Grand Gulf Nuclear Station

Unit 3

Combined
License
Application

Part 3: Environmental Report

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ACRONYMS AND ABBREVIATIONS

Terms	Definitions
ADS	Automatic Depressurization System
AECL	Atomic Energy of Canada, Limited
AHS	Auxiliary Heat Sink
AST	Alternate Source Term
BMP	Best Management Practices
BTA	Best Technology Available
CAA	Clean Air Act
CCN	Certificate of Convenience and Necessity
CEED	Center for Energy and Economic Development
CIRC	Circulating Water System
COLA	COL Application
CORMIX	Cornell Mixing Zone Expert System
DBH	Diameter at Breast Height
EAB	Exclusion Area Boundary
EAI	Entergy Arkansas Inc.
EEI	Edison Electric Institute
EES	Entergy Electric System
EGSL	Entergy Gulf States Louisiana LLC
EHV	Extra High Voltage
EIS	Environmental Impact Statement
EIV	Early In-Vessel
ELL	Entergy Louisiana LLC
EMI	Entergy Mississippi Inc.
EMI	Entergy Mississippi Inc.
ENO	Entergy New Orleans Inc.
EOI	Entergy Operations Inc.
EPA	U.S. Environmental Protection Agency

Terms	Definitions
EPP	Environmental Protection Plan
ESRP	Environmental Standard Review Plan
ETI	Entergy Texas Inc.
FAA	Federal Aviation Administration
GDCS	Gravity-Driven Cooling System
IC	Isolation Condenser
ISB	Intra-System Billing
LWR	Light-Water-Cooled Reactor
MNHP	Mississippi Natural Heritage Program
MPSC	Mississippi Public Service Commission
MSLB	Main Steam Line Break
NAPEE	National Action Plan for Energy Efficiency
NEPA	National Environmental Policy Act
NESC	National Electric Safety Code
NHPA	National Historic Preservation Act
NIEHS	National Institute of Environmental Health Sciences
NLCD	National Land Cover Dataset
NPHS	Normal Power Heat Sink
NRHP	National Register of Historic Places
O&M	Operation and Maintenance
OECD	Organization for Economic Co-operation and Development
OPCO	Operating Companies
PCCS	Passive Containment Cooling System
PPA	Purchased Power
PSDAR	Post-Shutdown Decommissioning Activities Report
PSWS	Plant service water system
PWS	Potable Water System
QA	Quality Assurance

Terms	Definitions
RAI	Request for Additonal Information
RCCWS	Reactor Component Cooling Water System
RWCU	Reactor Water Clean-Up
ROI	Radius of Influence
SAMA	Severe Accident Mitigation Alternative
SAMDA	Severe Accident Mitigation Design Alternative
SDC	Shutdown Cooling
SERC	Southeastern Electric Reliability Corporation
SHPO	State Historic Preservation Officer
SIS	System Impact Study
SPCC	Spill Protection, Control, and Countermeasures
SPO	System Planning and Operations
SPP-ICT	Southwest Power Pool - Independent Coordinator of Transmission
SSRP	Strategic Supply Resource Plan
SWS	Station Water System
TCCWS	Turbine Component Cooling Water System
UC	University of Chicago
UPC	Usage Per Customer
USDA	U.S. Department of Agriculture
USHR	U. S. House of Representatives

CHAPTER 1 INTRODUCTION

This environmental report (ER), as Part 3 of a Combined License Application (COLA), is submitted by (the Applicant) Entergy Operations, Inc. (EOI) on behalf of itself; Entergy Mississippi, Inc. (EMI); Entergy Louisiana, LLC (ELL); Entergy Gulf States Louisiana, LLC (EGSL); and System Energy Resources, Inc. (SERI).

Entergy Operations, Inc. (EOI) will construct and operate GGNS Unit 3; EOI will not have ownership interest is GGNS Unit 3. EOI has been authorized to act as agent for EMI, ELL, EGSL, and SERI.

In October 2003, SERI submitted its application to the NRC for an Early Site Permit (ESP), requesting that a site within the existing GGNS site boundaries be found suitable for the construction and operation of a new nuclear power generating facility and that the NRC issue an ESP for the proposed site, identified as the Grand Gulf ESP Site, co-located with the existing Unit 1. The NRC's analysis of environmental impacts of constructing and operating one or more new nuclear units at the Grand Gulf ESP Site (or at alternative sites) was documented in its environmental impact statement, NUREG-1817. The NRC issued the requested ESP to SERI on April 5, 2007 (Reference 201). SERI's ESP stage environmental report, submitted as part of its application, is referred to in this report as the "ESP ER."

The majority of environmental and siting issues were addressed and resolved in the ESP proceeding using the guidance in NUREG-1555 (the Environmental Standard Review Plan [ESRP], October1999) and RS-002 (Processing Applications For Early Site Permits). While Regulatory Guide 4.2 (Rev. 2, 1976) was considered in preparing the ESP ER, the ESRP and RS-002 were used as the current NRC guidance. Similarly, the ESRP has been used in the Combined License (COL) ER as the current guidance for addressing environmental issues discussed in this report. The ESRP is considered the most current and appropriate source of NRC staff guidance for this report regarding format and content. The content guidelines outlined in the ESRP are generally consistent with the guidance contained in RG 4.2. None of the other Division 4 regulatory guides are applicable to the supplemental analyses presented in this ER.

In accordance with 10 CFR 51.50(c)(1), this Environmental Report – Combined License Stage incorporates by reference the assessment of environmental issues that were resolved in the ESP proceeding and provides, where necessary, the following supplemental information:

i. Information demonstrating that the design of the facility falls within the site characteristics and design parameters specified in the GGNS ESP;

ii. Information resolving any significant environmental issue that was not resolved in the GGNS ESP proceeding;

iii. Any new and significant information for issues related to the impacts of construction and operation of the facility that were resolved in the GGNS ESP proceeding;

iv. A description of the process used to identify new and significant information regarding the NRC's conclusions in the GGNS ESP Environmental Impact Statement (EIS); and

v. Demonstration that all environmental terms and conditions that have been included in the GGNS ESP will be satisfied by the date of issuance of the combined license. Any terms or conditions of the early site permit that cannot be met by the time the combined license is issued must be set forth as terms or conditions of the combined license.

This ER is organized into the following chapters:

- Chapter 1, Introduction
- Chapter 2, Environmental Description
- Chapter 3, Plant Description
- Chapter 4, Environmental Impacts of Construction
- Chapter 5, Environmental Impacts of Station Operations
- Chapter 6, Environmental Measurement and Monitoring Programs
- Chapter 7, Environmental Impacts of Postulated Accidents Involving Radioactive Materials
- Chapter 8, Need for Power
- Chapter 9, Alternatives to Proposed Action
- Chapter 10, Unavoidable Adverse Environmental Impacts

Chapter 1, Introduction, is organized into the following sections:

- Section 1.1 – The Proposed Project
- Section 1.2 – Status of Reviews, Approvals, and Consultations
- Section 1.3 – Report Contents

1.1 THE PROPOSED PROJECT

The proposed action is the issuance of a combined construction permit and operating license (COL) for construction and operation of a new nuclear unit (Unit 3) at the Grand Gulf ESP Site. Unit 3 will be a General Electric (GE)–Hitachi Nuclear Energy designed ESBWR. The GGNS ESP site is located near Port Gibson, Mississippi. References within this ER to the ESBWR Design Control Document (DCD), or simply "DCD," should be understood to mean the ESBWR DCD, Tier 2, submitted by GE-Hitachi (GEH) as Revision 4 and dated September 2007, unless noted otherwise.

The reactor has a reactor thermal power level of 4500 megawatts thermal (MWt) and a gross electrical output of approximately 1600 ± 50 megawatts electric (MWe). Unit 3 is anticipated to generate approximately 1520 MWe net. The new facility powerblock will be located slightly to the west and north of the adjoining Unit 1, and will consist of a single reactor plant. The new facility is located within the powerblock location described in the GGNS ESP application.

The Applicant is making no commitment to the start of construction of a plant; rather, the Applicant seeks only to obtain a COL to enable the construction and operation of a new facility at any time during the lifetime of the license. A typical construction and operation timeline may be projected by assuming that a COL is granted in 2009. Current projections are for preliminary site work and regulatory permitting to start shortly upon authorization with construction taking an estimated 5–6 years. Fueling would then occur the first quarter of 2015 and commercial power operations would commence in the second quarter of 2015. The estimated elapsed time of 6 years is expected to be a conservative upper bound for the time from licensing to operation.

The ESBWR reactor design is proposed with waste heat dissipated by a primary natural draft cooling tower supplemented by a mechanical draft cooling tower. Makeup water for the cooling tower(s) and other plant cooling and miscellaneous needs would be drawn from the Mississippi River through a new intake structure, described in Subsection 3.4.2.1. Cooling system blowdown is discharged to the Mississippi River, as described in Subsection 3.4.1.

The existing GGNS switchyard will be expanded and utilized to connect the electrical output of the proposed Unit 3 to the existing transmission system. Approximately 55 miles of new transmission line right-of-way is necessary to support the new unit, as discussed in Section 3.7.

SERI owns the GGNS site property (approximately 2,100 acres) with the following clarifications:

- The property developed for the existing GGNS power plant and support facilities (approximately 104 acres) has subdivided ownership interests.
    - South Mississippi Electric Power Association (SMEPA), a Mississippi corporation, maintains a 10 percent undivided ownership interest in the property associated with the existing GGNS power plant and support facilities.
    - SERI's 90 percent ownership interest in the existing GGNS power plant and support facilities has been further subdivided. SERI has a sale/leaseback agreement in which SERI maintains 77.23 percent ownership. The remaining 12.77 percent interest is owned by equity investors Textron Financial Corporation and Resources Capital Management Corporation, and is leased back to SERI. Title to the property reverts back to SERI on termination of the sale/leaseback agreement.
- Entergy Mississippi Inc. (EMI), formerly named Mississippi Power & Light, owns the switchyard and transmission lines. EMI is a wholly owned subsidiary of Entergy Corporation.
- SMEPA also holds certain easement rights associated with the GGNS site property.

SERI, SMEPA, and Entergy Operations Inc. (EOI) own or effectively control the mineral rights in the proposed powerblock and associated exclusion area.

SERI has the exclusive rights to develop the GGNS site property outside the existing power plant and support facilities. SERI has the authority to enter into emergency planning agreements with government institutions as included in this COL application (COLA).

Entergy Operations Inc (EOI) is licensed to operate the existing GGNS power plant facility. EOI does not have an ownership interest in the GGNS site property.

The facility described in this ER is intended for use as a commercial electricity generating facility, and will be used to produce electricity for sale. The new facility constructed under the issued COL would be operated as a regulated plant under the retail jurisdiction of the Mississippi Public Service Commission.

1.1.1 REFERENCES

201 System Energy Resources, Inc., Grand Gulf ESP Site, Docket No. 52-009, Early Site Permit, ESP-002, April 2007

1.2 STATUS OF REVIEWS, APPROVALS, AND CONSULTATIONS

The information for this section is provided in the ESP Application Part 3 – Environmental Report, Section 1.2. NUREG-1817, Section 1.5, states that “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.”

A search for applicable regulations, permits, and consultations that may be required by federal, state, regional, local, and affected Native American tribal agencies was conducted during preparation of the ESP ER, and the results were presented in ESP ER Table 1.2-1. Table 1.2-201 is an updated version of ESP ER Table 1.2-1. The permits have not been applied for at this time; therefore, the columns for “License/Permit No.” and “Expiration Date” are blank. Only those permits that are needed to support specific plant activities will be obtained.

The U.S. Department of Energy's (DOE) Standard Contract for disposal of spent nuclear fuel contained in 10 CFR Part 961 is being modified by the DOE. The Nuclear Energy Institute (NEI) is actively engaged with the DOE in revising the language in the Standard Contract. It is expected that this revision will be completed and the Standard Contract will be entered into by the end of 2008.

1.2.1 REFERENCES

None.

TABLE 1.2-201 (SHEET 1 OF 9)
FEDERAL, STATE, AND LOCAL ENVIRONMENTAL AUTHORIZATIONS

Statute/Agency	Authority	Requirement	License/Permit No.	Expiration Date	Activity Covered
U.S. Nuclear Regulatory Commission (NRC)	10 CFR 52.79	Environmental Report			Preparation of a combined license application (COLA) for construction and operation of a commercial nuclear power plant.
Endangered Species Act (ESA) / U.S. Fish and Wildlife Service (USFWS)	16 U.S.C. §§1531 *et seq.*	Consultation			Consultation of potential impacts to federal threatened and endangered species.
Migratory Bird Treaty Act / USFWS	16 U.S.C. §703	Consultation			Consultation of potential impacts to protected migratory birds.
USFWS	16 U.S.C. §1539	Incidental Take Permit			Project-related mortality and modification of critical habitat of federal threatened and endangered species, if any.
MS Department of Wildlife, Fisheries and Parks / Mississippi Museum of Natural Science (MMNS)	16 U.S.C. §§1531 *et seq.*	Consultation			State-level consultation of potential impacts to threatened and endangered species.

TABLE 1.2-201 (SHEET 2 OF 9)
FEDERAL, STATE, AND LOCAL ENVIRONMENTAL AUTHORIZATIONS

Statute/Agency	Authority	Requirement	License/Permit No.	Expiration Date	Activity Covered
LA Department of Wildlife and Fisheries / LA Natural Heritage Program	16 U.S.C. §§1531 *et seq.*	Consultation			State-level consultation of potential impacts to threatened and endangered species.
U.S. Department of the Interior	42 U.S.C. §1996 25 U.S.C. §3001	Consultation			Identification and evaluation of historic properties, and any cultural sites of significance to Native American tribes.
National Historic Preservation Act of 1966 (NHPA) / Mississippi Department of Archives and History (MDAH); State Historic Preservation Officer (SHPO)	16 U.S.C. §§470 *et seq.*	Consultation			Review and analysis of cultural and historic resources. NRC is initiating formal NHPA Section 106 consultation with the SHPO as part of their EIS process.
Federal Aviation Administration (FAA)	Federal Aviation Act, 14 CFR 77	Notice			Preconstruction letter of notification to FAA results in a written response certifying that no hazards exist or recommending project modification.

TABLE 1.2-201 (SHEET 3 OF 9)
FEDERAL, STATE, AND LOCAL ENVIRONMENTAL AUTHORIZATIONS

Statute/Agency	Authority	Requirement	License/Permit No.	Expiration Date	Activity Covered
U.S. Coast Guard	14 U.S.C. 81, 83, 85, 633/49 49 U.S.C. §1655(b).	Authorization			Navigation markers authorization to protect river navigation from hazards connected with temporary construction activities in a river.
Mississippi Public Service Commission (MPSC)	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 or facility.
U.S. Army Corps of Engineers (USACE)	33 U.S.C. §1344; 33 U.S.C. §§401 *et seq.*	Permit			Placing structures or working in, or affecting navigable waters. Aquatic resource alteration (wetland filling, stream alteration).

TABLE 1.2-201 (SHEET 4 OF 9)
FEDERAL, STATE, AND LOCAL ENVIRONMENTAL AUTHORIZATIONS

Statute/Agency	Authority	Requirement	License/Permit No.	Expiration Date	Activity Covered
USACE	33 U.S.C. §1344; 33 U.S.C. §§401 *et seq.*	Permit			Jurisdictional wetlands significantly altered require a CWA Section 404 permit from USACE. Depending on determination of degree of impacts, either a general or individual permit is required. Individual permits involve state Section 401 certification that the action does not violate state water quality standards.
USACE	Section 10 of the Rivers and Harbors Act	Permit			Permit for obstruction to Mississippi River navigation.
Clean Air Act (CAA) / Mississippi Department of Environmental Quality (MDEQ)	42 U.S.C. §§7401 *et seq.* MS Code Ann. §49-17-29	Permit			Preconstruction Permit includes Prevention of Significant Deterioration (PSD) program elements. Includes best available control technology (BACT), if applicable, and pollutant specific ambient air quality analysis. PSD pollutants for this project include SO_2, NO_x, CO, and PM and PM_{10}.

TABLE 1.2-201 (SHEET 5 OF 9)
FEDERAL, STATE, AND LOCAL ENVIRONMENTAL AUTHORIZATIONS

Statute/Agency	Authority	Requirement	License/Permit No.	Expiration Date	Activity Covered
EPA	40 CFR 82.162	Certification			Certification to the EPA that the site has acquired certified Freon recovery or recycling equipment and is complying with the applicable requirements of 40 CFR 82.
MDEQ	MS Code Ann. §49-17-29 Regulation APC-S-2	Permit			Permit regulation for the construction and/or operation of air emissions equipment.
MDEQ	MS Code Ann. §49-17-29 Regulation APC-S-6	Permit			Air emissions operating permit regulations for the purpose of Title V of the Federal Clean Air Act.
Emergency Planning Community Right to Know Act	42 U.S.C. 11001	Annual Tier II Filing			Storage of hazardous chemicals above threshold planning quantities.

TABLE 1.2-201 (SHEET 6 OF 9)
FEDERAL, STATE, AND LOCAL ENVIRONMENTAL AUTHORIZATIONS

Statute/Agency	Authority	Requirement	License/Permit No.	Expiration Date	Activity Covered
Clean Water Act (CWA) / MDEQ	42 U.S.C. §1342 MS Code Ann. §49-17-29	Permit			Discharge of wastewater to surface waters and in-stream monitoring. Existing permit issued for operation of existing facilities at GGNS for discharge points, and limits and conditions of operation for those points, and those associated with the operation of a nuclear plant.
CWA / MDEQ	40 CFR 112	SPCC Plan			Oil Pollution Prevention regulations require the development of a spill prevention, control and countermeasure (SPCC) plan.
MDEQ	MS Code Ann. §51-3-5 Regulation LW-2	Permit			Surface water and groundwater use and protection regulations.

TABLE 1.2-201 (SHEET 7 OF 9)
FEDERAL, STATE, AND LOCAL ENVIRONMENTAL AUTHORIZATIONS

Statute/Agency	Authority	Requirement	License/Permit No.	Expiration Date	Activity Covered
MDEQ	MS Code Ann. §49-17-29 Regulation WPC-1	NPDES Stormwater Construction Permit /NPDES Stormwater Industrial Permit			Stormwater to surface water discharges associated with land disturbance and industrial activity.
MDEQ	MS Code Ann. §21-27-207 et seq. Regulation WPC-3	Certification			Regulations for the certification of municipal and domestic wastewater facility operators.
MDEQ	MS Code Ann. §17-17-27 Regulation SW-2	Permit			Non-hazardous solid waste management regulations and criteria.
MDEQ	Regulation HW-1	Registration			Hazardous waste management.
MDEQ	Regulation UST-2	Registration			Operation of underground storage tanks.

TABLE 1.2-201 (SHEET 8 OF 9)
FEDERAL, STATE, AND LOCAL ENVIRONMENTAL AUTHORIZATIONS

Statute/Agency	Authority	Requirement	License/Permit No.	Expiration Date	Activity Covered
MS Department of Wildlife, Fisheries and Parks	Mississippi Museum of Natural Science (MMNS)	Scientific Collectors Permit			Ecological monitoring programs.
LA Department of Wildlife and Fisheries	Natural Heritage Program	Scientific Collectors Permit			Ecological monitoring programs.
Public Service Commission	MS Code Ann. 77-3-11	Certification			Certification that present and future public convenience and necessity require the operation of such equipment or facility.
Executive Order 11514 (Protection of Enhancement of Environmental Quality)	40 CFR 1500-1508	Certification that action is consistent with executive order			Protect and enhance the quality of the environment; develop procedures to ensure the fullest practicable provision of timely public information and understanding of federal plans and programs that may have potential environmental impacts in order to obtain the views of interested parties.

TABLE 1.2-201 (SHEET 9 OF 9)
FEDERAL, STATE, AND LOCAL ENVIRONMENTAL AUTHORIZATIONS

Statute/Agency	Authority	Requirement	License/Permit No.	Expiration Date	Activity Covered
Executive Order 11988 (Floodplain Management)	10 CFR 1022 18 CFR 725	Certification that action is consistent with executive order			Floodplain impacts to be avoided to the extent practicable.
Executive Order 11990 (Protection of Wetlands)	10 CFR 1022 18 CFR 725	Certification that action is consistent with executive order			Requires federal agencies to avoid any short- and long-term adverse impacts on wetlands wherever there is a practicable alternative.
U.S. Department of Transportation (USDOT)	49 CFR 107, Subpart G	Registration			Radioactive and hazardous materials shipments.

1.3 REPORT CONTENTS

This report follows the same overall structure of the ESP ER, which was based on Appendix A of NUREG-1555 (the Environmental Standard Review Plan [ESRP], October 1999). Where a topic was previously addressed and resolved in the ESP proceeding, and no new and significant information has been identified, this report identifies the sections of the ESP ER and NUREG-1817 (ESP EIS) that addressed the topic, and states that no new and significant information has been identified. As required by 10 CFR 51.50(c)(1), supplemental information is provided as described in the following subsections.

1.3.1 DEMONSTRATION THAT THE FACILITY DESIGN FALLS WITHIN THE SITE CHARACTERISTICS AND DESIGN PARAMETERS IN THE ESP

10 CFR 51.50(c)(1)(i) requires that a COL application referencing an ESP contain "information to demonstrate that the design of the facility falls within the site characteristics and design parameters specified in the early site permit." The information provided in Section 3.0 and FSAR Section 2.0 fulfills the requirement for such a demonstration.

1.3.2 INFORMATION TO RESOLVE ANY SIGNIFICANT ENVIRONMENTAL ISSUES THAT WERE NOT RESOLVED IN THE ESP PROCEEDING

10 CFR 51.50(c)(1)(ii) requires that a COL application referencing an ESP contain "information resolving any significant environmental issue that was not resolved in the ESP proceeding." Several issues were not resolved in the GGNS ESP proceeding. Information necessary to resolve issues identified as unresolved in NUREG-1817 is provided in the applicable section of this report.

