standards.
Meteorology and Air Quality	Population growth in the vicinity of the site would not alter the population distribution in the region.
Meteorology and Air Quality	There have been no noteworthy environmental alterations on the Grand Gulf site since construction of the GGNS Unit 1 plant that contribute significantly to the existing patterns of plant and animal communities.
Ecology	The ecological descriptions in the Grand Gulf final environmental report (MP&L 1973) adequately describe current conditions at the Grand Gulf site in general.
Ecology	Because the two subspecies, American black bear (*Ursus americanus luteolus*) and Louisiana black bear (*U. a. americanus*), are indistinguishable by sight, it was conservatively assumed that all sightings in the vicinity of the Grand Gulf site were of the Louisiana black bear.
Ecology	It was assumed that resident Louisiana black bears likely still inhabit the Grand Gulf site.
Ecology	It was assumed that the presence/absence of Louisiana black bears the Grand Gulf site would be established via field surveys prior to construction.
Ecology	Wetlands on the Grand Gulf site and transmission line corridors that are impacted by construction would be restored.
Ecology	It was assumed that the amount of upland forest on the Grand Gulf site that would be lost to permanent structures and facilities – could be estimated by applying the proportion of the total disturbance (including for permanent facilities and temporary construction areas) in upland habitats attributable to hardwood forests to the total acreage dedicated to permanent structures and facilities in all uplands habitats.

Table J-2. (contd)

	Technical Area	Assumption
1	Ecology	Weedy plant species invasion in areas of the Grand Gulf site disturbed by construction would likely decelerate, or entirely prevent hardwood forest succession.
2	Ecology	The existing GGNS Unit 1 transmission and distribution system would be relied on to transmit electricity generated by a new nuclear unit(s). The same assumption was made for the existing transmission and distribution systems at the alternate sites.
3	Ecology	The existing GGNS Unit 1 transmission and distribution system would have to be upgraded in order to be able to transmit electricity generated by a new nuclear unit(s). The same assumption was made for the existing transmission and distribution systems at the alternate sites.
4	Ecology	Any upgrades (e.g., addition of new transmission lines) to the existing GGNS Unit 1 transmission and distribution system would be sited within the existing corridors, and no new corridors would be needed. The same assumption was made for upgrades to the existing transmission and distribution systems at the alternate sites.
5	Ecology	It was assumed that doubling the width of the existing GGNS Unit 1 transmission corridors would be required to accommodate any transmission and distribution system upgrades (e.g., addition of new transmission lines). The same assumption was made for upgrades to the existing transmission and distribution systems at the alternate sites.
6	Ecology	It was assumed that the nature of any upgrades to the existing GGNS Unit 1 transmission and distribution system and associated terrestrial and aquatic ecological impacts would be definitively determined by the transmission and distribution system owner and operator prior to or during the CP or COL stage.
7	Ecology	Temporary construction areas in forest habitat would be reforested/restored.
8	Ecology	Right-of-way clearing and waste disposal methods for expansion of the GGNS Unit 1 transmission corridors would likely be dictated in by land owner requirements. However, absent direction from the property owner(s), clearing and waste disposal would be done in accordance with industry guidelines and best practices.
9	Ecology	Construction of the Grand Gulf ESP facility would be done according to Federal and State regulations, permit conditions, and best management practices.

Table J-2. (contd)

	Technical Area	Assumption
1	Ecology	Fugitive dust would be minimized by watering the access roads and the construction site as necessary.
2	Ecology	Heavy construction equipment would undergo scheduled equipment maintenance procedures.
3	Ecology	It is assumed that a separation distance of about 732 m (2400 ft) would be required to reduce maximum construction noise levels (69 to 98 decibels at 15 m [50 ft]) to 65 decibels (well below the 80 to 85 dBA threshold at which birds and small mammals are startled or frightened).
4	Ecology	Wildlife have presumably become accustomed to typical operating facility noise levels at the GGNS Unit 1 plant.
5	Ecology	Distributing the increased traffic volume during construction over time and space (i.e., by timing the two shift changes of construction workers so they do not overlap those of the GGNS Unit 1 personnel, and by the proposed extension that would connect State Highway 18 from Port Gibson to Grand Gulf Road) would be expected to increase rather than decrease traffic-related wildlife mortalities, because more unique wildlife-vehicle encounters would be likely.
6	Ecology	Modifications and upgrades would be made to equipment in the switchyard of GGNS Unit 1.
7	Ecology	The new cooling tower(s) for the Grand Gulf ESP facility would produce salt concentrations similar to cooling towers at existing nuclear power plants. The same assumption was made for new cooling tower(s) at River Bend and FiztPatrick (but not Pilgrim because salt water would be drawn).
8	Ecology	Noise from operating natural or mechanical draft cooling towers at the Grand Gulf ESP site would not be likely to disturb wildlife beyond the site perimeter fence, over 305 m (1000 ft) from the source. The same assumption was made for new cooling tower(s) at the alternate sites.
9	Ecology	Existing access roads for the current GGNS Unit 1 transmission corridors would be sufficient for use in any expanded corridor and no new roads would be required.
10	Ecology	The same vegetation management practices currently in effect for the existing GGNS Unit 1 transmission corridors would be applied to any expanded corridors associated with the Grand Gulf ESP facility. The same assumption was made for any expanded corridors at the alternate sites.