1.3.3 NEW AND SIGNIFICANT INFORMATION

10 CFR 51.50(c)(1)(iii) requires that a COL application referencing an ESP include "any new and significant information for issues related to the impacts of construction and operation of the facility that were resolved in the ESP proceeding." Any new and significant information identified for an issue that was resolved in the ESP proceeding is evaluated in the appropriate section of this report.

For preparation of a COLA ER referencing an ESP, "new information" is information, related to a key input or assumption, that was both (1) not considered in preparing the ESP ER or NUREG-1817, and (2) not generally known or publicly available during preparation of the EIS. As discussed in NUREG-1817, the NRC staff made certain assumptions to support preparation of the EIS: "In its analysis of some issues, the staff relied on reasonable assumptions made by SERI or the staff. These assumptions, and their bases, are identified in each section, and are documented in Appendix J to this EIS. The NRC staff will verify the continued applicability of these assumptions at the CP or COL stage to determine whether there is new and significant information from that discussed herein." (NUREG-1817, page 1-4)

From this statement, it is understood that the ESP EIS documents key inputs[1] used by the NRC staff to support its findings and conclusions. Therefore, the ESP EIS is the primary document that must be reviewed for key inputs used by the NRC in its evaluations. These EIS key inputs identify the main sources of information that were considered to determine whether or not there could be new information potentially affecting an NRC finding or conclusion regarding an environmental impact.

In addition, the ESP ER was reviewed to identify any relevant key inputs not already identified in the EIS review, and for which new information may be available that bears on the NRS staff's EIS impact evaluations. As appropriate, other relevant documentation was also reviewed for key inputs not identified in the EIS or ESP ER.

The NRC has established three significance levels for environmental impacts: SMALL, MODERATE, and LARGE (see NUREG-1817, Subsection 1.1.3). In general, one of these three significance levels was assigned to each impact evaluated and resolved in the ESP EIS. For the purposes of the significance evaluations, new information was considered significant if it had the potential to change an NRC-assigned level of significance; that is, from SMALL to MODERATE or from MODERATE to LARGE for adverse impacts (or if it had the potential to change an NRC finding or conclusion, as in the case of the ESP EIS, Sections 8.2 and 8.3 on alternative energy sources and designs, respectively). This definition of significance is consistent with the NRC's Final Rule to Update 10 CFR Part 52: Licenses, Certifications, and Approvals for Nuclear Power Plants (Federal Register 72: 49,431).

1.3.4 NEW AND SIGNIFICANT INFORMATION PROCESS SUMMARY

10 CFR 51.50(c)(1)(iv) requires that a COL application referencing an ESP include "A description of the process used to identify new and significant information regarding the NRC's conclusions in the ESP EIS."

The "new and significant information" process is a multi-step process used to identify information that should be included in this COLA ER to satisfy the requirements of 10 CFR 51.50(c)(1)(iii). The steps of the process described below are performed by a "reviewer." For some activities or topics, the reviewer may be an individual, e.g., COLA ER section author or another subject matter expert (SME), environmental specialist, licensing support staff, etc. For other activities or topics and depending on the subject or issue, a larger group of environmental or technical specialists, SMEs, and/or project supervision may conduct the review as a review team. The reviewer or review team members are selected to ensure that the review is performed by individuals qualified to conduct the review, that new information that may exist for the key inputs being screened will be recognized, and that if new information is identified, the significance evaluation is conducted properly.

Figure 1.3-201 is a flowchart that illustrates the steps for the COLA ER new and significant information process. Following is a summary of this process.

1. The term "key inputs" as used here means those assumptions and inputs, explicitly identified or implied, that were considered in the environmental review by the NRC staff in the ESP EIS.

Step 1: Identify issues that are resolved in the ESP EIS related to the topic being addressed.

In general, an issue is resolved if an impact level of SMALL, MODERATE, or LARGE was assigned for the issue. In a few limited cases, the NRC staff stated their conclusions in terms that are specific to the subject area, such as alternative energy source and plant design alternatives (NUREG-1817 Sections 8.2 and 8.3). Conversely, if an issue was not resolved, NUREG-1817 explicitly states that the issue was not resolved.

Step 2: Document EIS key inputs.

ESP EIS sections that discussed resolved issues were identified. Within these sections, key inputs considered relevant to the resolved issue – that is, those key inputs used by the NRC to make EIS impact determinations – were identified.

Step 3a: Screen EIS key inputs.

EIS key inputs were screened to determine whether there is new information based on the reviewer's experience or knowledge of the topic or issue, or whether there is a need to perform further research for new information related to the key input. Consideration was given to the potential for change based on the amount of time passage from ESP EIS completion to COLA ER development.

Step 3b: Identify other and/or new key inputs.

The ESP ER, ESP Proceedings documentation (Atomic Safety Licensing Board [ASLB] hearings exhibits, Advisory Committee for Reactor Safeguards [ACRS] meetings materials, etc.), or external documents that were not otherwise identified in the ESP EIS review for key inputs were reviewed to identify other key inputs. The experience and knowledge of subject matter experts was also a source of potential key inputs. These key inputs, if any, were then screened in the same manner as described in Step 3a.

Step 4: Determine appropriate tasks to identify new information.

If it was not known whether new information exists related to a key input, or the extent of the new information was not readily apparent, the appropriate steps to take to evaluate whether new information exists for the key input were determined.

These steps or actions could include one or more of the following:

- Reviewing environmental monitoring results.
- Reviewing related scientific literature.
- Surveying environmental professionals familiar with the site environs (for example, the environmental and operations staff of the existing nuclear plant, or other nearby industrial facility).

- Exchanging information within the industry through peer groups and industry organizations.

- Consultations with academicians knowledgeable of the local environment.

- Consultations with Federal, State, Tribal, and local environmental, natural resource, permitting, and land use agencies.

- Verifying that the assumptions and representations made in the ESP ER are still valid.

- Verifying that the NRC staff's assumptions in the ESP EIS are still valid.

- Reviewing information needs in the Environmental Standard Review Plan.

Step 5: Perform actions identified in Step 4.

Any additional steps or actions identified in Step 4 determined to be appropriate were then conducted, to identify whether or not new information exists for a given key input.

Step 6: Conduct significance evaluation.

If new information was found for any key input, a significance evaluation of the new information related to the key input identified was conducted to determine whether or not the new information is significant. If the information was determined to be both new and significant it is included in this COLA ER.

Step 7: Address items identified as new and significant information in the appropriate section of the COLA ER.

New and significant information included in this COLA ER is evaluated in the appropriate section of the ER.

There may be special circumstances in which new information is not determined to be significant, but the information is included in this report to facilitate the NRC staff review of the subject. For example, it was determined that none of the findings and conclusions in NUREG-1817 were affected as a result of Hurricane Katrina. Nevertheless, the COLA ER discusses Hurricane Katrina due to its overall impact to the Gulf Coast region and the high public visibility of this event.

1.3.5 ENVIRONMENTAL TERMS AND CONDITIONS

10 CFR 51.50(c)(1)(v) requires that a COL application referencing an ESP include a "Demonstration that all environmental terms and conditions that have been included in the ESP will be satisfied by the date of issuance of the combined license. Any terms or conditions of the early site permit that cannot be met by the time the combined license is issued must be set forth as terms or conditions of the combined license." The following environmental terms and conditions are included in the GGNS ESP (ESP-002):

1. *"The values of plant parameters considered in the environmental review of the application and set forth in Appendix D to this ESP are hereby incorporated into this ESP." (ESP-002, Item 3.D)*

   Evaluation:
   The ESP plant parameters are described and evaluated against the COL design characteristics in Section 3.0.

2. *"An Applicant for a CP or COL referencing this ESP shall develop an Environmental Protection Plan (EPP) for construction and operation of the proposed reactor and include the EPP in the application. The portion of the EPP directed to operation shall include any environmental conditions derived in accordance with 10 C.F.R. § 50.36b." (ESP-002, Item 3.F)*

   Evaluation:
   An EPP for construction and operation of the proposed Unit 3 is included in the COL Application, Part 11B.

1.3.6 REFERENCES

None.

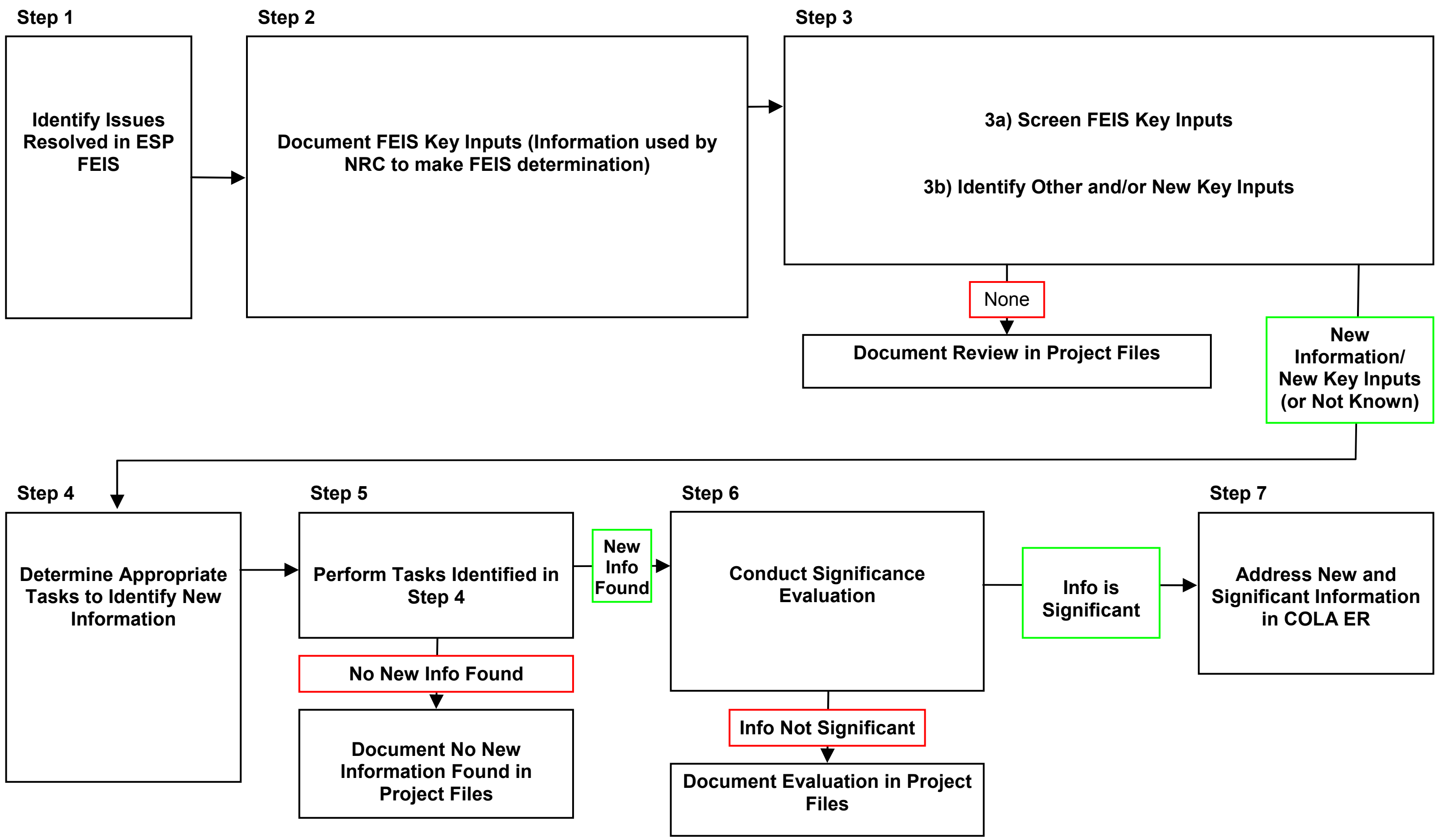


Figure 1.3-201. New and Significant Process Flow Chart

CHAPTER 2 ENVIRONMENTAL DESCRIPTION

Chapter 2 describes the existing environmental conditions at the Grand Gulf Nuclear Station, (GGNS) Unit 3 site, vicinity, and region. The environmental descriptions provide sufficient detail to identify those environmental resources that have the potential to be affected by the construction, operation, or decommissioning of the new unit. This chapter is divided into eight subsections:

- Station Location (Section 2.1)
- Land (Section 2.2)
- Water (Section 2.3)
- Ecology (Section 2.4)
- Socioeconomics (Section 2.5)
- Geology (Section 2.6)
- Meteorology and Air Quality (Section 2.7)
- Related Federal Project Activities (Section 2.8)

2.1 STATION LOCATION

The information for this section is provided in the ESP Application Part 3 – Environmental Report, Section 2.1; the following supplements are provided.

The approximate center point coordinates for the new reactor are defined in Table J-1 in Appendix J of the GGNS ESP Final Environmental Impact Statement (EIS), NUREG-1817. These coordinates are also presented in Section 2.1 of the ESP ER.

The Universal Transverse Mercator (UTM) Grid Coordinates for the center point of the Unit 3 powerblock are N3543166 meters and E684017 meters. The coordinates are in North American Datum 1983, Zone 15 North.

The latitude and longitude that correspond to the UTM coordinates for the center of the Unit 3 powerblock are 32.00966 N and 91.05176 W, North American Datum 1983.

Figure 2.1-201 illustrates the approximate location of the proposed Grand Gulf Unit 3 facility center point. This figure also illustrates the general locations of the proposed powerblock and important features related to construction land use, such as construction laydown and parking areas, the site of the new cooling towers, the expanded switchyard, and intake/discharge structure.

2.1.1 REFERENCES

None.

Figure 2.1-201. GGNS Site Center Point and Facility Layout

2.2 LAND

The information for this section is provided in the ESP Application Part 3 – Environmental Report, and associated impacts are not fully resolved in NUREG-1817; the following supplemental information is provided.

2.2.1 THE SITE AND VICINITY

The site and vicinity were described in Subsection 2.2.1 of NUREG-1817. However, the facility layout and construction areas specific to Unit 3 were not known at ESP. The following supplemental information is provided to describe the area affected by the proposed Unit 3 construction and operation. The site center point and construction footprint, including areas to be overlain by permanent Unit 3 structures, are illustrated in Figure 2.1-201. As illustrated in Figure 2.1-201, the proposed Unit 3 construction areas and permanent facility footprints occupy less land area than was described at ESP, and proposed disturbance falls generally within the areas designated for disturbance in ESP ER Figure 2.1-2 and in NUREG-1817 Figure 2-4.

The construction site cleared or disturbed areas for Unit 3 covers approximately 234 acres (ac.) of land, all located within the site boundary. The coordinates for the center point of Unit 3 are provided in Section 2.1, “Station Location.” The amount of site land described as construction laydown areas and building construction for Unit 3 are discussed in Section 4.3 and provided in Table 4.3-201.

2.2.2 TRANSMISSION CORRIDORS AND OFF-SITE AREAS

The off-site transmission corridors were discussed in Subsection 2.2.2 of NUREG-1817. The off-site transmission corridor routing was not known or identified in the ESP ER, and NRC staff assumed in the NUREG-1817 analysis that the existing corridor would be upgraded. The GGNS site is currently linked to load centers through the GGNS-Baxter-Wilson and GGNS-Franklin 500-kV transmission lines operated by the Entergy Mississippi Inc. (EMI) system. Unit 3 will require the construction of a new transmission line in addition to the existing GGNS system. Though the precise routing coordinates of the new line have not been finalized, the proposed general alignment was utilized for the purposes of this evaluation. This proposed alignment is described in Section 3.7.

The U.S. Federal Energy Regulatory Commission (FERC) has a mandated oversight role regarding connection of Unit 3 to the existing transmission grid. This role is implemented in FERC Order 2003 which mandates specific studies be performed to demonstrate that the location and design of interconnecting equipment is sufficient to protect overall system stability and integrity. These studies were performed by the Southwest Power Pool - Independent Coordinator of Transmission (SPP-ICT), for the Entergy Operating Companies’ transmission system.

Transmission line construction in the state of Mississippi is regulated solely by the Mississippi Public Service Commission (MPSC) by way of issuance of a Certificate of Convenience and Necessity (CCN) from the MPSC before construction and right-of-way (ROW) acquisition can begin. Entergy Mississippi Inc. will own and operate any new transmission line that will connect to the Unit 3 switchyard and transmit power to customers along the grid. There is no direct federal authorization issued for transmission line construction; although, related approvals for specific activities, such as placement of fill in wetlands or incidental taking of threatened or endangered species, can be required as an adjunct to the CCN, depending on site-specific circumstances.

The proposed new transmission line and associated transmission line upgrades, including ROW widths, are described in Section 3.7. The proposed route is illustrated in Figure 2.2-201. The area covered by the new corridor represents ROW totaling 1333 ac. This estimate is based on calculating acreage for a 200 feet (ft.) buffer located along the proposed corridor.

Because the proposed transmission line route has not been finalized and is still subject to change, no on-site field studies were performed during the preparation of this ER. An analysis of the proposed new transmission line ROW for Unit 3 was conducted using publicly available data, and ESRI ArcGIS 9.2 mapping and analysis software (Reference 202). The land ownership/administration categories included in the analysis included:

- National Wetlands Inventory
- Bureau of Indian Affairs
- Bureau of Land Management
- Bureau of Reclamation
- U.S. Department of Defense
- USDA Forest Service
- U.S. Fish and Wildlife Service
- National Park Service
- Tennessee Valley Authority
- Federal parkways
- All other federal lands not listed above
- State and local parks

The proposed transmission line route was digitized from a reference drawing that had been georectified for spatial correctness. Land-use data was extracted from the 2001 National Land Cover Dataset (NLCD) for the region (50 mi. radius) surrounding the GGNS site. Data from the NLCD has a resolution of 30 m resulting in a pixel size of 900 m^2, using the ArcGIS 9.2 Spatial Analyst Raster Clip Tool, which counts a pixel as intersecting the overlying vector layer if the whole pixel is contained within the vector layer. Pixels overlain by the transmission line ROW were extracted.

At the resolution described above, using a transmission line buffer of 200 ft., as described in Section 3.7, would produce a substantial undercount of the land cover impacted by the new transmission line ROW. Therefore, in the interest of providing a conservative estimate of land cover types affected by the transmission line ROW, the buffer applied to each segment of the digitized transmission line was increased to 350 ft. This increase was done to allow a more representative number of land use pixels to be counted. The number of pixels for each land-use land-cover type was then summed to provide a total for each category. Each category count was then divided by the total number of pixels for the corridor to obtain land cover percentages. Category percentages for the entire region were then calculated and compared to the proposed transmission ROW percentages, as shown in Table 2.2-201.

Waterbodies crossed by the proposed transmission line ROW are depicted in Figure 2.2-201. These waterbodies include the Big Black River, Fourteen Mile Creek and Bakers Creek. The proposed transmission line would traverse Mississippi Highways 27 and 61. Except for the Natchez Trace Parkway, administered by the U.S. National Park Service, no federal lands or state or local parks fall within the corridor right-of-way.

In addition to the analysis described above, informal consultation letters were sent to the U.S. Fish and Wildlife Service (USFWS), the Mississippi Natural Heritage Program (MNHP), the State Historic Preservation Officer (SHPO), and appropriate tribal representatives to obtain information on any threatened or endangered species, or cultural resource concerns within the proposed off-site transmission line ROW.

The primary land use categories located within the proposed new transmission corridors ROW are hay and pasture land (33 percent), deciduous forest (29 percent), and mixed forest (21 percent). Areas classified as developed open spaces, developed low-intensity, and developed medium-intensity, constitute only 0.3 percent of the total area covered by the transmission corridor right-of-way. According to data derived from the U.S. Geological Survey National Land Cover Database, approximately 7 percent, or 90 ac. of the new transmission ROW, overlays areas with wetland characteristics (Reference 201).

2.2.3 THE REGION

Characteristics of the GGNS region were described in Subsection 2.2.3 of NUREG-1817; there is no new and significant information for this section.

2.2.4 REFERENCES

201 U.S. Environmental Protection Agency, National Land Cover Data, Website, http://www.epa.gov/mrlc/nlcd.html, Accessed April 30, 2007.

202 ESRI ArcGIS 9.2 mapping software and extension “Spatial Analyst”, 2006.

TABLE 2.2-201
LAND USE DISTRIBUTION – PROPOSED OFF-SITE TRANSMISSION RIGHT-OF-WAY

Transmission ROW Land Use				Regional Land Use[1]
Description	Pixel Count	ROW Acres	Percent	Percent
Open Water	48	5.5	0.4%	3.2%
Developed, Open Space	13	1.5	0.1%	0.9%
Developed, Low Intensity	21	2.4	0.2%	0.1%
Developed, Medium Intensity	2	0.2	<0.1%	0.3%
Unconsolidated Shore	5	0.6	<0.1%	0.0%
Transitional	211	24.2	1.8%	0.6%
Deciduous Forest	3333	382.6	28.7%	15.5%
Evergreen Forest	319	36.6	2.7%	10.6%
Mixed Forest	2440	280.1	21.0%	12.6%
Pasture/Hay	3854	442.4	33.2%	10.8%
Cultivated Crops	553	63.5	4.8%	27.6%
Palustrine Forested Wetland	815	93.6	7.0%	14.7%
TOTAL		1333.3	100.0%	96.8%

Notes:

1. There is a 50-mile radius surrounding the GGNS site.

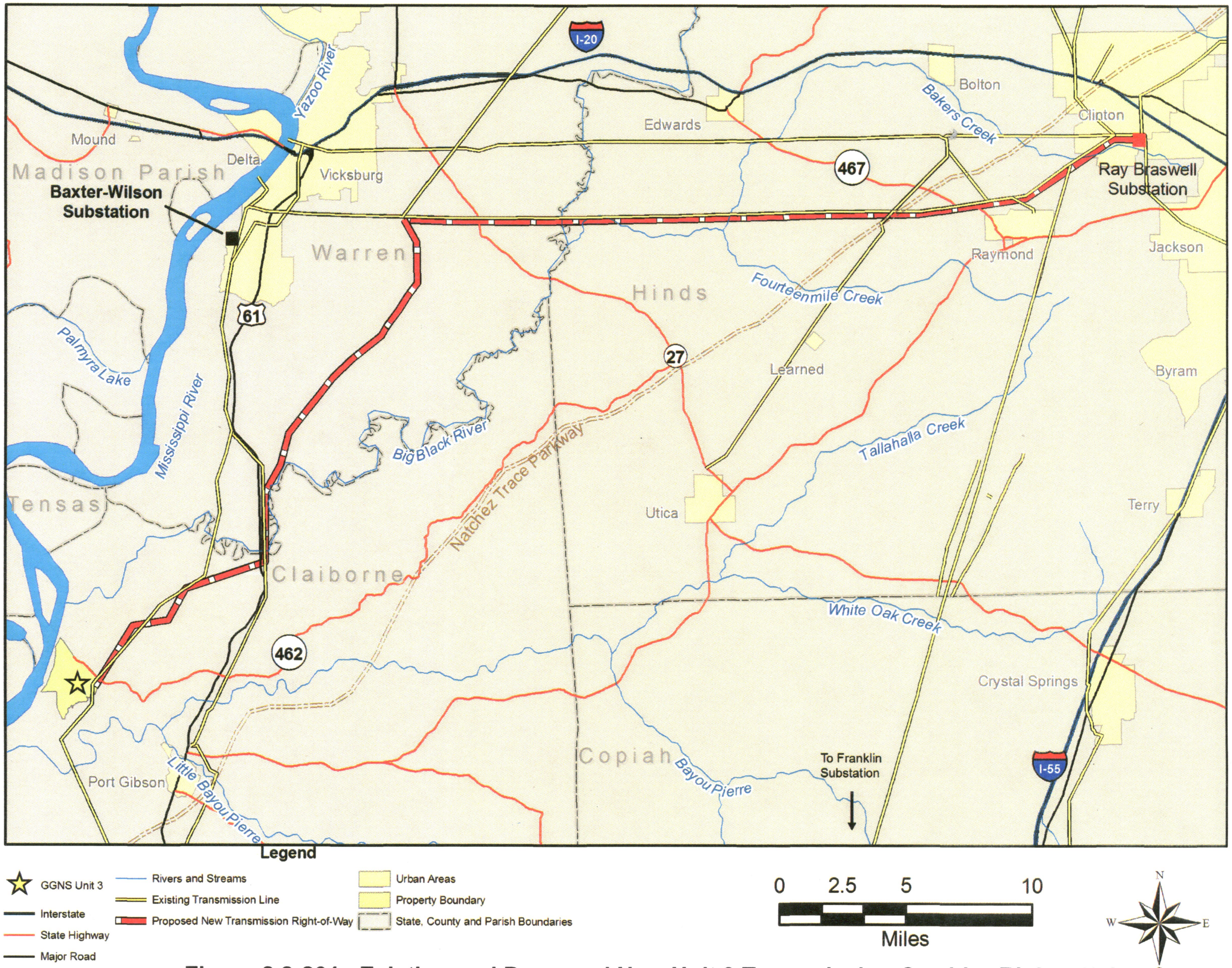


Figure 2.2-201. Existing and Proposed New Unit 3 Transmission Corridor Right of Way

2.3 WATER

The information for this section is provided in the ESP Application Part 3 – Environmental Report, Section 2.3, and associated impacts are not fully resolved in NUREG-1817; the following supplemental information is provided.

Section 2.3 of the ESP Application Environmental Report (ER) provided approximate center point coordinates for the powerblock for a new facility. The center point coordinates for the powerblock of the Unit 3 ESBWR are provided in Section 2.1.

2.3.1 HYDROLOGY

2.3.1.1 Surface Water

The surface water hydrologic description is provided in Subsection 2.3.1 of the ESP ER. NUREG-1817 Subsection 2.6.1 also summarizes the surface water hydrology for the site. The following supplemental information is provided to address issues that were unresolved in NUREG-1817.

2.3.1.1.1 Mississippi River

The Mississippi River hydrological characteristics were provided in the ESP ER Subsection 2.3.1.1.1 and summarized in NUREG-1817 Subsection 2.6.1.1. Additional information on Mississippi River velocity and temperature monitoring, based on the results of a bathymetric study conducted in October 2006, is provided in Subsection 2.3.3.1. This information is provided to address potential thermal monitoring suggested in NUREG-1817 Subsection 2.6.3.3.

2.3.1.1.2 Local Streams

The proposed Unit 3 layout and associated construction areas are provided in Figure 2.1-201. Figure 2.3-201 provides the locations of Unit 3 structures in relation to Stream A and Stream B. Small areas of clearing and grading, development of construction-related facilities, and a portion of the property where the new cooling towers are located are outside the boundary of land disturbance presented within the ESP ER. However, Unit 3 construction areas continue to drain surface water runoff and storm flow to Stream A and Stream B, as stated in the ESP ER 2.3.1.1.2.

The ESP ER states that no new transmission line right-of-way is planned for a new facility on the GGNS ESP site. Subsequent evaluation has determined that Unit 3 requires construction of new transmission line ROW and distribution facilities. Transmission systems are described in Section 3.7. Impacts from construction of new transmission and distribution facilities on hydrological conditions of local streams or wetland areas are discussed in Subsection 4.2.1.2 and Section 4.3.

2.3.1.1.3 Wetlands

Supplemental wetland information obtained during COLA investigations is provided in Section 2.4.

2.3.1.2 Groundwater

NUREG-1817 Subsection 2.6.1.2 states that a plant design for the ESP site was not selected, and the specific footprint and embedment depth of the plant were not determined. The Grand Gulf ESP (Reference 201) stated additional site exploration, laboratory testing, and geotechnical analyses would be performed to develop final plant design criteria for the CP or COL phase of the project.

The NRC staff stated in NUREG-1817 Subsection 2.6.1.3 that the hydraulic conductivity information reported in the ESP ER from various permeability tests for the Catahoula Formation was inadequate to provide a reliable basis to estimate the groundwater drawdowns associated with withdrawals from this formation. The Catahoula Formation is part of the Southern Hills regional aquifer system, a sole-source aquifer. Corrections to the ESP ER information and supplemental information related to Catahoula Formation groundwater withdrawals and permeability are discussed below (Subsection 2.3.2.2).

2.3.1.2.1 Regional Conditions

Nomenclature for the Unit 3 investigations is changed from that used in the ESP ER and Unit 1 Final Environmental Report (FER) (Reference 202) to be consistent with more up-to-date geologic references (Reference 203). The primary stratigraphic units encountered are the Mississippi River Alluvium, Loess, Upland Complex (referred to as the Pleistocene Terrace Deposits in the ESP ER and Unit 1 FER (Reference 202)), and the Catahoula Formation. Where the Upland Complex is mentioned in this report, this is understood to refer to the Terrace Deposits as well.

2.3.1.2.2 Plant Site Conditions

Groundwater Levels and Movement

Additional geologic and hydrologic data from Unit 3 COLA site investigations are presented to provide more detailed information on the aquifers, and the location and movement of groundwater. Additional geologic and hydrologic characterization data from COLA investigations are presented in the following subsections to refine the conceptual hydrogeologic model related to the occurrence and movement of groundwater, local groundwater use, and characteristics of the GGNS site aquifers.

During the Unit 3 COLA site characterization investigation, 97 soil borings were drilled to characterize subsurface geologic conditions and to obtain laboratory geotechnical test samples. The details of the geologic investigation, including cross sections, are provided in the Final Safety Analysis Report (FSAR) Section 2.5, Figures 2.5.4-217 through 228.

A total of 44 groundwater monitoring wells were installed in 23 locations selected to further characterize the Unit 3 area (Figure 2.3-201) with locations indicated below. Unit 3 wells have a 4-digit numerical designation. Wells were installed in all 23 of the selected boring locations in the Upland Complex or Mississippi River Alluvium.

- 12 wells were screened in the lower portion of the Loess (a well was installed only if moisture was encountered in the lower portion of the formation), designated with suffix “A”.
- 19 wells were screened in the Upland Complex or Mississippi River Alluvium, designated with suffix “B”.
- 9 wells were screened in thin sand lenses encountered in the upper portion of the Catahoula Formation, designated with suffix “C”.
- 4 wells were screened in the Upland Complex to provide water levels during pump tests, designated with prefix “OW” and a 4-digit numerical designation.

Figure 2.3-201 provides the locations of the Unit 1 monitoring wells (with 2-digit numerical designations), drinking water wells, and other Unit 1 wells monitored during the Unit 3 site investigations. Table 2.3-201 summarizes installation information for the Unit 3 COLA investigations.

Table 2.3-202 provides a summary of the water level data collected over a period of one year. Figures 2.3-202A through 202F provide hydrographs of selected wells. Figures 2.3-203A and 203B provide groundwater gradient maps for the Upland Complex groundwater monitoring program for the months with the lowest and highest groundwater elevations (December 2006 and May 2007, respectively). A groundwater gradient for the Loess was not determined due to the discontinuous nature of the water-bearing layers.

The monitoring data reported in Table 2.3-202 show three distinct formations in which groundwater occurs in the vicinity of the Unit 3 powerblock. Table 2.3-202 and the water level hydrographs in Figures 2.3-202A through 202F illustrate these distinct formations. These measured water levels indicate the hydraulic separation between perched groundwater, encountered in some locations, from the water table in the Upland Complex and the Catahoula Formation. Additional information regarding the hydraulic separation of the Upland Complex and Catahoula Formation is provided in the discussions of the hydrogeologic properties of subsurface materials, below.

The perched layers were generally encountered at elevations between approximately 70 – 90 ft. msl, or approximately 40 – 60 ft. below the Unit 3 plant grade. Eight of the 12 wells installed in the Loess (“A” wells) were dry at every gauging event (Table 2.3-202). Figure 2.3-204 depicts wells installed in the Loess with indications of perched groundwater. ESP ER Figure 2.3-20 depicts areas of perched groundwater encountered during the Unit 1 investigations.

While these water levels in the monitored wells generally increase or decline together, closer review of these data reveals occasional lag or differential movement of water levels between wells in the Upland Complex and those in the upper portion of the Catahoula Formation. The measured water level increase or decline also differs between the formations. Water levels in some of the upper layers of the Catahoula Formation show greater seasonal variation than the water levels monitored in the Upland Complex. For example, the seasonal variation in levels measured in well MW1007C varied by 4.3 ft., while the variation in well MW1007B varied by 3.3 ft. In February 2007, the water level measurements of wells MW1007B and MW1007C revealed a potentiometric hydraulic head differential of 5.4 ft. (75.6 ft. above msl for well MW1007B versus 70.2 ft. above msl for well MW1007C). These data are consistent with data reported for previous Unit 1 investigations, in that the water levels generally tend to increase or decline together, but show distinct hydraulic separation between the formations.

As indicated in Table 2.3-202, the potentiometric surface of the water table aquifer in the Upland Complex during the monitoring period was approximately 72 – 76 ft. above msl. The potentiometric surface of water in the upper portion of the Catahoula Formation during the monitoring period was between 68 – 72 ft. above msl. Approximately 3 ft. of hydraulic separation exists between the Upland Complex potentiometric surface and the potentiometric surface of groundwater in the Catahoula Formation, although the actual water-bearing zone in the Catahoula Formation is typically 85 ft. beneath the measured water level of wells screened in the Catahoula Formation. This separation indicates the groundwater in the Catahoula Formation near the Unit 3 powerblock is locally confined or semi-confined. Further, these data indicate that there is limited communication locally between the Upland Complex and the Catahoula Formation groundwaters.

The groundwater gradient observed in the Upland Complex is generally to the west toward the Mississippi River, as indicated in Figures 2.3-203A and 203B. These figures are representative of seasonal fluctuations, and include the groundwater gradients for the highest and lowest water table levels during the period from July 2006 through June 2007. The gradient is consistent with the historical gradient reported for the Unit 1 investigations. The Unit 1 UFSAR provides groundwater gradient maps for measurements in May 1973, October 1973, August 1979, November 1979, and December 1979 (Reference 204, Figures 2.4-27, 2.4-34, 2.4-38 2.4-39, and 2.4-40). The May 1973 measurements were conducted when the Mississippi River was under flood conditions and, as shown in ESP ER Table 2.3-5, the 1973 flood had the highest discharge in the last 70 years. The December 1979 measurement was also conducted when the river was under flood conditions. With the exception of the May 1973 map, all the Unit 1 UFSAR maps show a groundwater gradient to the west with water level contours indicating an approximate water level of 65 – 75 ft. msl in the Unit 3 area. The May 1973 map shows an eastward groundwater gradient in the Unit 3 area, with a water level of 84 ft. msl. Measurements during Unit 3 COLA investigations did not show a groundwater gradient reversal; however, reversal is possible when the Mississippi River is in extreme flood stage conditions as also discussed in the ESP Site Safety Analysis Report (SSAR) Subsection 2.4.12.2.3.

Hydrologic impacts during construction and station operations based on the Unit 3 ESBWR design are discussed in Sections 4.2 and 5.2, respectively. The Unit 3 reactor embedment is approximately 70 ft. beneath the final plant grade, with its base at approximately 60 ft. above msl. This embedment depth is located within the Upland Complex, above the Catahoula Formation. Select groundwater monitoring wells provide data for characterization of groundwater conditions in the Upland Complex and Catahoula Formation near the center of the Unit 3 powerblock. Wells OW1008, MW1009B, MW1012B, and OW1013 are screened in the Upland Complex. Wells MW1009C and MW1012C are screened in sand in the upper portion of the Catahoula Formation approximately 50 ft. beneath the wells screened in the Upland Complex. Data in Table 2.3-202, for wells near the center of the powerblock for Unit 3 (wells OW1008, MW1009B, MW1009C, MW1012B, MW1012C, and OW1013), indicate the highest and lowest groundwater elevations measured (data reproduced below).

	Highest Elevation Measured		Lowest Elevation Measured	
	Feet msl	Feet Below TOC*	Feet msl	Feet Below TOC*
Well Screened In				
Catahoula Formation	72.98	61.13	68.00	66.29
Upland Complex	75.80	58.15	71.79	62.45

*TOC – top of casing

Hydrogeologic Properties of Subsurface Materials

Pump tests were completed to define hydrogeologic characteristics of the various aquifers to support the Unit 1 construction. Aquifer tests were completed to design the Unit 1 Ranney well system and the Unit 1 potable water wells. This information is included in the Unit 1 FER (Reference 202) and UFSAR (Reference 204). Additional pump tests were completed to support the Unit 3 COLA site characterization to confirm the hydrogeologic characteristics of select water-bearing strata or aquifers to compare to the Unit 1 data. Pump tests were not completed in the Loess strata with perched groundwater because of the limited extent and indicated saturated thickness. Pump test results are described below.

Mississippi River Alluvium

Well MW1042B was screened within a sand-and-gravel layer in the Mississippi River Alluvium aquifer west of the Loess bluff upon which GGNS is located (See Figure 2.3-201). Data from a step test conducted on monitoring well MW1042B, screened in the Mississippi River Alluvium, indicate a hydraulic conductivity of 1.7 x 10-2 centimeters per second (cm/s) and an intrinsic permeability of 1.7 x 10-7 cm2. The well was screened within a sand-and-gravel layer. The aquifer transmissivity developed from this test is approximately 12,900 gpd/ft.(1,700 ft^2/day). This transmissivity is lower than previous estimates of transmissivity developed from past pumping tests, but previous tests were conducted near the Mississippi River in coarser alluvium deposits. Alluvium aquifer test transmissivity results cited in Table 2.4B-1 of the Unit 1 UFSAR range from 21,500 – 163,500 gpd/ft.

Laboratory tests conducted during the Unit 1 investigations of two samples from the Mississippi River Alluvium indicate hydraulic conductivities of 7.8 x 10^{-8} cm/s and 5.9 x 10^{-8} cm/s. These tests were conducted on silty clay and clayey silt samples.

Although the aquifer transmissivity values from the Unit 3 investigations are somewhat lower than previous Unit 1 test results, these results of the aquifer test for Unit 3 are generally consistent with previous estimates developed during Unit 1 site characterization. As indicated from Unit 1 aquifer tests in the Mississippi River Alluvium, aquifer results may vary dependent upon location of the well, test method utilized, and well penetration of the total aquifer thickness.

<u>Upland Complex</u>

During the Unit 3 COLA investigations, a 72-hr. pumping test was conducted on monitoring well MW1009B, and seven monitoring wells (MW1012B, OW1013, OW1008, OW1068, OW1108, MW1009C, and MW1012C) were gauged during the test. The drawdown measured in observation wells screened in the same zone as the pumping well at the end of the test ranges from 0.6 – 0.8 ft. Measurements continued after pumping ceased until groundwater levels in the wells recovered to static levels. Aquifer characteristics were calculated for each monitoring well surrounding the pumping well, and the results were averaged. Based on these test data, the average aquifer hydraulic conductivity determined from this test is 1.1 x 10-1 cm/s and the average aquifer intrinsic permeability is 1.2 x 10-6 cm2. The aquifer transmissivity developed from this test is approximately 92,000 gpd/ft.(12,300 ft^2/day). This transmissivity is close to the transmissivity developed from the distance-drawdown estimate of the pump test of TW-1 (120,300 gpd/ft.) cited in Table 2.4B-1 of the Unit 1 UFSAR.

Field tests were conducted during the Unit 1 investigations at multiple locations within the Upland Complex. The tests indicated hydraulic conductivities ranging from 1.1 x 10^{-1} – 2.6 x 10^{-4} cm/s. The results from the Unit 3 tests are within the ranges of values determined from the Unit 1 tests.

Monitoring wells MW1009C and MW1012C are screened in the upper portion of the Catahoula Formation. Drawdown measurements were recorded in these wells during the pump test of well MW1009B. No drawdown was detected in either of these two Catahoula Formation monitoring wells during the performance of the pump test. These data further support the conclusion of limited hydraulic communication between the Upland Complex and the Catahoula Formation in the powerblock area of Unit 3.

<u>Catahoula Formation</u>

A 5-hr. pumping test was conducted on monitoring well MW1009C, screened in a sand unit within the upper portion of the Catahoula Formation. Two monitoring wells (MW1012B and MW1012C) were gauged to detect changes in water levels during the test. The drawdown measured in observation well MW1012C (completed in the same zone as the pumping well) at the end of the test is 21.5 ft. Measurements continued after pumping ceased until groundwater levels in the wells recovered to static levels. Aquifer characteristics were calculated for each monitoring well surrounding the pumping well, and the results were averaged. Based on these test data, the average aquifer hydraulic conductivity is 6.6 x 10-4 cm/s and the average aquifer intrinsic permeability is 6.8 x 10-9 cm2. The calculated transmissivity estimate for these upper Catahoula water-bearing strata is approximately 300 gpd/ft.The hydraulic conductivity and transmissivity indicate the limited permeability of the water-bearing strata in the upper portion of the Catahoula Formation.

Laboratory hydraulic conductivity tests were conducted on samples from three borings (B1010, B1014, and two samples from P1109). These samples were collected from finer materials than the materials the pump tests were screened in. The hydraulic conductivities ranged from 1.5×10^{-8} to 1.3×10^{-7} cm/s.

Field and laboratory tests were conducted during the Unit 1 investigations at three locations within the Catahoula Formation. The tests indicated hydraulic conductivities ranging from 2.2×10^{-8} to 6.3×10^{-9} cm/s. The laboratory tests were conducted on samples of fine indurated sand and hard silty clay. The piezometer was screened in clayey sand and sandy silty clay. The hydraulic conductivity results from the Unit 3 laboratory tests are similar to the values determined from the Unit 1 tests, which were conducted on similar materials.

Monitoring wells MW1009C and MW1012C were screened in the upper portion of the Catahoula Formation. Drawdown measurements recorded in well MW1012B during the pump test of well MW1009C indicate no drawdown in that Upland Complex monitoring well during the performance of the upper Catahoula pump test. These data also support the conclusion of limited hydraulic communication between the Upland Complex and the Catahoula in the powerblock area of Unit 3.

Soil Moisture Characteristics

During the COL investigation, 97 soil borings were drilled to characterize subsurface geologic conditions and to obtain laboratory geotechnical test samples. Soil samples were collected from select boreholes for laboratory analyses to provide the following soil characteristics: moisture content, particle size, Atterberg limits, specific gravity, pH, sulfates, and chlorides. Each sample was analyzed in accordance with the appropriate ASTM standard, or other applicable standard and appropriate quality assurance (QA) program. From this investigation, 104 soil samples were submitted for laboratory analysis for moisture content. Table 2.3-203 provides the results of the grain size and moisture content analyses.

2.3.2 WATER USE

2.3.2.1 Surface Water

Subsection 2.6.2.1 of NUREG-1817 provided information regarding area and GGNS surface water use. The following discussions provide supplemental information regarding surface water usage, based on the Unit 3 design.

Plant Use – Unit 3

Table 3.0-201 provides a comparison of bounding parameters for the ESP and parameters for Unit 3, and Table 2.3-204 provides a comparison of the parameters related to hydrology.

Makeup water (cooling tower makeup and other raw water needs), normal service water, fire protection water, and demineralized water for Unit 3 that was included in the original groundwater needs analysis, is supplied from the Mississippi River via an intake located on the east bank of the river on the north side of the existing barge slip. Figure 3.3-201 provides a water use diagram that illustrates specific uses of this makeup water, the amounts required, and the rates of return.

2.3.2.2 Groundwater

Subsection 2.6.2.2 of NUREG-1817 stated that water was pumped from three wells in the Catahoula Formation used for general site purposes, including potable, sanitary, air conditioning, and landscape maintenance. The following discussions provide a correction for this statement regarding groundwater usage for Unit 1. The following discussions also provide supplemental information regarding groundwater usage for Unit 3.