Table J-2. (contd)

	Technical Area	Assumption
1	Ecology	Additional transmission lines for the Grand Gulf ESP facility would likely present few new opportunities for bird collisions. The same assumption was made for additional transmission lines for an ESP plant at the alternate sites.
2	Ecology	The additional number of bird collisions due to the addition of transmission lines for the Grand Gulf ESP facility would not be expected to cause a measurable reduction in local bird populations. The same assumption was made for additional transmission lines at the alternate sites.
3	Ecology	EMFs would be the same in transmission corridors expanded (doubled in width due to addition of new lines) for the Grand Gulf ESP facility, except that they would occur over twice the area. The same assumption was made for EMFs in expanded transmission corridors at the alternate sites.
4	Ecology	There has been a relatively small loss of terrestrial animal and plant species due to agricultural conversion in the region surrounding the Grand Gulf ESP site.
5	Ecology	Removal of terrestrial habitat types for an ESP facility at the River Bend site would occur in the same proportions as those removed for the existing River Bend plant.
6	Ecology	An ESP facility at the Pilgrim site would be located on the western part of the site.
7	Ecology	An ESP facility at the FitzPatrick site would be located on the northeastern and/or southern part of the site.
8	Ecology	State- and Federal-listed species known to occur within 16 km (10 mi) of the Grand Gulf site were assumed to potentially occur onsite based on habitat affinities, if such habitats were represented onsite. The same assumption was made for the alternate sites.
9	Ecology	The applicant will work with the Mississippi Department of Environmental Quality to develop and implement any aquatic monitoring programs necessary for regulation of water quality and the protection of aquatic resources.
10	Ecology	The PPE proposed for the cooling water system will meet the performance standards specified in 66 FR 65255 and 69 FR 41576.
11	Ecology	Prior to issuance of the COL, the applicant would be required to collect sufficient temperature data to a variety of locations and a variety of stream conditions to calibrate the CORMIX model.

Table J-2. (contd)

	Technical Area	Assumption
1	Ecology	Per the discussion in the ER, the staff assumed that 50% of the workforce would come from the 80 km zone surrounding the plant, with almost all immigrating personnel and families living in Vicksburg, suburban Jackson, and Natchez. The staff also did the impact analysis under the alternative assumption that personnel and families would be distributed the same as the current plant-related population for GGNS.
2	Socioeconomics	The staff identified two ways in which a new nuclear plant might be treated for property tax purposes. If the plant were a merchant plant, it might be taxed as an ordinary taxable business asset, taxable by Claiborne County. The other possibility is that the State of Mississippi might decide to tax the asset instead, and provide some share of the funds back to the county and to the city of Port Gibson. The staff did the analysis both ways.
3	Socioeconomics	The staff relied on the applicant's statement in a reply to an RAI that they had no plans to restore the former rail spur to the GG ESP site. This implies that large items and bulk materials would come in by barge, or by truck. SERI also said that a rail spur could not be precluded.
4	Socioeconomics	The staff assumed that most (70%) plant workers would come from the local area, including Baton Rouge, per Entergy Nuclear's site selection report. Any new immigrating workers were assumed to live in or near Baton Rouge.
5	Socioeconomics	The staff assumed the plant would be taxed as an ordinary taxable business asset, taxable by West Feliciana Parish.
6	Socioeconomics	The staff identified some Louisiana government plans to upgrade some of the roads near the River Bend plant. The staff assumed that there are no other plans to upgrade roads.
7	Socioeconomics	The staff found no Massachusetts government plans to upgrade any of the roads near the Pilgrim plant. The staff assumed that there are none.
8	Socioeconomics	Per discussions with local officials, the staff assumed the plant would be subject to a PILOT agreement, with a negotiated tax base, and taxable by Plymouth.
9	Socioeconomics	The staff assumed that most plant workers (75%) would come from the local area, including Boston, per Entergy Nuclear's site selection report. Any new immigrating workers were assumed to not live in Plymouth due to housing shortages.
10	Socioeconomics	The staff identified some New York government plans to upgrade some of the roads near the FitzPatrick plant. The staff assumed that there are no other plans to upgrade roads.

Table J-2. (contd)

	Technical Area	Assumption
1	Socioeconomics	Per discussions with local officials, the staff assumed the plant would be subject to a PILOT agreement, with a negotiated tax base, and taxable by Oswego County, City of Scriba and the local school district (Mexico).
2	Socioeconomics	The staff assumed that most plant workers (70%) would come from the local area, per Entergy Nuclear's site selection report. Any new immigrating workers were assumed to live in all towns in the region, including Oswego, Franklin, Syracuse, and Rome-Utica.

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10. SUPPLEMENTARY NOTES

Docket Number 52-009

11. ABSTRACT *(200 words or less)*

This draft environmental impact statement (DEIS) has been prepared in response to an application submitted to the NRC by System Energy Resources, Inc. (SERI) for an early site permit (ESP) for the Grand Gulf ESP site located adjacent to the Grand Gulf Nuclear Generating Station, Unit 1, in Claiborne County, Mississippi. The ESP does not authorize construction or operation of a nuclear power plant.

The staff's preliminary recommendation to the Commission related to the environmental aspects of the proposed action is that the ESP should be issued. This recommendation is based on (1) the application, including the environmental report (ER) submitted by SERI; (2) consultation with Federal, State, Tribal, and local agencies; (3) the staff's independent review; (4) the staff's consideration of comments related to the environmental review that were received during the scoping process; (5) the assessments summarized in this DEIS; and (6) the staff's conclusion in this DEIS that there are no environmentally preferable or obviously superior alternative sites.

12. KEY WORDS/DESCRIPTORS *(List words or phrases that will assist researchers in locating the report.)*

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