Unit 1 Facility Requirements

Three potable water wells completed within the Upland Complex are currently used to supply water for general site purposes for Unit 1. The ESP ER erroneously stated that water from these wells is supplied from the Catahoula Formation. The Mississippi Department of Environmental Quality (MDEQ) has recognized and concurs that the Unit 1 potable water wells are not screened in the Catahoula Formation.

GGNS currently submits an Annual Water Use Survey to the MDEQ. According to the most recent data available the 2005 calendar year, the facility currently has 18 water wells with a total of 1.12×10^{10} gal. pumped in 2005. This total includes the four radial collector wells rated at 10,000 gpm; three wells used for general site purposes (two in routine use rated at 400 and 500 gpm); and dewatering wells. The average withdrawal rate reported in 2001 for the two potable wells in the Upland Complex that are in routine use was 55 gpm (north well) and 57 gpm (south well), which is well below the rate allowed by the MDEQ permit. The average withdrawal rate reported in 2005 for these same wells was 36 gpm (north well) and 37 gpm (south well). As stated in ESP ER Subsection 2.3.2.2, these two wells operate at near full capacity during Unit 1 refueling outages. Because of this limitation, new wells are necessary to support Unit 3 construction and operations as discussed below.

Unit 3 Requirements

The Unit 3 potable water system (PWS) is designed to supply up to 200 gpm of potable water during peak demand periods. The average demand is 35 gpm. Both of these values fall within the ESP bounding parameter value of 240 gpm.

The installation of one or two additional wells in the Upland Complex is necessary to meet the demand requirements of the PWS. Placement of new groundwater wells is anticipated to be along the bluff area similar to existing wells. The new wells are expected to be screened, as the existing wells are, in the Upland Complex. The Upland Complex deposits are heterogeneous with varying thicknesses of sand and gravel. There is a potential that adequate well spacing cannot be achieved for all the required wells needed during Unit 3 construction and operation due to this depositional heterogeneity. This is discussed in Sections 4.2 and 5.2. As a result, actual well installation and placement are dependent upon confirmation that the thickness and aquifer characteristics of the Upland Complex at the sites selected for new water well installation are appropriate to supply adequate volumes of water for construction and operation of Unit 3. If the Upland Complex cannot meet the demand, additional wells in the Mississippi River Alluvium can adequately meet the groundwater demand.

The upper portion of the Catahoula Formation is impermeable (although thin sand lenses are encountered in the upper portion in some of the Unit 3 borings) and acts as a confining unit. Groundwater levels in wells screened in the Catahoula Formation have a higher potentiometric head than the level of the formation itself, indicating the water is under confined conditions. At well MW1009C, the water-bearing sand lens within the Catahoula Formation is separated from the Upland Complex by approximately 50 ft. of less permeable Catahoula Formation deposits. Pump tests did not result in impacts to the well screened within the Catahoula Formation when the well in the Upland Complex was being pumped. Because of the impermeable nature of the Catahoula Formation underlying the Upland Complex, no significant impacts are expected to the Catahoula Formation as a result of additional withdrawals from the Upland Complex.

The potential impact of withdrawal from the Upland Complex is discussed in Sections 4.2 and 5.2. Potential impact of withdrawal from the Mississippi River Alluvium, if needed, is also discussed in Sections 4.2 and 5.2.

Construction Requirements

NUREG-1817 Subsection 4.3.2 concludes that construction dewatering impacts would be small, temporary, and localized. Historic information on dewatering revealed that dewatering for construction of Unit 1 did not impact the regional water table (Reference 202). An evaluation of proposed dewatering for Unit 3 construction is provided in FSAR Subsection 2.5.4, and impacts are discussed in Subsection 4.2.2.2 of this report.

Construction dewatering is anticipated to pump about 420 gpm (most likely estimate) during excavations to construct Unit 3, based on most likely estimates of horizontal hydraulic conductivity for the Upland Complex. Dewatering is anticipated to extend over a period lasting about 2 years. This dewatering is necessary to achieve approximately 15 – 20 ft. of drawdown in the Upland Complex water table in the vicinity of the excavation. The radius of influence (ROI) in the Upland Complex water table surrounding the excavation is estimated to extend to approximately 600 ft. from the excavation, with a predicted drawdown of essentially zero (about 1 in.) at that distance.

Additional groundwater wells are required for Unit 3 construction activities such as concrete batch plant operation, dust suppression, potable water, and sanitary needs.

The average and maximum construction water use estimates for Unit 3 are shown in Table 4.2-201. It is anticipated for construction activities to require a maximum of 115 gpm of water to supply concrete batch plant operation, dust suppression, makeup to fire protection tanks, and sanitary needs.

Water for construction of Unit 3 is expected to be provided by the withdrawal of groundwater from wells installed in the Upland Complex aquifer or the Mississippi River Alluvium, both of which overlie the Catahoula Formation. It is anticipated that one or two additional new wells are required to provide water for the concrete batch plant operation, dust suppression, and potable water supply for construction site workers. Installation of the new wells is anticipated in the Upland Complex in the vicinity of the existing three wells along the bluff area as described above for Unit 3 station operations, but may be sited within the Mississippi River Alluvium west of the bluff if adequate aquifer thickness is not available in the Upland Complex. Plant construction plans do not require groundwater withdrawal from the Catahoula Formation.

2.3.3 WATER QUALITY

2.3.3.1 Surface Water Quality

In Subsection 2.6.3.3 of NUREG-1817, the NRC staff found the thermal plume data for the existing Unit 1 discharge are currently inadequate to calibrate the CORMIX model. This subsection provides supplemental data to support the thermal impact evaluation.

2.3.3.1.1 Mississippi River

2.3.3.1.2 Physical Properties of Surface Waters

Flow Velocity

A bathymetric survey including temperature and velocity measurements was conducted in October 2006 in the Mississippi River in the vicinity of the proposed Unit 3 intake and discharge structures. A cross section of the Mississippi River completed as part of the bathymetric survey is illustrated in Figures 2.3-205 and 2.3-206. These data are generally consistent with published U.S. Army Corps of Engineers (USACE) hydrographic maps referenced in the ESP ER submittal.

The proposed Unit 3 intake lines are located approximately 365 ft. inside the mouth of the intake embayment. The outfall diffuser is located approximately 310 ft. downstream of the mouth of the intake embayment. Figure 2.3-207 shows the locations of waypoints used for temperature and velocity measurements, and Table 2.3-205 provides a summary of the results. Velocity measurements were taken at the surface, then at 5 ft. intervals to a depth of 15 ft. below the water surface (where allowable due to total depth at that location). Velocity measurements near the location of the proposed Unit 3 and Unit 1 combined outfall (waypoints 31 – 36) ranged from 1.5 – 0.35 ft. per second (ft/s) at the surface, 1.39 – 0.31 ft/s at 5 ft. below the surface, 1.38 – 0.12 ft/s at 10 ft. below the surface, and 1.42 – 0.28 ft/s at 15 ft. below the surface. The higher flow rates were recorded at the waypoints located further away from the river bank. The flow rates recorded during the 2006 survey are lower than the low-flow scenario (2.5 ft/s) assumed in the CORMIX plume model described in NUREG-1817 Subsection 5.3.3.1. The highest flows in the Mississippi River are typically in February through May (NUREG-1817, Section 2.6). Lower flow velocities are typical in the fall, thus the velocity measurements described during the 2006 survey are expected to reflect conservative conditions for evaluating recirculation of discharges from the Unit 3 discharge and its intake. Further, the flow rates recorded during the 2006 survey were measured relatively close to the shoreline, which may also have contributed to the low flow rates observed.

Based on the location of the outfall diffuser outside and downstream of the intake embayment and the velocity characteristics defined in the bathymetric survey analyses, recirculation to the embayment area and intake pipes is not expected.

The licensee is required to coordinate with the USACE and MDEQ to obtain authorizations for construction of the intake structure. The design and placement of the intake structure is in accordance with the USACE guidance, and meets the technology requirements of §316(b) of the Clean Water Act.

Water Temperature

Figure 2.3-207 shows the locations of waypoints used for temperature and velocity measurements, and Table 2.3-205 provides measurement data. Temperature measurements were taken at the surface and at 5-ft. intervals to a depth of 15 ft. below the water surface (where depth allowed). In general, the temperature did not vary with depth (aside from measurements taken near the discharge for Unit 1), which is consistent with data from the original studies in the 1970s. These data confirm the results of the 1973 sampling that the rate of temperature change with depth in the main channel of the river is extremely small. In addition, the temperature readings upriver and downriver of GGNS show little variation.

Table 2.3-206 provides recent USACE water temperature data for the Mississippi River at Vicksburg, Mississippi.

Area Conditions

The scope of this section is addressed in the ESP ER Subsection 2.3.3.1, and in NUREG-1817 Subsection 2.6.3.1.

Plant Site Conditions

The scope of this section is addressed in the ESP ER Subsection 2.3.3.1, and in NUREG-1817 Subsection 2.6.3.1.

2.3.3.2 Groundwater

Area Conditions

The information for this subsection is provided in Subsection 2.3.3.2 of the ESP ER, and in NUREG-1817 Subsection 2.6.3.2.

Plant Site Conditions

The NRC stated in NUREG-1817 that some of the construction activities at the GGNS site were not known at the ESP stage, so the NRC Staff's analysis of groundwater impacts was not performed to the depth warranted for actual construction. Based on the information provided at the ESP stage, the NRC stated in NUREG-1817 Subsection 4.3.3 that the impacts on the Catahoula Formation could be SMALL if the proposed withdrawal had little effect on the Catahoula Formation or LARGE if the proposed withdrawal were to induce degradation of the water quality of the sole source aquifer. NUREG-1817 Subsection 4.3.3 included a need for the Applicant to provide additional information on the ability of the Catahoula aquifer to sustain proposed withdrawals in order for the staff to make a significance determination with respect to this resource.

As discussed above, groundwater withdrawal for Unit 3 from the Catahoula Formation is not expected. The separation of the Catahoula Formation is indicated by the differences in water levels in the Catahoula Formation wells during gauging events, the lack of impacts on Catahoula Formation wells during the Upland Complex pump tests, and the laboratory hydraulic conductivity results. Unit 1 groundwater use is anticipated to continue to be from the Upland Complex. Future groundwater use for Unit 3 construction, and Unit 1 and Unit 3 operations, is expected to be supplied by the Upland Complex and/or the Mississippi River Alluvium. The primary recharge of the Catahoula Formation lies north of GGNS in Warren and Hinds Counties, although some limited recharge may occur near the site. The investigations of groundwater occurrence and characteristics of water-bearing units beneath GGNS indicate limited recharge, if any, occurs directly at the site. Therefore, Unit 3 construction and operation would not be expected to cause degradation of Catahoula Formation water quality. Groundwater, to any practical extent, is not withdrawn from this or any sole source aquifer.

2.3.4 REFERENCES

201 U.S. Nuclear Regulatory Commission, System Energy Resources, Inc., Grand Gulf Early Site Permit, Site Docket No. 52-009, Early Site Permit ESP-002, April 5, 2007

202 GGNS Unit 1 Final Environmental Report (FER), Section 2.3, March 1979.

203 Saucier, Roger T., Geomorphology and Quaternary Geologic History of the Lower Mississippi Valley, U.S. Army Engineer Waterways Experiment Station, December 1994.

204 GGNS Unit 1 Updated Final Safety Analysis Report (UFSAR), Subsection 2.4.12, June 2007.

TABLE 2.3-201 (SHEET 1 OF 6)
WELL INSTALLATION INFORMATION

Well ID	Top of Casing Elevation (ft. msl)	Ground Surface Elevation (ft. msl)	Screened Interval (depth below ground surface (bgs))	Screened Interval (ft. msl)	Casing Diameter (in.)	Formation
MW1007A	133.32	133.36	50.1	83.26	2	Loess
			64.5	68.86		
MW1007B	133.57	133.36	77.6	55.76	2	Upland Complex
			92.0	41.36		
MW1007C	133.16	133.36	148.5	-15.14	4	Catahoula
			162.9	-29.54		
OW1008	134.20	134.34	75.1	59.24	2	Upland Complex
			94.5	39.84		
MW1009B	134.09	134.38	74.75	59.63	6	Upland Complex
			99.15	35.23		
MW1009C	134.11	134.38	148.25	-13.87	4	Catahoula
			167.65	-33.27		
MW1012B	134.24	134.14	74.25	59.89	6	Upland Complex
			98.65	35.49		

TABLE 2.3-201 (SHEET 2 OF 6)
WELL INSTALLATION INFORMATION

Well ID	Top of Casing Elevation (ft. msl)	Ground Surface Elevation (ft. msl)	Screened Interval (depth below ground surface (bgs))	Screened Interval (ft. msl)	Casing Diameter (in.)	Formation
MW1012C	134.29	134.14	149.75	-15.61	4	Catahoula
			169.15	-35.01		
OW1013	133.95	134.18	75.25	58.93	2	Upland Complex
			94.65	39.53		
MW1016A	158.16	155.57	65.1	90.47	2	Loess
			74.5	81.07		
MW1016B	158.40	155.57	95.1	60.47	4	Upland Complex
			114.5	41.07		
MW1019A	133.79	133.78	41.75	92.03	2	Loess
			51.15	82.63		
MW1019B	133.52	133.78	88.75	45.03	2	Upland Complex
			108.15	25.63		
MW1020B	132.52	132.20	60.1	72.10	2	Upland Complex
			79.5	52.70		
MW1020C	132.60	132.20	120.1	12.10	4	Catahoula
			139.5	-7.30		

TABLE 2.3-201 (SHEET 3 OF 6)
WELL INSTALLATION INFORMATION

Well ID	Top of Casing Elevation (ft. msl)	Ground Surface Elevation (ft. msl)	Screened Interval (depth below ground surface (bgs))	Screened Interval (ft. msl)	Casing Diameter (in.)	Formation
MW1022B	133.56	133.72	89.75	43.97	2	Upland Complex
			109.15	24.57		
MW1023A	157.69	155.33	65.1	90.23	2	Loess
			74.5	80.83		
MW1023B	157.78	155.33	80.1	75.23	2	Upland Complex
			99.5	55.83		
MW1024A	158.22	155.88	50.1	105.78	2	Loess
			69.5	86.38		
MW1024B	158.41	155.88	90.1	65.78	2	Upland Complex
			109.5	46.38		
MW1024C	158.41	155.88	154.9	0.98	4	Catahoula
			174.3	-18.42		
MW1025A	147.83	147.61	55.1	92.51	2	Loess
			69.5	78.11		
MW1025B	147.18	147.61	90.1	57.51	2	Upland Complex
			109.5	38.11		

TABLE 2.3-201 (SHEET 4 OF 6)
WELL INSTALLATION INFORMATION

Well ID	Top of Casing Elevation (ft. msl)	Ground Surface Elevation (ft. msl)	Screened Interval (depth below ground surface (bgs))	Screened Interval (ft. msl)	Casing Diameter (in.)	Formation
MW1026A	131.68	131.66	30.1	101.56	2	Loess
			39.5	92.16		
MW1026B	131.81	131.66	80.1	51.56	2	Upland Complex
			99.5	32.16		
MW1027A	133.14	133.31	35.1	98.21	2	Loess
			49.5	83.81		
MW1027B	132.89	133.31	84.1	49.21	2	Upland Complex
			98.5	34.81		
MW1027C	133.24	133.31	158.1	-24.79	4	Catahoula
			167.5	-34.19		
MW1033A	158.24	155.45	55.1	100.35	2	Loess
			69.5	85.95		
MW1033B	158.54	155.45	85.1	70.35	2	Upland Complex
			89.5	65.95		
MW1040A	161.36	158.88	69.75	89.13	2	Loess
			79.15	79.73		

TABLE 2.3-201 (SHEET 5 OF 6)
WELL INSTALLATION INFORMATION

Well ID	Top of Casing Elevation (ft. msl)	Ground Surface Elevation (ft. msl)	Screened Interval (depth below ground surface (bgs))	Screened Interval (ft. msl)	Casing Diameter (in.)	Formation
MW1040B	161.47	158.88	94.75	64.13	4	Upland Complex
			114.15	44.73		
MW1042B	87.09	84.57	32.75	51.82	2	Mississippi River
			47.15	37.42		Alluvium
MW1042C	86.53	84.56	83.75	0.81	2	Catahoula
			98.15	-13.59		
MW1043A	121.45	121.61	30.1	91.51	2	Loess
			44.5	77.11		
MW1043B	121.84	121.61	60.1	61.51	2	Upland Complex
			74.5	47.11		
MW1045B	100.24	99.60	70.25	29.35	2	Mississippi River
			84.65	14.95		Alluvium
OW1068	158.19	155.81	90.25	65.56	2	Upland Complex
			109.65	46.16		
MW1082B	199.18	196.14	77.6	118.54	2	Upland Complex
			97.0	99.14		

TABLE 2.3-201 (SHEET 6 OF 6)
WELL INSTALLATION INFORMATION

Well ID	Top of Casing Elevation (ft. msl)	Ground Surface Elevation (ft. msl)	Screened Interval (depth below ground surface (bgs))	Screened Interval (ft. msl)	Casing Diameter (in.)	Formation
MW1082C	199.18	196.14	149.1	47.04	4	Catahoula
			168.5	27.64		
OW1108	134.01	134.26	75.25	59.01	2	Upland Complex
			94.65	39.61		
MW1134A	136.25	133.39	44.75	88.64	2	Loess
			54.15	79.24		
MW1134B	136.45	133.77	69.75	64.02	2	Upland Complex
			84.15	49.62		
MW1134C	136.91	133.97	153.75	-19.78	4	Catahoula
			163.15	-29.18		

TABLE 2.3-202 (SHEET 1 OF 8)
GROUNDWATER LEVEL DATA

Well ID	Top Of Casing Elevation (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)
		July 2006		August 2006		September 2006		October 2006		November 2006		December 2006	
MW1007A	133.32	56.88	76.44	57.26	76.06	57.44	75.88	57.63	75.69	57.78	75.54	57.87	75.45
MW1007B	133.57	58.78	74.79	59.53	74.04	60.60	72.97	61.16	72.41	61.08	72.49	61.24	72.33
MW1007C	133.16	64.56	68.60	65.52	67.64	66.73	66.43	67.24	65.92	67.24	65.92	67.07	66.09
OW1008	134.20	59.73	74.47	60.49	73.71	61.58	72.62	62.10	72.10	62.02	72.18	62.20	72.00
MW1009B	134.09	59.74	74.35	60.51	73.58	61.54	72.55	62.15	71.94	62.05	72.04	62.25	71.84
MW1009C	134.11	63.38	70.73	64.36	69.75	65.43	68.68	66.00	68.11	66.06	68.05	66.05	68.06
MW1012B	134.24	59.97	74.27	60.73	73.51	61.74	72.50	62.35	71.89	62.27	71.97	62.45	71.79
MW1012C	134.29	63.71	70.58	64.52	69.77	65.70	68.59	66.08	68.21	66.29	68.00	66.24	68.05
OW1013	133.95	59.50	74.45	NM*		61.28	72.67	61.88	72.07	61.78	72.17	62.00	71.95
MW1016A[1]	158.16	Dry	Dry	78.44	79.72	78.44	79.72	78.46	79.70	78.45	79.71	78.45	79.71
MW1016B	158.40	84.28	74.12	84.92	73.48	85.96	72.44	86.54	71.86	86.55	71.85	86.70	71.70
MW1019A	133.79	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
MW1019B	133.52	59.26	74.26	59.98	73.54	60.95	72.57	61.53	71.99	61.47	72.05	61.64	71.88

TABLE 2.3-202 (SHEET 2 OF 8)
GROUNDWATER LEVEL DATA

Well ID	Top Of Casing Elevation (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)
		July 2006		August 2006		September 2006		October 2006		November 2006		December 2006	
MW1020B	132.52	57.14	75.38	57.82	74.70	58.75	73.77	59.37	73.15	59.40	73.12	59.50	73.02
MW1020C	132.60	58.13	74.47	58.80	73.80	59.70	72.90	60.26	72.34	60.24	72.36	60.39	72.21
MW1022B	133.56	59.19	74.37	59.84	73.72	60.78	72.78	61.08	72.48	61.33	72.23	61.47	72.09
MW1023A	157.69	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
MW1023B	157.78	84.27	73.51	84.93	72.85	86.03	71.75	86.55	71.23	86.56	71.22	86.75	71.03
MW1024A	158.22	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
MW1024B	158.41	84.60	73.81	85.24	73.17	86.25	72.16	86.76	71.65	86.82	71.59	86.99	71.42
MW1024C	158.41	84.56	73.85	85.22	73.19	86.18	72.23	86.73	71.68	86.84	71.57	86.90	71.51
MW1025A	147.83	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
MW1025B	147.18	72.61	74.57	73.24	73.94	74.13	73.05	73.63	73.55	74.75	72.43	74.86	72.32
MW1026A	131.68	39.42	92.26	39.44	92.24	39.21	92.47	39.44	92.24	39.44	92.24	39.43	92.25
MW1026B	131.81	55.58	76.23	56.26	75.55	56.93	74.88	57.54	74.27	57.60	74.21	57.74	74.07
MW1027A	133.14	44.59	88.55	44.79	88.35	45.11	88.03	45.14	88.00	45.10	88.04	45.12	88.02

TABLE 2.3-202 (SHEET 3 OF 8)
GROUNDWATER LEVEL DATA

Well ID	Top Of Casing Elevation (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)
		July 2006		August 2006		September 2006		October 2006		November 2006		December 2006	
MW1027B	132.89	57.30	75.59	58.08	74.81	59.11	73.78	59.73	73.16	59.59	73.30	59.76	73.13
MW1027C	133.24	65.41	67.83	66.36	66.88	67.66	65.58	68.19	65.05	68.03	65.21	67.88	65.36
MW1033A	158.24	64.71	93.53	64.95	93.29	65.52	92.72	65.44	92.80	65.70	92.54	65.84	92.40
MW1033B	158.54	66.58	91.96	66.89	91.65	67.18	91.36	67.45	91.09	67.16	91.38	67.82	90.72
MW1040A	161.36	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
MW1040B	161.47	85.00	76.47	85.76	75.71	86.70	74.77	87.28	74.19	87.13	74.34	87.12	74.35
MW1042B	87.09	14.19	72.90	14.82	72.27	15.75	71.34	16.24	70.85	16.23	70.86	16.32	70.77
MW1042C	86.53	13.92	72.61	14.61	71.92	15.53	71.00	15.94	70.59	15.91	70.62	15.88	70.65
MW1043A	121.45	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
MW1043B	121.84	48.54	73.30	49.23	72.61	50.36	71.48	50.91	70.93	50.84	71.00	51.02	70.82
MW1045B	100.24	27.57	72.67	28.27	71.97	29.44	70.80	29.93	70.31	29.83	70.41	29.96	70.28
OW1068	158.19	84.07	74.12	84.79	73.40	85.82	72.37	86.42	71.77	86.38	71.81	86.54	71.65
MW1082B	199.18	89.54	109.64	89.55	109.63	88.61	110.57	89.76	109.42	89.86	109.32	89.88	109.30

TABLE 2.3-202 (SHEET 4 OF 8)
GROUNDWATER LEVEL DATA

Well ID	Top Of Casing Elevation (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)
		July 2006		August 2006		September 2006		October 2006		November 2006		December 2006	
MW1082C	199.18	90.01	109.17	90.05	109.13	91.16	108.02	91.33	107.85	91.50	107.68	91.52	107.66
OW1108	134.01	59.70	74.31	60.45	73.56	61.48	72.53	62.08	71.93	62.00	72.01	62.18	71.83
MW1134A[1]	136.25	57.73	78.52	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
MW1134B	136.45	60.08	76.37	60.85	75.60	61.89	74.56	62.52	73.93	62.34	74.11	62.50	73.95
MW1134C	136.91	70.41	66.50	71.40	65.51	72.73	64.18	73.25	63.66	73.17	63.74	72.84	64.07

*NM – not measured, well inaccessible
[1]-Water level below screened interval

TABLE 2.3-202 (SHEET 5 OF 8)
GROUNDWATER LEVEL DATA

Well ID	Top Of Casing Elevation (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)
		January 2007		February 2007		March 2007		April 2007		May 2007		June 2007	
MW1007A	133.32	57.91	75.41	57.27	76.05	57.27	76.05	57.43	75.89	57.02	76.30	57.19	76.13
MW1007B	133.57	60.09	73.48	57.97	75.60	58.66	74.91	58.89	74.68	57.52	76.05	58.91	74.66
MW1007C	133.16	66.08	67.08	62.95	70.21	63.34	69.82	62.67	70.49	61.65	71.51	63.23	69.93
OW1008	134.20	61.02	73.18	58.90	75.30	59.60	74.60	NM	NM	58.36	75.84	59.80	74.40
MW1009B	134.09	61.08	73.01	58.94	75.15	59.62	74.47	59.85	74.24	58.39	75.70	59.82	74.27
MW1009C	134.11	65.00	69.11	62.24	71.87	62.69	71.42	62.32	71.79	61.13	72.98	62.67	71.44
MW1012B	134.24	61.28	72.96	59.15	75.09	59.80	74.44	60.05	74.19	58.59	75.65	60.01	74.23
MW1012C	134.29	65.22	69.07	62.41	71.88	62.87	71.42	62.54	71.75	61.32	72.97	62.86	71.43
OW1013	133.95	60.79	73.16	58.68	75.27	59.35	74.60	59.60	74.35	58.15	75.80	59.58	74.37
MW1016A[1]	158.16	78.44	79.72	78.44	79.72	78.44	79.72	78.42	79.74	78.44	79.72	78.44	79.72
MW1016B	158.40	85.60	72.80	83.50	74.90	84.10	74.30	84.29	74.11	82.90	75.50	84.30	74.10
MW1019A	133.79	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
MW1019B	133.52	60.56	72.96	58.56	74.96	59.10	74.42	59.36	74.16	57.98	75.54	59.31	74.21

TABLE 2.3-202 (SHEET 6 OF 8)
GROUNDWATER LEVEL DATA

Well ID	Top Of Casing Elevation (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)
		January 2007		February 2007		March 2007		April 2007		May 2007		June 2007	
MW1020B	132.52	58.60	73.92	56.55	75.97	57.06	75.46	57.41	75.11	56.14	76.38	57.33	75.19
MW1020C	132.60	59.36	73.24	57.47	75.13	57.95	74.65	58.20	74.40	56.93	75.67	58.22	74.38
MW1022B	133.56	60.42	73.14	58.47	75.09	58.99	74.57	59.27	74.29	57.97	75.59	59.25	74.31
MW1023A	157.69	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
MW1023B	157.78	85.58	72.20	83.32	74.46	84.10	73.68	84.16	73.62	82.68	75.10	84.20	73.58
MW1024A	158.22	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
MW1024B	158.41	85.92	72.49	83.83	74.58	84.40	74.01	84.62	73.79	83.66	74.75	84.58	73.83
MW1024C	158.41	85.76	72.65	83.93	74.48	84.33	74.08	84.52	73.89	83.22	75.19	85.58	73.83
MW1025A	147.83	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
MW1025B	147.18	73.90	73.28	71.95	75.23	72.41	74.77	72.61	74.57	71.45	75.73	72.69	74.49
MW1026A	131.68	39.46	92.22	39.43	92.25	39.43	92.25	39.44	92.24	39.43	92.25	39.44	92.24
MW1026B	131.81	56.94	74.87	55.03	76.78	55.41	76.40	55.72	76.09	54.78	77.03	55.81	76.00
MW1027A	133.14	45.23	87.91	45.16	87.98	45.26	87.88	45.36	87.78	45.56	87.58	45.74	87.40

TABLE 2.3-202 (SHEET 7 OF 8)
GROUNDWATER LEVEL DATA

Well ID	Top Of Casing Elevation (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)
		January 2007		February 2007		March 2007		April 2007		May 2007		June 2007	
MW1027B	132.89	58.58	74.31	56.55	76.34	57.23	75.66	57.51	75.38	56.22	76.67	57.55	75.34
MW1027C	133.24	66.99	66.25	63.65	69.59	64.03	69.21	63.22	70.02	62.21	71.03	63.88	69.36
MW1033A	158.24	66.06	92.18	66.20	92.04	66.35	91.89	66.48	91.76	66.63	91.61	66.77	91.47
MW1033B	158.54	67.91	90.63	67.79	90.75	68.00	90.54	68.23	90.31	68.26	90.28	68.51	90.03
MW1040A	161.36	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
MW1040B	161.47	87.83	73.64	84.13	77.34	84.57	76.90	85.12	76.35	84.61	76.86	85.68	75.79
MW1042B	87.09	14.74	72.35	13.09	74.00	13.62	73.47	13.88	73.21	12.64	74.45	14.10	72.99
MW1042C	86.53	14.13	72.40	13.42	73.11	13.07	73.46	13.23	73.30	12.06	74.47	13.78	72.75
MW1043A	121.45	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
MW1043B	121.84	49.75	72.09	47.49	74.35	48.29	73.55	48.37	73.47	46.84	75.00	48.44	73.40
MW1045B	100.24	28.53	71.71	26.37	73.87	27.08	73.16	27.04	73.20	25.47	74.77	27.30	72.94
OW1068	158.19	85.38	72.81	83.19	75.00	83.89	74.30	84.05	74.14	82.60	75.59	84.08	74.11
MW1082B	199.18	89.91	109.27	89.93	109.25	90.15	109.03	90.13	109.05	90.24	108.94	90.36	108.82

TABLE 2.3-202 (SHEET 8 OF 8)
GROUNDWATER LEVEL DATA

Well ID	Top Of Casing Elevation (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)	Depth To Water (ft.)	Water Elev. (ft. msl)
		January 2007		February 2007		March 2007		April 2007		May 2007		June 2007	
MW1082C	199.18	91.54	107.64	91.82	107.36	92.02	107.16	92.12	107.06	92.25	106.93	92.48	106.70
OW1108	134.01	61.01	73.00	58.90	75.11	59.55	74.46	59.81	74.20	58.36	75.65	59.77	74.24
MW1134A[1]	136.25	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
MW1134B	136.45	61.34	75.11	59.37	77.08	60.00	76.45	60.33	76.12	59.15	77.30	60.42	76.03
MW1134C	136.91	71.86	65.05	68.32	68.59	68.70	68.21	67.68	69.23	67.72	69.19	68.55	68.36

*NM – not measured, well inaccessible
[1]-Water level below screened interval

TABLE 2.3-203 (SHEET 1 OF 11)
SUMMARY OF SOIL CLASSIFICATION AND SOIL MOISTURE CONTENT

Boring Number	Depth(3) (ft.)	Sample Type(6)	Gravel(1) (%)	Sand(1) (%)	Fines(1,2) (%)	Silt(1) (%)	0.005mm Clay(1) (%)	USCS Symbol(7)	Natural Moisture (%)
B-1007	85-86.5	SPT	30.7	65.8	3.5			SP	
B-1007	110-111.5	SPT						CH	22.6
B-1008B	85-86.5	SPT						CL	20.7
B-1008B	90-91.5	SPT	45.4	47.6	7.0			SP-SM	
B-1008B	105-106.5	SPT						CH	21.6
B-1008B	125-126.5	SPT						CH	23.2
B-1009	68.5-70	SPT	0.0	10.1	89.9	70.4	19.4	CL	25.3
B-1009	83.5-85	SPT	0.0	88.1	11.6			SP-SM	
B-1009	88.5-90.0	SPT						CL	26.1
B-1009	93.5-95.0	SPT	28.3	44.3	27.4			SM	
B-1009	108.5-110.0	SPT						CH	18.6
B-1009	138.5-140.0	SPT						MH	27.7
B-1009	163.5-165.0	SPT		73.7	26.3			SM	
B-1010	65-67	SPT		28.8	71.2			ML	
B-1010	67-68.5	SPT							18.1

TABLE 2.3-203 (SHEET 2 OF 11)
SUMMARY OF SOIL CLASSIFICATION AND SOIL MOISTURE CONTENT

Boring Number	Depth[3] (ft.)	Sample Type[6]	Gravel[1] (%)	Sand[1] (%)	Fines[1,2] (%)	Silt[1] (%)	0.005mm Clay[1] (%)	USCS Symbol[7]	Natural Moisture (%)
B-1010	75.0-76.5	SPT		27.1	72.9				
B-1010	95.0-96.5	SPT	46.0	50.2	3.8			SP	
B-1010	100.0-101.5	SPT						CL	21.4
B-1010	118.0-119.5	SPT						CH	24.2
B-1010	128.0-129.5	SPT		88.7	11.3			SP-SM	
B-1011	38.2-39.2	SPT							18.6
B-1012	9.0-10.0	Soil Core		0.6	99.4	88.3	11.1	ML	
B-1012	9.0-10.0	Soil Core							14.0
B-1012	19.0-20.0	Soil Core		0.2	98.8	88.0	11.8	ML	
B-1012	19.0-20.0	Soil Core							17.6
B-1012	29.0-30.0	Soil Core		0.4	99.6	89.6	10.0	ML	
B-1012	29.0-30.0	Soil Core							14.5
B-1012	39.0-40.0	Soil Core	0.1	0.6	99.3	90.5	8.8	ML	
B-1012	39.0-40.0	Soil Core							14.9
B-1012	49.0-50.0	Soil Core		0.9	99.1	90.1	9.0	ML	
B-1012	49.0-50.0	Soil Core							15.7

TABLE 2.3-203 (SHEET 3 OF 11)
SUMMARY OF SOIL CLASSIFICATION AND SOIL MOISTURE CONTENT

Boring Number	Depth(3) (ft.)	Sample Type(6)	Gravel(1) (%)	Sand(1) (%)	Fines(1,2) (%)	Silt(1) (%)	0.005mm Clay(1) (%)	USCS Symbol(7)	Natural Moisture (%)
B-1012	64.0-65.0	Soil Core		7.4	92.6	64.6	28.0	ML	
B-1012	64.0-65.0	Soil Core							18.8
B-1012	72.0-73.0	Soil Core		14.2	85.8	65.8	20.0	CL	24.4
B-1012	75.3-76.5	SPT		98.9	1.1			SP	
B-1012	80.5-81.5	SPT		99.0	1.0			SP	
B-1012	85.0-86.5	SPT		99.8	0.2			SP	
B-1012	90.0-90.9	SPT	10.1	84.6	5.3			SP-SM	
B-1012	94.0-95.5	SPT	45.3	50.2	4.5			SP	
B-1012	100.0-101.5	SPT		13.7	86.3	56.7	29.6	CL	51.6
B-1012	115.0-116.5	SPT		2.7	97.3	59.7	37.6	CL	27.2
B-1012	125.0-126.5	SPT		33.7	66.3	37.8	28.5	CL	19.6
B-1012	145.0-146.5	SPT		1.6	98.4	51.3	47.1	CH	33.6
B-1012	170.0-171.5	SPT		11.5	88.5	70.9	17.6	CL	25.0
B-1012	195.0-195.5	SPT		18.8	81.2	58.7	22.5	CL	26.7
B-1013	75-77.1	UD	0.6	66.0	33.4				
B-1013	77.0-78.5	SPT		91.1	8.9			SP-SM	

TABLE 2.3-203 (SHEET 4 OF 11)
SUMMARY OF SOIL CLASSIFICATION AND SOIL MOISTURE CONTENT

Boring Number	Depth[3] (ft.)	Sample Type[6]	Gravel[1] (%)	Sand[1] (%)	Fines[1,2] (%)	Silt[1] (%)	0.005mm Clay[1] (%)	USCS Symbol[7]	Natural Moisture (%)
B-1013	90.2-91.7	SPT	3.5	94.5	2.0			SP	
B-1013	108.0-109.5	SPT						MH	26.7
B-1013	128.0-129.5	SPT						CL	16.9
B-1013	133.0-134.5	SPT		47.8	52.2			ML	
B-1014	75-76	UD		94.9	5.1				11.9
B-1015	33.5-35.0	SPT							17.2
B-1030	68.5-70.0	SPT						CL	18.7
B-1030	73.5-75.0	SPT						CL	22.6
B-1030	83.5-85.0	SPT		81.5	18.5				
B-1030	98.5-100.0	SPT						CL	21.2
B-1032	68.5-70.0	SPT						CH	20.4
B-1032	88.5-90.0	SPT		84.4	15.6			SM	
B-1032	108.5-110.0	SPT	55.6	40.1	4.3			GW	
B-1035	78.5-80.0	SPT						CL	19.1
B-1035	83.5-85.0	SPT		29.9	70.1	54.6	15.5	CL	
B-1035	88.5-90.0	SPT		92.0	8.0				

TABLE 2.3-203 (SHEET 5 OF 11)
SUMMARY OF SOIL CLASSIFICATION AND SOIL MOISTURE CONTENT

Boring Number	Depth(3) (ft.)	Sample Type(6)	Gravel(1) (%)	Sand(1) (%)	Fines(1,2) (%)	Silt(1) (%)	0.005mm Clay(1) (%)	USCS Symbol(7)	Natural Moisture (%)
B-1035	93.5-95.0	SPT	3.4	44.3	52.3			CL	
B-1035	108.5-110.0	SPT	51.8	45.3	2.9			GW	
B-1035	123.5-125.0	SPT		7.0	93.0	69.2	23.8	CH	19.8
B-1040	109.0-110.5	SPT			97.1			CL	26.5
B-1043	12	Soil Core		1.2	98.8	91.3	7.5	ML	
B-1043	35	Soil Core	7.1	10.7	82.2	73.3	8.9	ML	
B-1044	28.5-30.0	SPT						ML	23.6
B-1045	10.0-12.0	Soil Core							1.4 (4)
B-1045	70.0-71.5	SPT						CL	38.6
B-1048	23.5-24.5	SPT		64.7	35.3			SM	
B-1048	53.5-55.0	SPT	0.4	99.2	0.4			SP	
B-1049	15.5-17.0	SPT							19.2
B-1049	20.5-22.0	SPT							39.3
B-1049	40.5-42.0	SPT						CL	34.3
B-1049	60.5-62.0	SPT	45.6	44.9	9.5			ND	
B-1050	10.0-11.5	SPT							5.8

TABLE 2.3-203 (SHEET 6 OF 11)
SUMMARY OF SOIL CLASSIFICATION AND SOIL MOISTURE CONTENT

Boring Number	Depth[3] (ft.)	Sample Type[6]	Gravel[1] (%)	Sand[1] (%)	Fines[1,2] (%)	Silt[1] (%)	0.005mm Clay[1] (%)	USCS Symbol[7]	Natural Moisture (%)
B-1050	20.0-21.5	SPT						ML	38.6
B-1050	55.0-56.5	SPT		93.6	6.4			SP-SM	
B-1050	65.0-66.5	SPT		84.4	15.6			SM	
B-1059	3.5-5.0	SPT							13.6
B-1059	18.5-20.0	SPT							12.9
B-1061	3.5-5.0	SPT							15.6
B-1061	8.5-10.0	SPT							18.0
B-1079	105.0-106.5	SPT	1.8	83.0	15.2			ND	
B-1084	34.5-36.0	SPT							20.8
B-1100	73.5-74.4	SPT		81.0	19.0	14.0	5.0	SM	18.3
B-1100	83.5-85.0	SPT		93.1	6.9			ND	
B-1100	103.5-105.0	SPT						CH	21.3
B-1100	127.5-129.0	SPT						CL	23.5
B-1101	73.0-74.5	SPT		88.3	11.7			SP-SC	
B-1101	78.0-79.5	SPT		43.0	57.0			ML	
B-1101	83.5-85.0	SPT						CL	14.5

TABLE 2.3-203 (SHEET 7 OF 11)
SUMMARY OF SOIL CLASSIFICATION AND SOIL MOISTURE CONTENT

Boring Number	Depth(3) (ft.)	Sample Type(6)	Gravel(1) (%)	Sand(1) (%)	Fines(1,2) (%)	Silt(1) (%)	0.005mm Clay(1) (%)	USCS Symbol(7)	Natural Moisture (%)
B-1101	94.0-95.5	SPT	51.5	46.5	2.0			GW	
B-1101	128.0-129.5	SPT						CL	24.0
B-1102	67.5-69.0	SPT						ML	29.7
B-1102	81-83.5	UD							24.6
B-1103	70.0-70.4	SPT		18.1	81.9			CL	
B-1103	75.0-76.5	SPT		76.0	24.0			SM	
B-1104	68.0-69.5	SPT			77.7			CL	
B-1104	78.0-79.5	SPT		88.3	11.7			SP-SM	
B-1104	94.0-95.5	SPT	59.9	38.2	1.9			GW	
B-1104	104.0-1-5.5	SPT						CL	25.8
B-1104	123.0-124.5	SPT						MH	24.9
B-1104	133.0-134.5	SPT		74.8	25.2			SM	
B-1104	143.0-144.5	SPT						MH	31.4
P-1105	73.5-76	UD		15.0	85.0				20.1 (5)
P-1105	76-77.5	UD		95.9	4.1			SP	23.8
P-1105	96-98.5	UD	6.5	46.7	46.8	34.1	12.7	SC	17.7

TABLE 2.3-203 (SHEET 8 OF 11)
SUMMARY OF SOIL CLASSIFICATION AND SOIL MOISTURE CONTENT

Boring Number	Depth(3) (ft.)	Sample Type(6)	Gravel(1) (%)	Sand(1) (%)	Fines(1,2) (%)	Silt(1) (%)	0.005mm Clay(1) (%)	USCS Symbol(7)	Natural Moisture (%)
P-1105	98.5-100.0	UD	85.9	7.7	6.4	3.5	2.9	GP-GC	18.5
B-1105	73-74.5	UD		61.2	38.8			SM	23.3
B-1105	88.5-90.0	SPT		87.9	12.1			SM	
B-1105	98.5-100.0	SPT						CL	21.5
B-1106	10.0-11.5	SPT							10.3
B-1106	20.0-21.5	SPT		0.7	99.3	86.6	12.7	ML	
B-1106	30.0-31.5	SPT						ML	21.5
B-1106	40.0-41.5	SPT		0.5	99.5	90.1	9.4	ML	
B-1106	50.0-51.5	SPT						CL-ML	24.5
B-1106	58-60	UD		10.7	89.3	61.1	28.2	CL	21.4
B-1106	60.0-61.5	SPT						CL	16.6
B-1106	70.0-71.5	SPT		50.9	49.1			SC	
B-1106	95.0-96.5	SPT	15.4	70.6	49.1			SM	
B-1107	13.5-15.0	SPT						ML	17.8
B-1107	23.5-25.0	SPT		0.4	99.6	89.5	10.1	ML	
B-1107	33.5-35.0	SPT						ML	21.6

TABLE 2.3-203 (SHEET 9 OF 11)
SUMMARY OF SOIL CLASSIFICATION AND SOIL MOISTURE CONTENT

Boring Number	Depth(3) (ft.)	Sample Type(6)	Gravel(1) (%)	Sand(1) (%)	Fines(1,2) (%)	Silt(1) (%)	0.005mm Clay(1) (%)	USCS Symbol(7)	Natural Moisture (%)
B-1107	43.5-45.0	SPT		1.5	98.5	89.9	8.6	ML	
B-1107	50.0-51.5	SPT						CH	23.5
B-1107	60.0-61.5	SPT							15.2
B-1107	68.5-70.0	SPT		93.4	6.6			SP-SC	
B-1107	88.5-90.0	SPT						CL-ML	38.7
B-1107	103.5-105.0	SPT	39.2	56.2	4.6			SP	
B-1107	108.5-109.2	SPT	51.9	46.0	2.1			GW	
B-1107	118.5-120.0	SPT						ML	21.5
B-1108	30.0-31.5	SPT							20.2
B-1108	34.5-36.0	SPT						CL-ML	19.4
B-1108	45.0-46.5	SPT		0.6	99.4	89.6	9.8	ML	
B-1108	49.0-50.5	SPT							17.4
B-1108	60.0-61.5	SPT							16.7
B-1108	64.2-65.7	SPT							16.0
B-1108	70.5-71.5	SPT							15.6
B-1108	78.1-79.6	SPT		94.9	5.1			SP-SM	

TABLE 2.3-203 (SHEET 10 OF 11)
SUMMARY OF SOIL CLASSIFICATION AND SOIL MOISTURE CONTENT

Boring Number	Depth(3) (ft.)	Sample Type(6)	Gravel(1) (%)	Sand(1) (%)	Fines(1,2) (%)	Silt(1) (%)	0.005mm Clay(1) (%)	USCS Symbol(7)	Natural Moisture (%)
B-1108	95.5-96.5	SPT						CL	21.8
P-1109	68.5-71	UD		10.0	90.0				19.8
P-1109	71.0-73.5	UD							22.5
P-1109	76-77.5	UD		93.1	6.9				20.4
P-1109	78.5-80	UD		92.7	7.3				22.1
P-1109	96-98.2	UD	5.6	46.2	48.2	35.7	12.5	SC	19.6
P-1109	101-102.2	UD	34.1	43.7	22.2	14.8	7.4	SM	20.1
B-1109	77.5-79.0	SPT		67.3	32.7			SM	
B-1109	87.5-89.0	SPT						CL	30.8
B-1109	92.5-94.0	SPT						CL	26.0
B-1109	97.5-99.0	SPT						CL	19.5
B-1110	68.5-70.0	SPT							14.8
B-1116	65-67	UD		38.6	61.4				22.7 (5)
B-1116	67.0-68.5	SPT							11.7
B-1116	69-71	UD		94.5	5.5				
B-1117	45.5-47.5	UD	0.3	2.5	97.2	90.2	7.0	ML	24.2

TABLE 2.3-203 (SHEET 11 OF 11)
SUMMARY OF SOIL CLASSIFICATION AND SOIL MOISTURE CONTENT

Boring Number	Depth(3) (ft.)	Sample Type(6)	Gravel(1) (%)	Sand(1) (%)	Fines(1,2) (%)	Silt(1) (%)	0.005mm Clay(1) (%)	USCS Symbol(7)	Natural Moisture (%)
B-1117	50.5-52.5	UD		6.2	93.8	67.2	26.6	CL	23.0
B-1117	122.5-124	UD		30.3	69.7	51.0	18.7	ML	22.5
B-1123	83.5-85.3	UD		49.9	50.1			ML	21.0
B-1125	43.5-45.5	UD		0.7	93.3	88.6	10.7	ML	31.2
B-1135	28-30	UD	4.1	1.2	94.7	69.6	25.1	CL	24.9
B-1135	48-50	UD		0.3	99.7	88.4	11.3	ML	16.1
B-1135	88-90	UD		54.4	45.6	34.2	11.4	SC	22.6
B-1142	103.5-104	UD	12.9	34.7	52.4	34.3	18.1	CH	32.7

Notes:

1. Due to computer round-off, particle size fractions may total 100 ± 1.
2. Fines include silt plus clay.
3. Depth interval shown reflects total pushed depth of UD tube.
4. Moisture content from soil core affected by sample drying after sampling.
5. Average of two triaxial test specimens.
6. UD – Undisturbed. SPT – Standard Penetration Test.
7. Uniform Soil Classification System (USCS) symbols.

TABLE 2.3-204
COMPARISON OF ESP BOUNDING PARAMETERS AND PARAMETERS FOR UNIT 3

Parameter	Definition	ESP Value	ESP Source	Unit 3 Value	Unit 3 Source
Makeup water flow (max)	Maximum flow required to replenish evaporation and blowdown losses from normal heat sink cooling towers	78,000 gpm	Mississippi River	28,800 gpm	Mississippi River
Potable water/sanitary waste system (max)	Maximum flow of water for plant housekeeping	240 gpm	Groundwater	200 gpm	Groundwater
Potable water/sanitary waste system (monthly avg)	Monthly average flow of water for plant housekeeping	180 gpm	Groundwater	35 gpm	Groundwater
Demineralized water system (max)	Maximum water flow for demineralization of blowdown discharge	1440 gpm	Groundwater	554 gpm	Mississippi River
Demineralized water system (monthly avg)	Monthly average flow for demineralization of blowdown discharge	1100 gpm	Groundwater	137 gpm	Mississippi River
Fire Protection System (max)	Maximum water for fire fighting system	1890 gpm	Groundwater	1075 gpm	Mississippi River
Fire Protection System (monthly avg)	Monthly average water for fire fighting system	30 gpm	Groundwater	<30 gpm	Mississippi River

TABLE 2.3-205 (SHEET 1 OF 2)
MISSISSIPPI RIVER BATHYMETRY STUDY
TEMPERATURE AND VELOCITY DATA

Waypoint Number	Temperature (degrees Fahrenheit)				Velocity (feet per second)				Comments
	Surface	5 ft. bws*	10 ft. bws*	15 ft. bws*	Surface	5 ft. bws*	10 ft. bws*	15 ft. bws*	
13									2,000 ft. upstream of discharge
14									No data
15									2658ft. downstream of discharge
16	78.8								discharge location, surface & bottom points same
17	78.3								surface & bottom points same
18	76.6								surface & bottom points same
19	73.5								surface & bottom points same
20	72.6								surface & bottom points same
21	71.7								surface & bottom points same
23	71.9	71.9			0.35	0.32	0.12	*	maximum depth 10 ft.
24	71.6	71.6			0.46	0.4	1.41	1.66	
25	72.1	72.1			0.37	0.31	0.29	0.28	

TABLE 2.3-205 (SHEET 2 OF 2)
MISSISSIPPI RIVER BATHYMETRY STUDY
TEMPERATURE AND VELOCITY DATA

Waypoint Number	Temperature (degrees Fahrenheit)				Velocity (feet per second)				Comments
	Surface	5 ft. bws*	10 ft. bws*	15 ft. bws*	Surface	5 ft. bws*	10 ft. bws*	15 ft. bws*	
26	83.4	83.5			1.4	1.38			discharge location, maximum depth 5 ft.
27	79	74.7			0.36	0.31	0.31	0.29	mouth of discharge
28	71.7	71.8			0.39	0.56	0.62		
29	71.7	71.8			0.61	0.59	0.51	0.42	
30	71.7	71.7			0.89	0.92	1.01	0.98	
31	71.8	71.8			0.43	0.52			downstream in MS river, maximum depth 5 ft.
32	71.7	71.7			0.97	0.88	0.92	1.2	
33	71.7	71.7			1.5	1.32	1.27	**	
34	71.7	71.7			0.38	0.32			maximum depth 5 ft.
35	71.8	71.7			0.57	0.53	0.56	0.67	
36	71.7	71.7			1.25	1.39	1.38	1.42	
max (31 to 36)					1.5	1.39	1.38	1.42	
min (31 to 36)					0.35	0.31	0.12	0.28	

* below water surface

** current too fast to take a measurement

Refer to Figure 2.3-207 for waypoint locations.

TABLE 2.3-206 (SHEET 1 OF 19)
ARMY CORPS OF ENGINEERS WATER TEMPERATURE DATA
MISSISSIPPI RIVER AT VICKSBURG

Date	Time	Temperature (ºF)
02/15/1995	08:00	41
02/22/1995	08:00	50
03/01/1995	08:00	46
03/08/1995	08:00	49
03/15/1995	08:00	51
03/29/1995	08:00	59
04/05/1995	08:00	60
04/19/1995	08:00	65
04/26/1995	08:00	62
05/03/1995	08:00	63
05/10/1995	08:00	63
05/17/1995	08:00	73
05/24/1995	08:00	70
05/26/1995	08:00	71
05/30/1995	08:00	72
05/31/1995	08:00	72
06/01/1995	08:00	73
06/06/1995	08:00	74
06/09/1995	08:00	75
06/13/1995	08:00	76
06/16/1995	08:00	76
06/20/1995	08:00	77
06/23/1995	08:00	78
06/27/1995	08:00	80
06/30/1995	08:00	80
07/05/1995	08:00	80
07/07/1995	08:00	79
07/11/1995	08:00	80
07/14/1995	08:00	82
07/21/1995	08:00	85
07/26/1995	08:00	85

**TABLE 2.3-206 (SHEET 2 OF 19)
ARMY CORPS OF ENGINEERS WATER TEMPERATURE DATA
MISSISSIPPI RIVER AT VICKSBURG**

Date	Time	Temperature (ºF)
08/02/1995	08:00	84
08/09/1995	08:00	85
08/16/1995	08:00	86
08/23/1995	08:00	88
08/30/1995	08:00	88
09/06/1995	08:00	83
09/13/1995	08:00	81
09/20/1995	08:00	78
09/27/1995	08:00	72
11/08/1995	08:00	60
11/15/1995	08:00	57
11/22/1995	08:00	57
11/29/1995	08:00	54
12/06/1995	08:00	53
12/13/1995	08:00	47
12/20/1995	08:00	49
01/03/1996	08:00	40
01/10/1996	08:00	39
01/17/1996	08:00	40
01/24/1996	08:00	41
01/30/1996	08:00	40
02/05/1996	08:00	35
02/07/1996	08:00	34
02/14/1996	08:00	37
02/21/1996	08:00	40
02/28/1996	08:00	43
02/29/1996	08:00	42
03/06/1996	08:00	46
03/13/1996	08:00	42
03/20/1996	08:00	44
03/27/1996	08:00	45
04/03/1996	08:00	45
04/10/1996	08:00	47

TABLE 2.3-206 (SHEET 3 OF 19)
ARMY CORPS OF ENGINEERS WATER TEMPERATURE DATA
MISSISSIPPI RIVER AT VICKSBURG

Date	Time	Temperature (ºF)
04/17/1996	08:00	52
04/24/1996	08:00	62
04/30/1996	08:00	62
05/09/1996	08:00	63
05/14/1996	08:00	64
05/22/1996	08:00	70
05/24/1996	08:00	71
05/29/1996	08:00	74
05/31/1996	08:00	75
06/04/1996	08:00	75
06/06/1996	08:00	74
06/10/1996	08:00	72
06/12/1996	08:00	72
06/14/1996	08:00	72
06/18/1996	08:00	75
06/20/1996	08:00	74
06/24/1996	08:00	79
06/26/1996	08:00	80
06/28/1996	08:00	82
07/02/1996	08:00	82
07/05/1996	08:00	82
07/09/1996	08:00	82
07/11/1996	08:00	81
07/15/1996	08:00	81
07/17/1996	08:00	81
07/19/1996	08:00	82
07/23/1996	08:00	82
07/25/1996	08:00	82
07/30/1996	08:00	82
08/09/1996	08:00	82
08/13/1996	08:00	81
08/22/1996	08:00	84
08/27/1996	08:00	84

TABLE 2.3-206 (SHEET 4 OF 19)
ARMY CORPS OF ENGINEERS WATER TEMPERATURE DATA
MISSISSIPPI RIVER AT VICKSBURG

Date	Time	Temperature (ºF)
09/05/1996	08:00	82
09/10/1996	08:00	82
09/19/1996	08:00	80
09/24/1996	08:00	74
09/26/1996	08:00	75
10/01/1996	08:00	74
10/10/1996	08:00	70
10/17/1996	08:00	68
10/24/1996	08:00	67
11/05/1996	08:00	59
11/14/1996	08:00	54
11/19/1996	08:00	51
11/27/1996	08:00	50
12/10/1996	08:00	46
12/12/1996	08:00	48
12/19/1996	08:00	46
12/24/1996	08:00	42
01/03/1997	08:00	44
01/07/1997	08:00	46
01/16/1997	08:00	39
01/22/1997	08:00	39
01/30/1997	08:00	39
02/04/1997	08:00	40
02/13/1997	08:00	40
02/14/1997	08:00	45
02/19/1997	08:00	42
02/27/1997	08:00	48
03/03/1997	08:00	49
03/11/1997	08:00	51
03/13/1997	08:00	51
03/17/1997	08:00	52
03/18/1997	08:00	52
03/21/1997	08:00	52

**TABLE 2.3-206 (SHEET 5 OF 19)
ARMY CORPS OF ENGINEERS WATER TEMPERATURE DATA
MISSISSIPPI RIVER AT VICKSBURG**

Date	Time	Temperature (ºF)
03/23/1997	08:00	52
03/26/1997	08:00	53
03/31/1997	08:00	56
04/04/1997	08:00	56
04/07/1997	08:00	58
04/10/1997	08:00	58
04/14/1997	08:00	57
04/21/1997	08:00	56
04/23/1997	08:00	56
04/25/1997	08:00	56
04/28/1997	08:00	56
04/30/1997	08:00	56
05/02/1997	08:00	60
05/05/1997	08:00	59
05/07/1997	08:00	62
05/08/1997	08:00	62
05/12/1997	08:00	64
05/14/1997	08:00	64
05/16/1997	08:00	64
05/19/1997	08:00	64
05/21/1997	08:00	67
05/23/1997	08:00	67
05/27/1997	08:00	68
05/29/1997	08:00	68
06/02/1997	08:00	70
06/04/1997	08:00	70
06/06/1997	08:00	69
06/09/1997	08:00	69
06/10/1997	08:00	69
06/13/1997	08:00	69
06/16/1997	08:00	71
06/18/1997	08:00	73
06/20/1997	08:00	73

TABLE 2.3-206 (SHEET 6 OF 19)
ARMY CORPS OF ENGINEERS WATER TEMPERATURE DATA
MISSISSIPPI RIVER AT VICKSBURG

Date	Time	Temperature (ºF)
06/23/1997	08:00	78
06/25/1997	08:00	78
07/01/1997	08:00	81
07/03/1997	08:00	82
07/08/1997	08:00	82
07/10/1997	08:00	82
07/14/1997	08:00	83
07/16/1997	08:00	83
07/18/1997	08:00	83
07/21/1997	08:00	84
07/23/1997	08:00	85
07/25/1997	08:00	87
07/28/1997	08:00	87
07/30/1997	08:00	89
08/01/1997	08:00	89
08/04/1997	08:00	87
08/06/1997	08:00	87
08/07/1997	08:00	86
08/11/1997	08:00	84
08/15/1997	08:00	85
08/18/1997	08:00	87
08/20/1997	08:00	88
08/22/1997	08:00	87
08/25/1997	08:00	85
08/27/1997	08:00	85
11/18/1997	08:00	49
11/26/1997	08:00	48
12/08/1997	08:00	48
12/18/1997	08:00	42
12/30/1997	08:00	42
01/17/1998	08:00	44
01/23/1998	08:00	42
01/27/1998	08:00	42

TABLE 2.3-206 (SHEET 7 OF 19)
ARMY CORPS OF ENGINEERS WATER TEMPERATURE DATA
MISSISSIPPI RIVER AT VICKSBURG

Date	Time	Temperature (ºF)
02/04/1998	08:00	44
02/13/1998	08:00	44
02/18/1998	08:00	44
03/16/1998	08:00	46
03/25/1998	08:00	48
04/02/1998	08:00	54
04/16/1998	08:00	58
04/22/1998	08:00	61
04/30/1998	08:00	62
05/07/1998	08:00	64
05/14/1998	08:00	68
05/20/1998	08:00	71
05/28/1998	08:00	77
06/03/1998	08:00	79
06/09/1998	08:00	79
06/18/1998	08:00	79
06/25/1998	08:00	79
07/01/1998	08:00	78
07/10/1998	08:00	86
07/17/1998	08:00	84
07/23/1998	08:00	84
07/27/1998	08:00	86
08/06/1998	08:00	84
08/14/1998	08:00	82
08/20/1998	08:00	84
08/25/1998	08:00	86
09/03/1998	08:00	86
09/08/1998	08:00	86
09/17/1998	08:00	81
09/23/1998	08:00	82
10/02/1998	08:00	81
10/08/1998	08:00	77
10/16/1998	08:00	72

TABLE 2.3-206 (SHEET 8 OF 19)
ARMY CORPS OF ENGINEERS WATER TEMPERATURE DATA
MISSISSIPPI RIVER AT VICKSBURG

Date	Time	Temperature (ºF)
10/22/1998	08:00	68
10/29/1998	08:00	66
11/06/1998	08:00	62
11/12/1998	08:00	58
11/19/1998	08:00	56
11/25/1998	08:00	54
12/04/1998	08:00	54
12/10/1998	08:00	54
12/16/1998	08:00	51
12/24/1998	08:00	48
12/31/1998	08:00	42
01/14/1999	08:00	39
01/21/1999	08:00	40
01/26/1999	08:00	42
02/04/1999	08:00	46
02/11/1999	08:00	49
02/18/1999	08:00	48
02/23/1999	08:00	46
03/04/1999	08:00	48
03/12/1999	08:00	48
03/18/1999	08:00	44
03/25/1999	08:00	49
04/01/1999	08:00	51
04/08/1999	08:00	59
04/16/1999	08:00	62
04/22/1999	08:00	59
05/06/1999	08:00	64
05/13/1999	08:00	68
05/20/1999	08:00	72
05/28/1999	08:00	72
06/02/1999	08:00	73
06/09/1999	08:00	79
06/17/1999	08:00	81

TABLE 2.3-206 (SHEET 9 OF 19)
ARMY CORPS OF ENGINEERS WATER TEMPERATURE DATA
MISSISSIPPI RIVER AT VICKSBURG

Date	Time	Temperature (ºF)
06/22/1999	08:00	79
06/29/1999	08:00	79
07/09/1999	08:00	84
07/13/1999	08:00	84
07/22/1999	08:00	84
07/29/1999	08:00	88
08/05/1999	08:00	90
08/13/1999	08:00	88
08/19/1999	08:00	86
08/24/1999	08:00	84
08/31/1999	08:00	82
09/07/1999	08:00	82
09/16/1999	08:00	77
09/21/1999	08:00	77
09/30/1999	08:00	73
10/05/1999	08:00	72
10/14/1999	08:00	72
10/22/1999	08:00	66
10/27/1999	08:00	62
11/11/1999	08:00	60
11/18/1999	08:00	60
11/25/1999	08:00	58
12/03/1999	08:00	52
12/09/1999	08:00	52
12/16/1999	08:00	49
12/23/1999	08:00	46
12/30/1999	08:00	44
01/06/2000	08:00	46
01/11/2000	08:00	46
01/20/2000	08:00	46
01/25/2000	08:00	42
02/03/2000	08:00	39
02/10/2000	08:00	40

TABLE 2.3-206 (SHEET 10 OF 19) ARMY CORPS OF ENGINEERS WATER TEMPERATURE DATA MISSISSIPPI RIVER AT VICKSBURG

Date	Time	Temperature (ºF)
02/15/2000	08:00	44
02/23/2000	08:00	46
03/10/2000	08:00	54
03/16/2000	08:00	54
03/21/2000	08:00	54
03/30/2000	08:00	56
04/06/2000	08:00	58
04/19/2000	08:00	60
04/25/2000	08:00	62
05/01/2000	08:00	64
05/08/2000	08:00	68
05/16/2000	08:00	72
05/22/2000	08:00	75
05/31/2000	08:00	77
06/08/2000	08:00	75
06/13/2000	08:00	79
06/22/2000	08:00	81
06/28/2000	08:00	81
07/03/2000	08:00	81
07/11/2000	08:00	84
07/20/2000	08:00	88
07/24/2000	08:00	84
08/03/2000	08:00	84
08/08/2000	08:00	84
08/17/2000	08:00	86
08/31/2000	08:00	86
09/06/2000	08:00	84
09/14/2000	08:00	81
09/28/2000	08:00	77
10/05/2000	08:00	73
10/12/2000	08:00	64
10/20/2000	08:00	64
10/26/2000	08:00	66

TABLE 2.3-206 (SHEET 11 OF 19)
ARMY CORPS OF ENGINEERS WATER TEMPERATURE DATA
MISSISSIPPI RIVER AT VICKSBURG

Date	Time	Temperature (ºF)
11/02/2000	08:00	68
11/09/2000	08:00	64
11/17/2000	08:00	54
11/23/2000	08:00	51
11/29/2000	08:00	49
12/07/2000	08:00	42
12/13/2000	08:00	42
12/21/2000	08:00	39
12/28/2000	08:00	35
01/05/2001	08:00	33
01/12/2001	08:00	35
01/18/2001	08:00	40
01/26/2001	08:00	39
02/01/2001	08:00	40
02/09/2001	08:00	43
02/15/2001	08:00	44
02/22/2001	08:00	42
02/26/2001	08:00	44
03/12/2001	08:00	48
03/22/2001	08:00	49
03/28/2001	08:00	48
04/06/2001	08:00	52
04/09/2001	08:00	56
04/19/2001	08:00	62
04/26/2001	08:00	62
05/04/2001	08:00	66
05/09/2001	08:00	68
05/17/2001	08:00	72
05/25/2001	08:00	72
06/01/2001	08:00	72
06/14/2001	08:00	73
06/22/2001	08:00	79
06/29/2001	08:00	79

**TABLE 2.3-206 (SHEET 12 OF 19)
ARMY CORPS OF ENGINEERS WATER TEMPERATURE DATA
MISSISSIPPI RIVER AT VICKSBURG**

Date	Time	Temperature (ºF)
07/06/2001	08:00	81
07/12/2001	08:00	84
07/20/2001	08:00	84
07/26/2001	08:00	84
07/31/2001	08:00	86
08/09/2001	08:00	86
08/17/2001	08:00	84
08/23/2001	08:00	86
08/31/2001	08:00	82
09/07/2001	08:00	79
09/11/2001	08:00	81
09/20/2001	08:00	79
09/28/2001	08:00	73
10/05/2001	08:00	72
10/19/2001	08:00	64
10/21/2001	08:00	68
10/25/2001	08:00	64
11/01/2001	08:00	60
11/06/2001	08:00	60
11/15/2001	08:00	58
11/21/2001	08:00	55
11/30/2001	08:00	55
12/07/2001	08:00	52
12/20/2001	08:00	49
12/24/2001	08:00	50
01/02/2002	08:00	72
01/10/2002	08:00	40
01/16/2002	08:00	42
01/24/2002	08:00	46
01/29/2002	08:00	46
02/07/2002	08:00	46
02/12/2002	08:00	44
02/18/2002	08:00	46

TABLE 2.3-206 (SHEET 13 OF 19)
ARMY CORPS OF ENGINEERS WATER TEMPERATURE DATA
MISSISSIPPI RIVER AT VICKSBURG

Date	Time	Temperature (ºF)
02/26/2002	08:00	48
03/08/2002	08:00	46
03/15/2002	08:00	49
03/21/2002	08:00	52
03/28/2002	08:00	50
04/04/2002	08:00	52
04/09/2002	08:00	54
04/19/2002	08:00	64
04/25/2002	08:00	68
05/02/2002	08:00	70
05/07/2002	08:00	65
05/16/2002	08:00	68
05/21/2002	08:00	68
05/31/2002	08:00	70
06/04/2002	08:00	73
06/10/2002	08:00	77
06/21/2002	08:00	79
06/24/2002	08:00	81
07/02/2002	08:00	82
07/08/2002	08:00	86
07/16/2002	08:00	86
07/26/2002	08:00	84
07/29/2002	08:00	86
08/08/2002	08:00	88
08/12/2002	08:00	86
08/19/2002	08:00	82
08/30/2002	08:00	84
09/03/2002	08:00	84
09/12/2002	08:00	82
09/18/2002	08:00	81
09/24/2002	08:00	77
09/30/2002	08:00	75
10/11/2002	08:00	73

TABLE 2.3-206 (SHEET 14 OF 19)
ARMY CORPS OF ENGINEERS WATER TEMPERATURE DATA
MISSISSIPPI RIVER AT VICKSBURG

Date	Time	Temperature (ºF)
10/18/2002	08:00	66
10/22/2002	08:00	64
10/28/2002	08:00	65
11/06/2002	08:00	56
11/11/2002	08:00	58
11/18/2002	08:00	54
11/28/2002	08:00	49
12/03/2002	08:00	49
12/09/2002	08:00	44
12/20/2002	08:00	51
12/27/2002	08:00	45
01/03/2003	08:00	44
01/09/2003	08:00	44
01/17/2003	08:00	40
01/23/2003	08:00	39
01/28/2003	08:00	39
02/04/2003	08:00	41
02/12/2003	08:00	40
02/18/2003	08:00	42
02/26/2003	08:00	42
03/03/2003	08:00	40
03/10/2003	08:00	44
03/17/2003	08:00	50
03/25/2003	08:00	52
03/31/2003	08:00	54
04/07/2003	08:00	60
04/18/2003	08:00	60
04/23/2003	08:00	62
05/02/2003	08:00	68
05/06/2003	08:00	69
05/12/2003	08:00	72
05/19/2003	08:00	72
05/26/2003	08:00	72

TABLE 2.3-206 (SHEET 15 OF 19)
ARMY CORPS OF ENGINEERS WATER TEMPERATURE DATA
MISSISSIPPI RIVER AT VICKSBURG

Date	Time	Temperature (ºF)
06/03/2003	08:00	73
06/10/2003	08:00	73
06/17/2003	08:00	75
06/26/2003	08:00	79
07/01/2003	08:00	79
07/07/2003	08:00	82
07/16/2003	08:00	86
07/21/2003	08:00	86
07/29/2003	08:00	84
08/04/2003	08:00	84
08/11/2003	08:00	84
08/18/2003	08:00	84
08/26/2003	08:00	88
09/02/2003	08:00	84
09/09/2003	08:00	82
09/15/2003	08:00	79
09/22/2003	08:00	79
10/03/2003	08:00	72
10/08/2003	08:00	70
10/17/2003	08:00	70
10/21/2003	08:00	70
10/27/2003	08:00	66
11/05/2003	08:00	66
11/13/2003	08:00	62
11/17/2003	08:00	60
11/27/2003	08:00	56
12/03/2003	08:00	51
12/08/2003	08:00	48
12/18/2003	08:00	44
12/24/2003	08:00	42
01/02/2004	16:40	51
01/05/2004	16:40	46
01/12/2004	16:40	42

**TABLE 2.3-206 (SHEET 16 OF 19)
ARMY CORPS OF ENGINEERS WATER TEMPERATURE DATA
MISSISSIPPI RIVER AT VICKSBURG**

Date	Time	Temperature (ºF)
01/20/2004	16:40	40
01/27/2004	16:40	40
02/02/2004	16:40	40
02/09/2004	16:40	39
02/16/2004	16:40	39
02/26/2004	16:40	44
03/01/2004	16:40	48
03/08/2004	16:40	51
03/15/2004	16:40	51
03/22/2004	16:40	53
03/29/2004	16:40	56
04/05/2004	16:40	56
04/13/2004	16:40	56
04/21/2004	16:40	62
04/26/2004	16:40	64
05/04/2004	16:40	64
05/13/2004	16:40	70
05/20/2004	16:40	73
05/24/2004	16:40	75
05/31/2004	16:40	77
06/07/2004	16:40	77
06/14/2004	16:40	77
06/21/2004	16:40	81
06/28/2004	16:40	79
07/06/2004	16:40	81
07/15/2004	16:40	84
07/20/2004	16:40	84
07/27/2004	16:40	84
08/03/2004	16:40	84
08/10/2004	16:40	82
08/17/2004	16:40	80
08/24/2004	16:40	81
09/02/2004	16:40	81

TABLE 2.3-206 (SHEET 17 OF 19)
ARMY CORPS OF ENGINEERS WATER TEMPERATURE DATA
MISSISSIPPI RIVER AT VICKSBURG

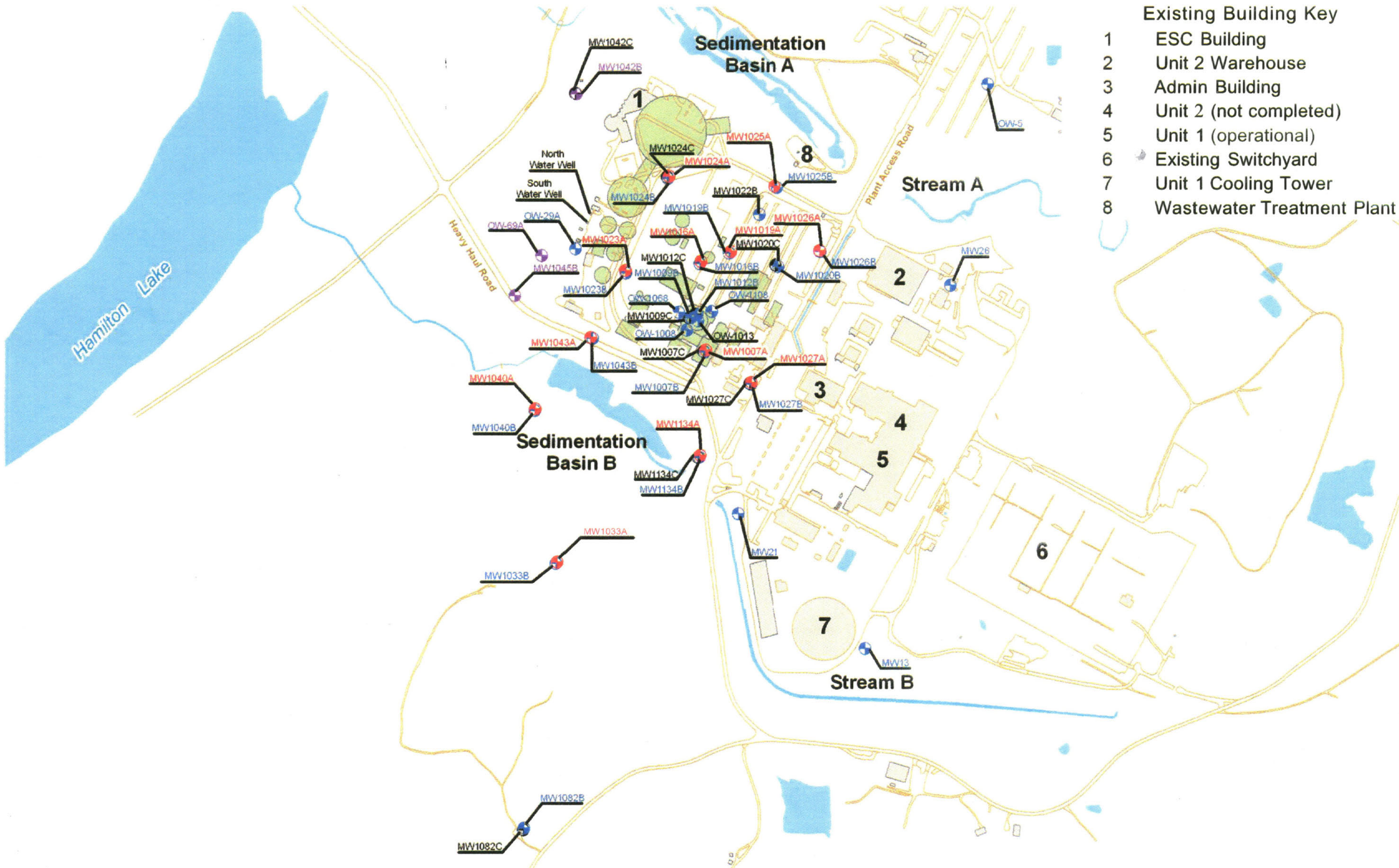
Date	Time	Temperature (ºF)
09/08/2004	16:40	79
09/14/2004	16:40	81
09/21/2004	16:40	77
09/27/2004	16:40	77
10/08/2004	16:40	72
10/11/2004	16:40	70
10/18/2004	16:40	68
10/26/2004	16:40	68
11/02/2004	16:40	70
11/11/2004	16:40	62
11/15/2004	16:40	58
11/25/2004	16:40	56
11/30/2004	16:40	54
12/06/2004	16:40	52
12/17/2004	16:40	48
12/20/2004	16:40	46
12/27/2004	16:40	42
01/04/2005	16:40	44
01/10/2005	16:40	48
01/18/2005	16:40	44
01/21/2005	16:40	46
01/24/2005	16:40	42
01/27/2005	16:40	41
01/31/2005	16:40	41
02/11/2005	16:40	42
02/14/2005	16:40	44
02/22/2005	16:40	48
02/28/2005	16:40	46
03/09/2005	16:40	48
03/14/2005	16:40	49
03/22/2005	16:40	48
03/29/2005	16:40	52
04/04/2005	16:40	54

TABLE 2.3-206 (SHEET 18 OF 19)
ARMY CORPS OF ENGINEERS WATER TEMPERATURE DATA
MISSISSIPPI RIVER AT VICKSBURG

Date	Time	Temperature (ºF)
04/11/2005	16:40	58
04/20/2005	16:40	64
04/25/2005	16:40	66
05/06/2005	16:40	62
05/09/2005	16:40	64
05/18/2005	16:40	70
05/23/2005	16:40	75
06/01/2005	16:40	73
06/07/2005	16:40	78
06/16/2005	16:40	82
06/20/2005	16:40	81
06/27/2005	16:40	82
07/05/2005	16:40	86
07/11/2005	16:40	84
07/18/2005	16:40	84
07/25/2005	16:40	86
08/01/2005	16:40	86
08/09/2005	16:40	88
08/19/2005	16:40	90
08/24/2005	16:40	88
08/29/2005	16:40	88
09/06/2005	16:40	82
09/12/2005	16:40	82
09/21/2005	16:40	84
09/26/2005	16:40	81
10/03/2005	16:40	79
10/13/2005	16:40	72
10/17/2005	16:40	72
10/24/2005	16:40	66
11/04/2005	16:40	62
11/07/2005	16:40	64
11/15/2005	16:40	64
11/24/2005	16:40	54

**TABLE 2.3-206 (SHEET 19 OF 19)
ARMY CORPS OF ENGINEERS WATER TEMPERATURE DATA
MISSISSIPPI RIVER AT VICKSBURG**

Date	Time	Temperature (ºF)
11/28/2005	16:40	54
12/05/2005	16:40	49
12/16/2005	16:40	42
12/22/2005	16:40	40
12/27/2005	16:40	42



Existing Building Key

1 ESC Building
2 Unit 2 Warehouse
3 Admin Building
4 Unit 2 (not completed)
5 Unit 1 (operational)
6 Existing Switchyard
7 Unit 1 Cooling Tower
8 Wastewater Treatment Plant

Legend

- Monitoring Wells screened in Alluvium
- Monitoring Wells screened in Catahoula Formation
- Monitoring Wells Screened In Loess
- Monitoring Wells Screened in Upland Complex

New Buildings
Surface Water
Existing Buildings

0 850 1,700 3,400
Feet

N S W E

Wells designated as "MW" were installed as monitoring wells for water levels.
Wells designated as "OW" were installed as observation wells for pump tests.
Construction and installation mehtods for "MW" wells and "OW" wells were the same.

Figure 2.3-201. Well Location Map

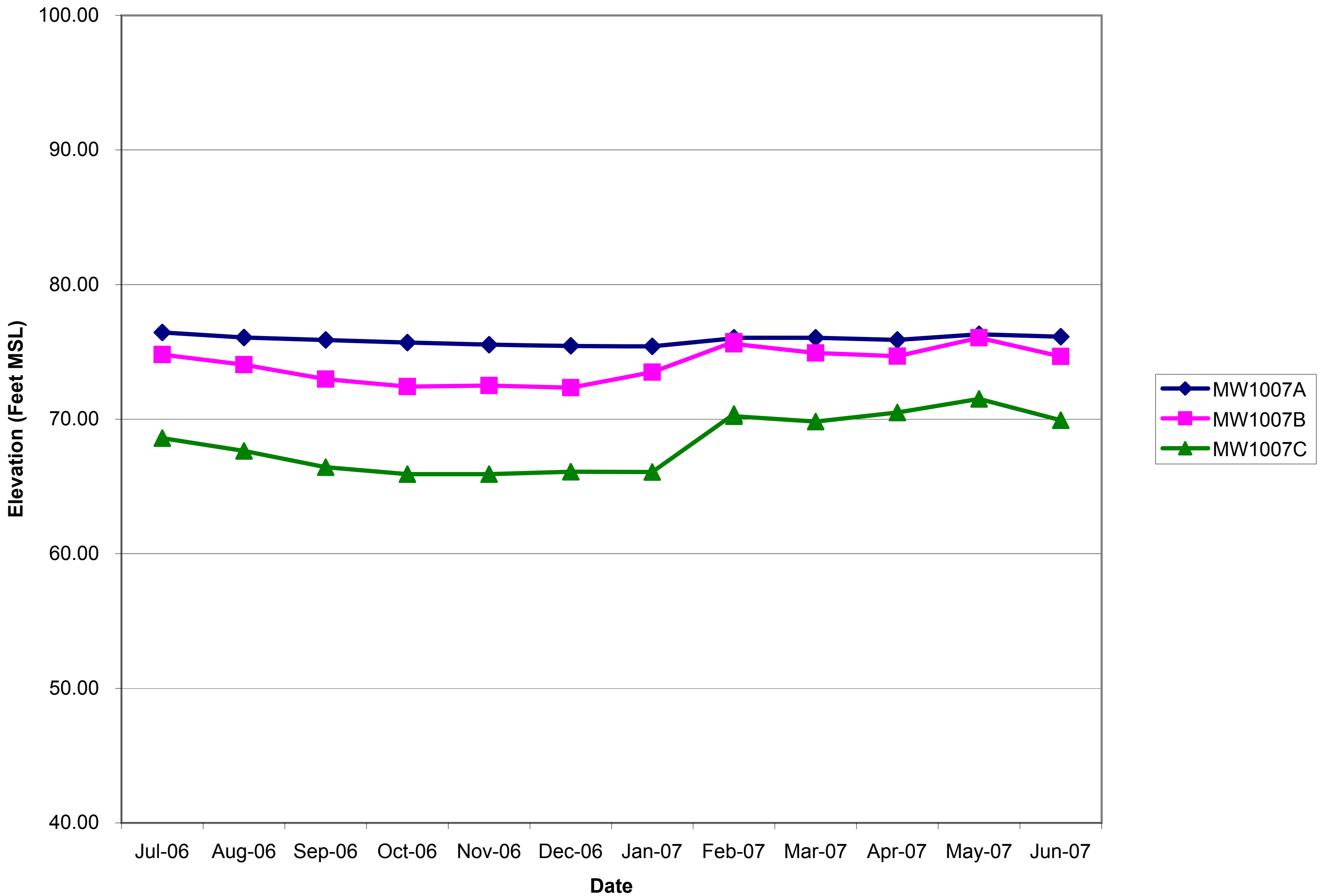


Figure 2.3-202A. Groundwater Well Hydrograph - MW1007

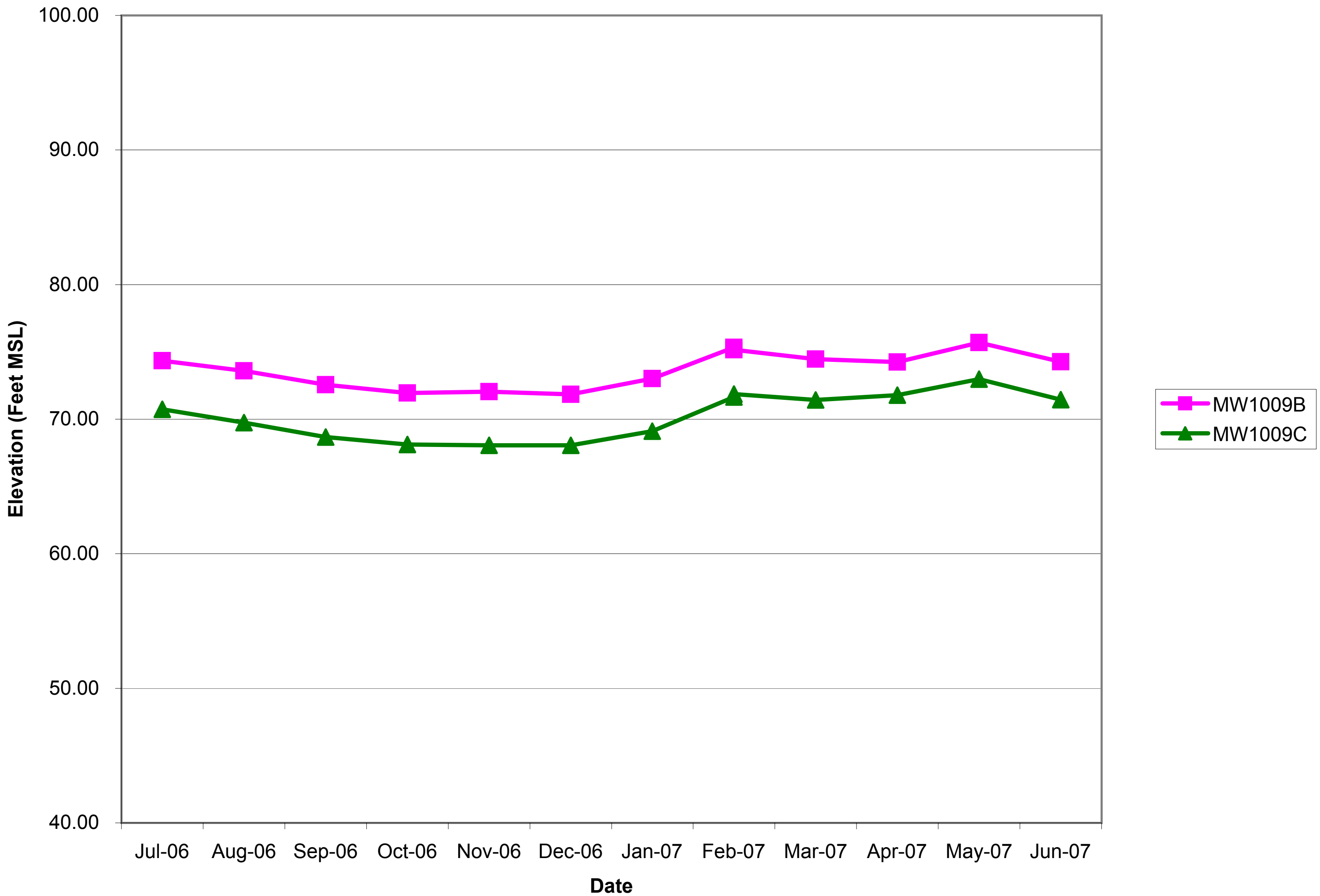


Figure 2.3-202B. Groundwater Well Hydrograph - MW1009

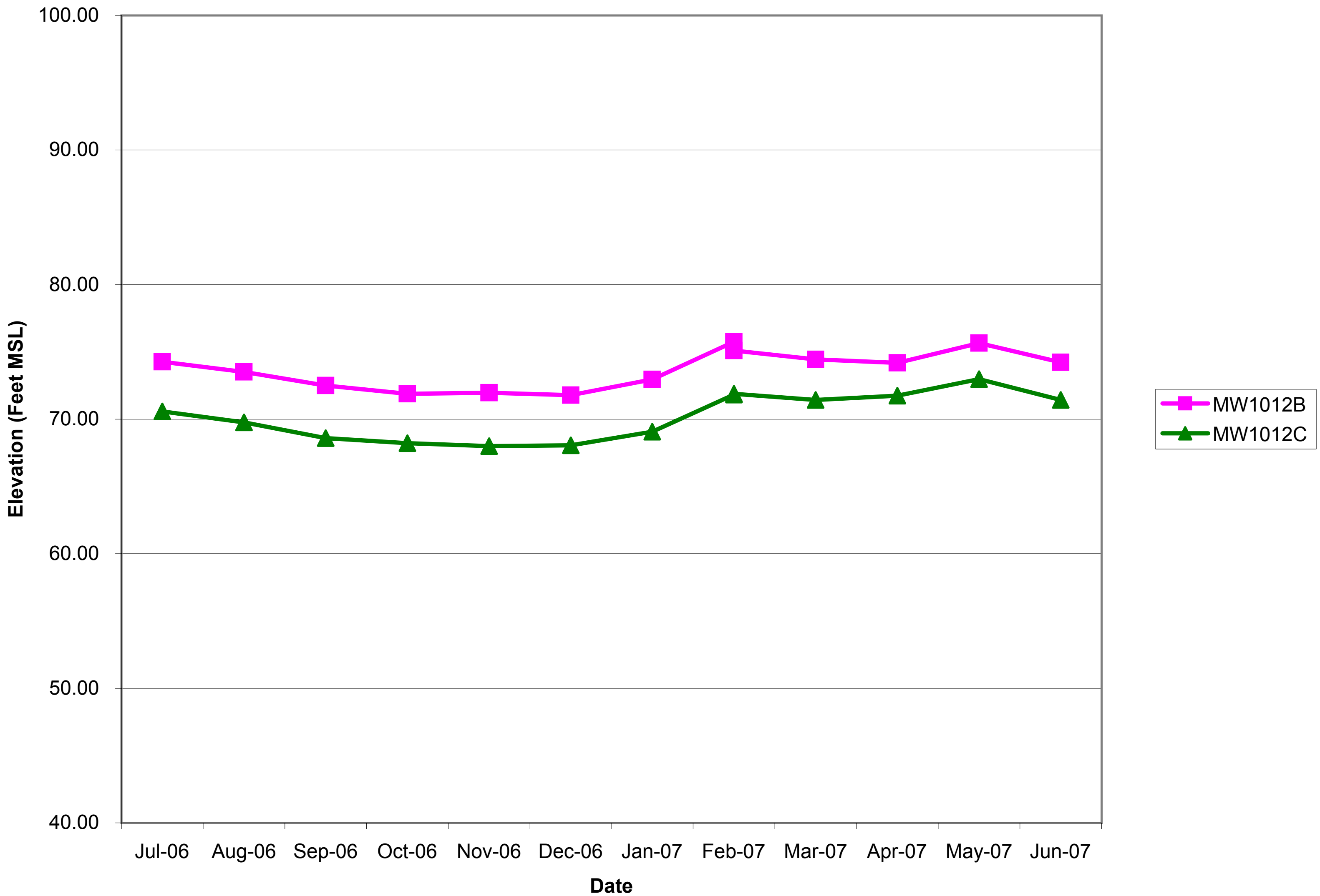


Figure 2.3-202C. Groundwater Well Hydrograph - MW1012

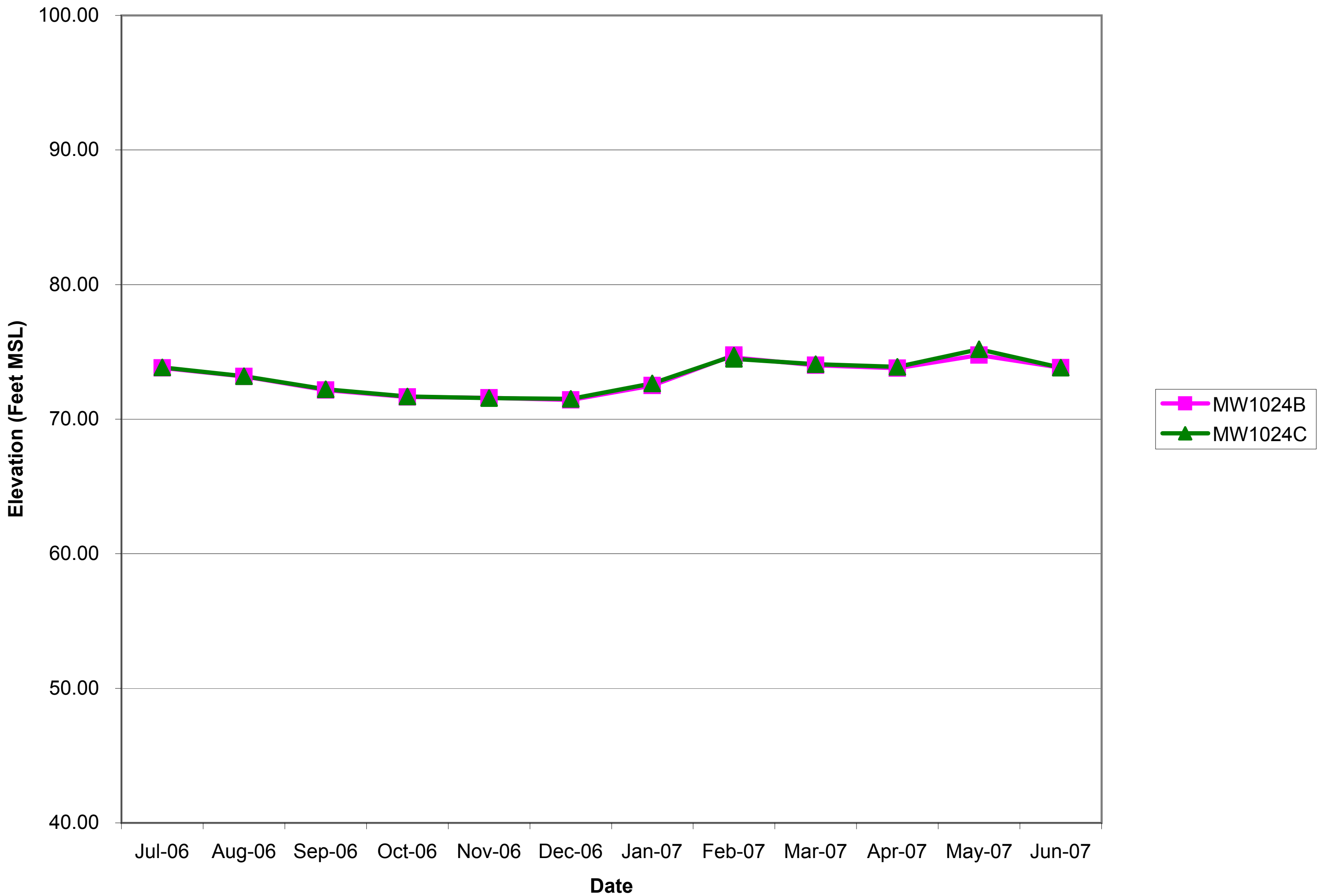


Figure 2.3-202D. Groundwater Well Hydrograph - MW1024

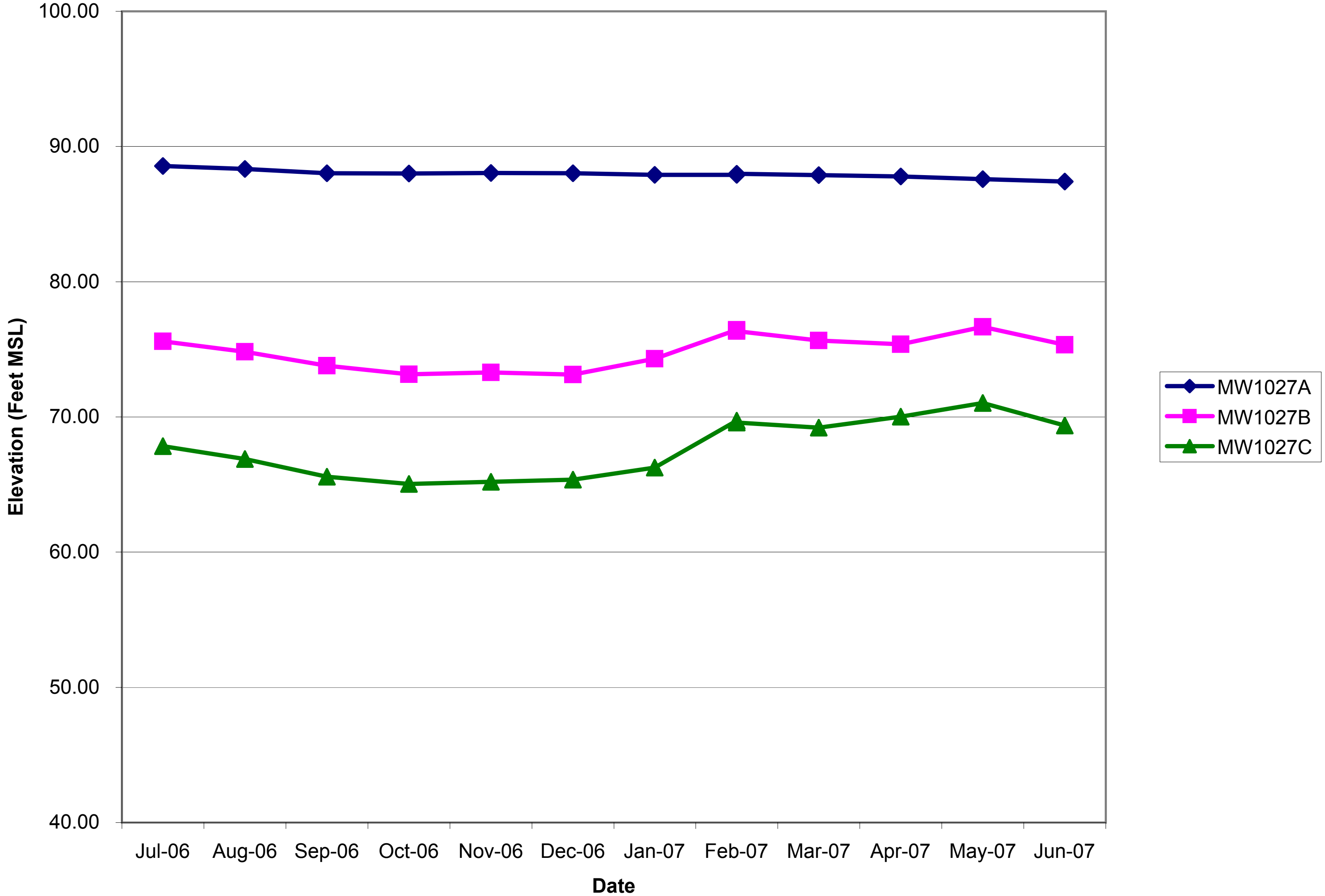


Figure 2.3-202E. Groundwater Well Hydrograph - MW1027

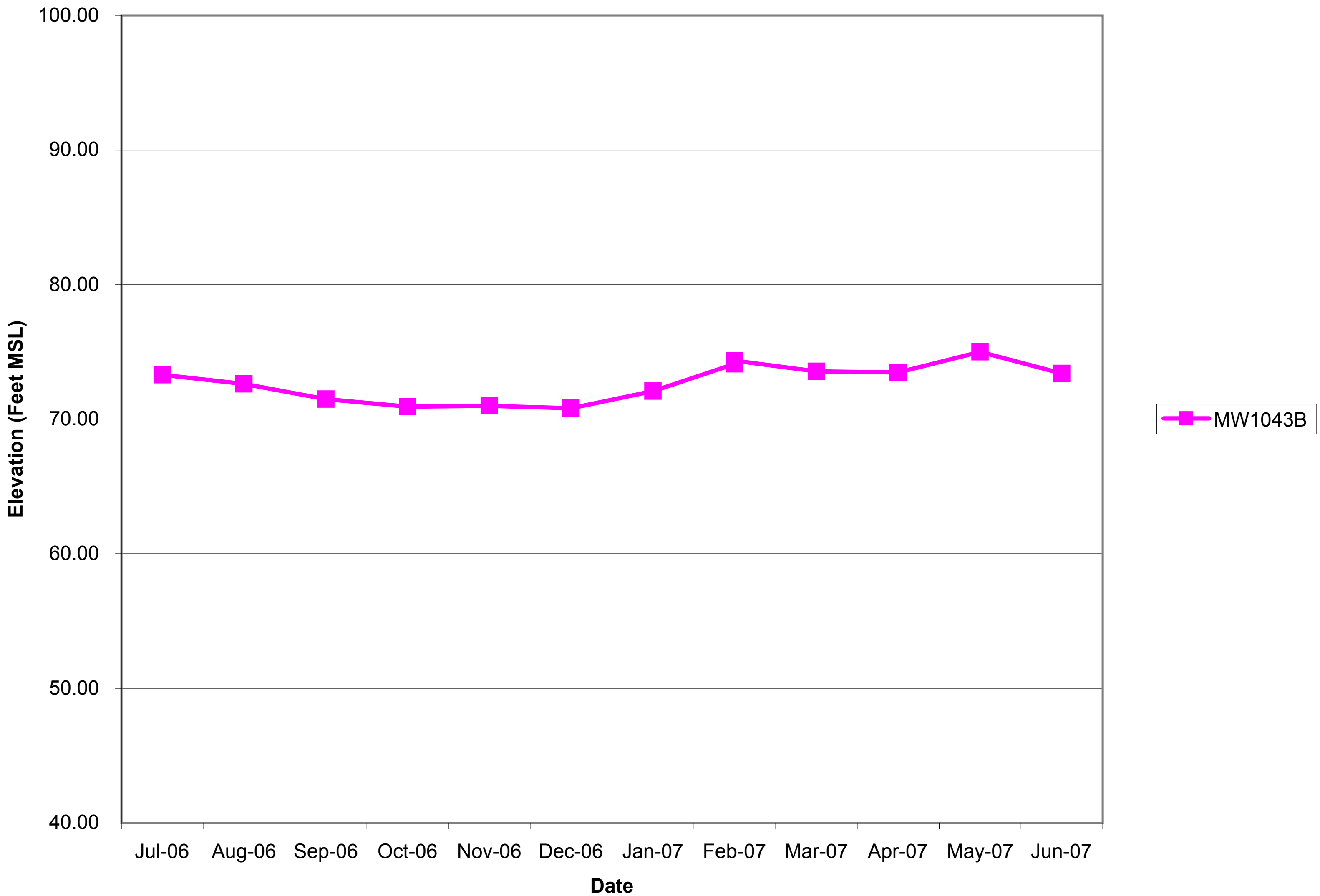


Figure 2.3-202F. Groundwater Well Hydrograph - MW1043

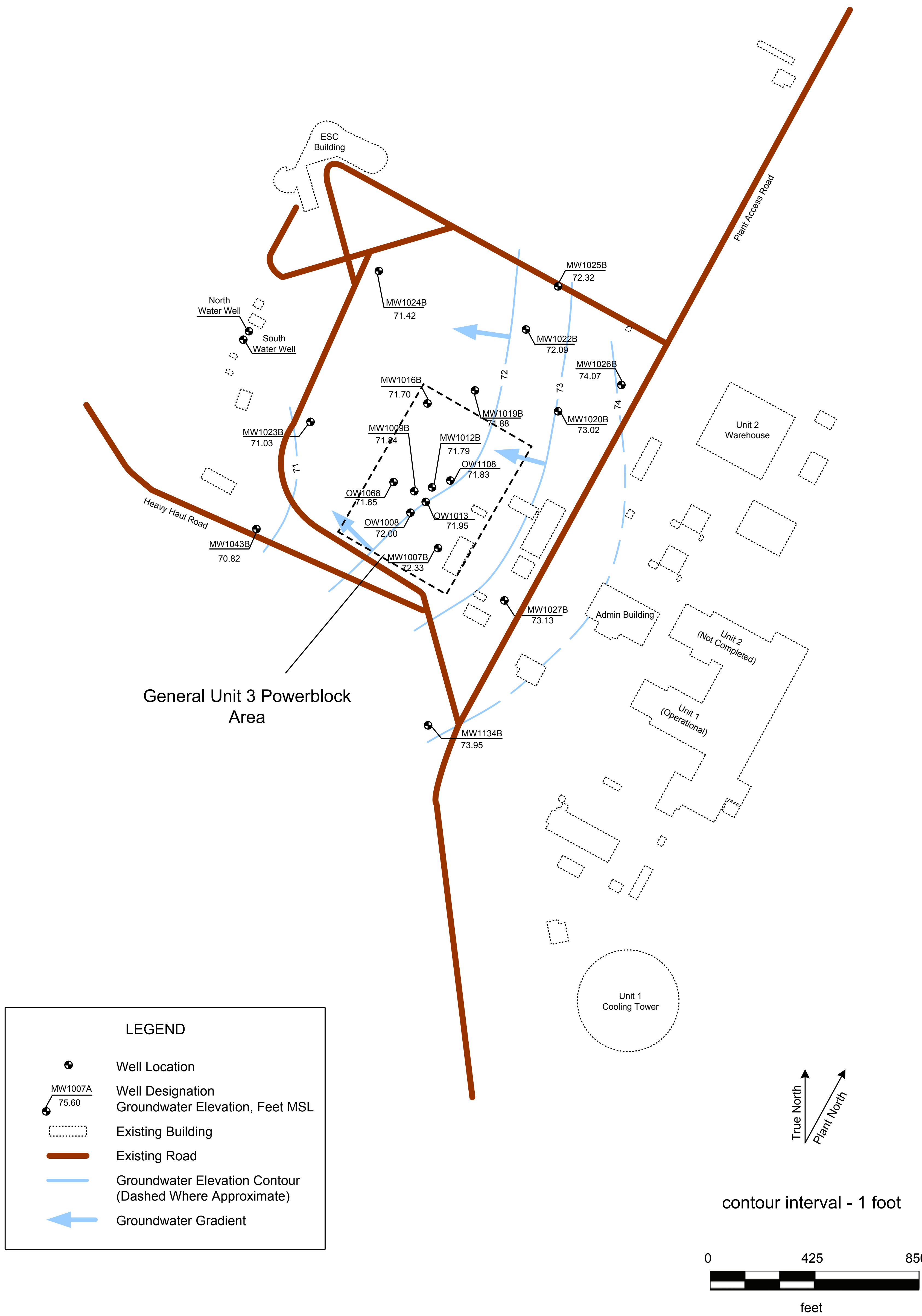


Figure 2.3-203A. December 2006 Groundwater Gradient Map, Wells Screened in the Upland Complex

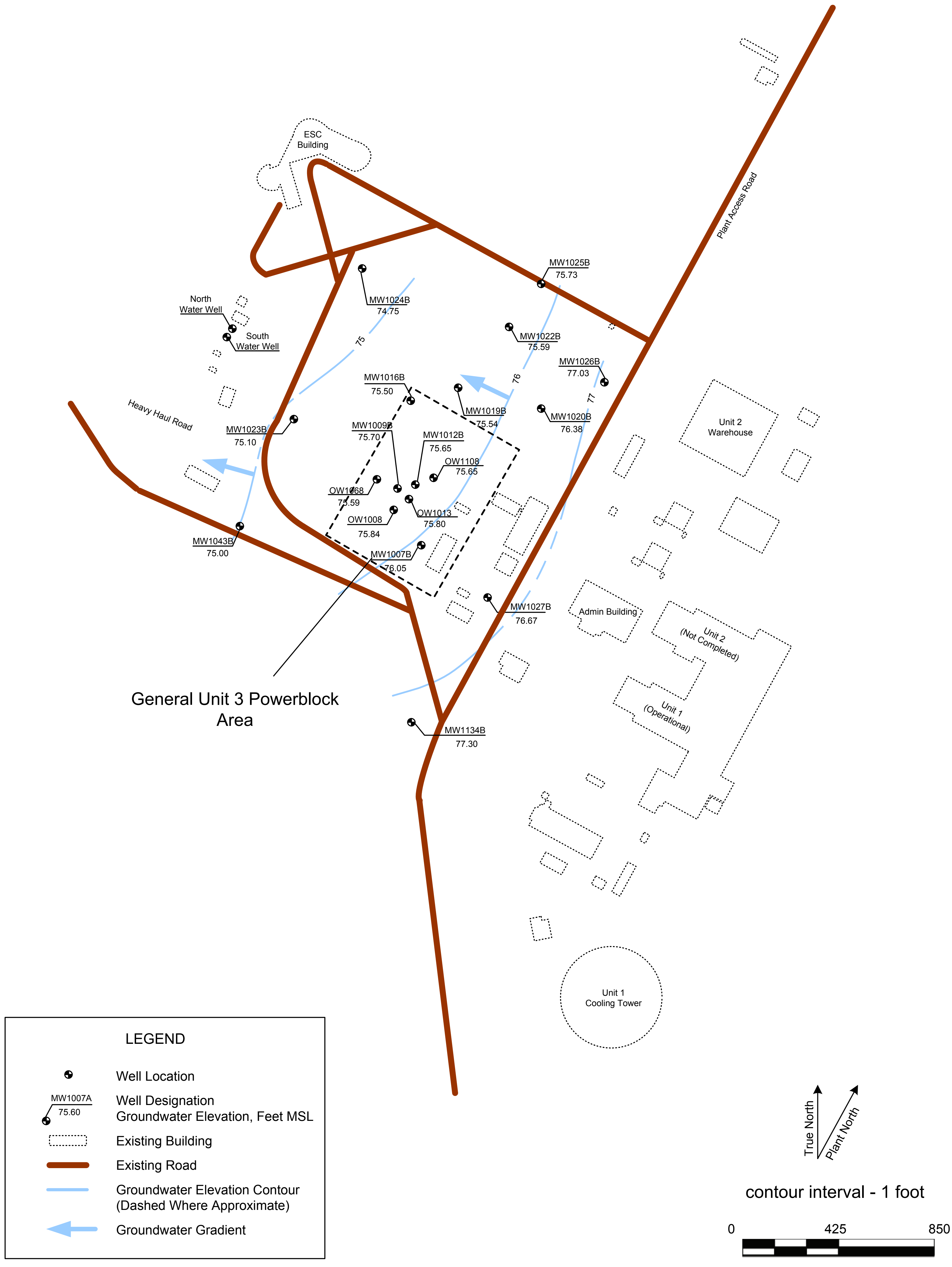


Figure 2.3-203B. May 2007 Groundwater Gradient Map, Wells Screened in the Upland Complex

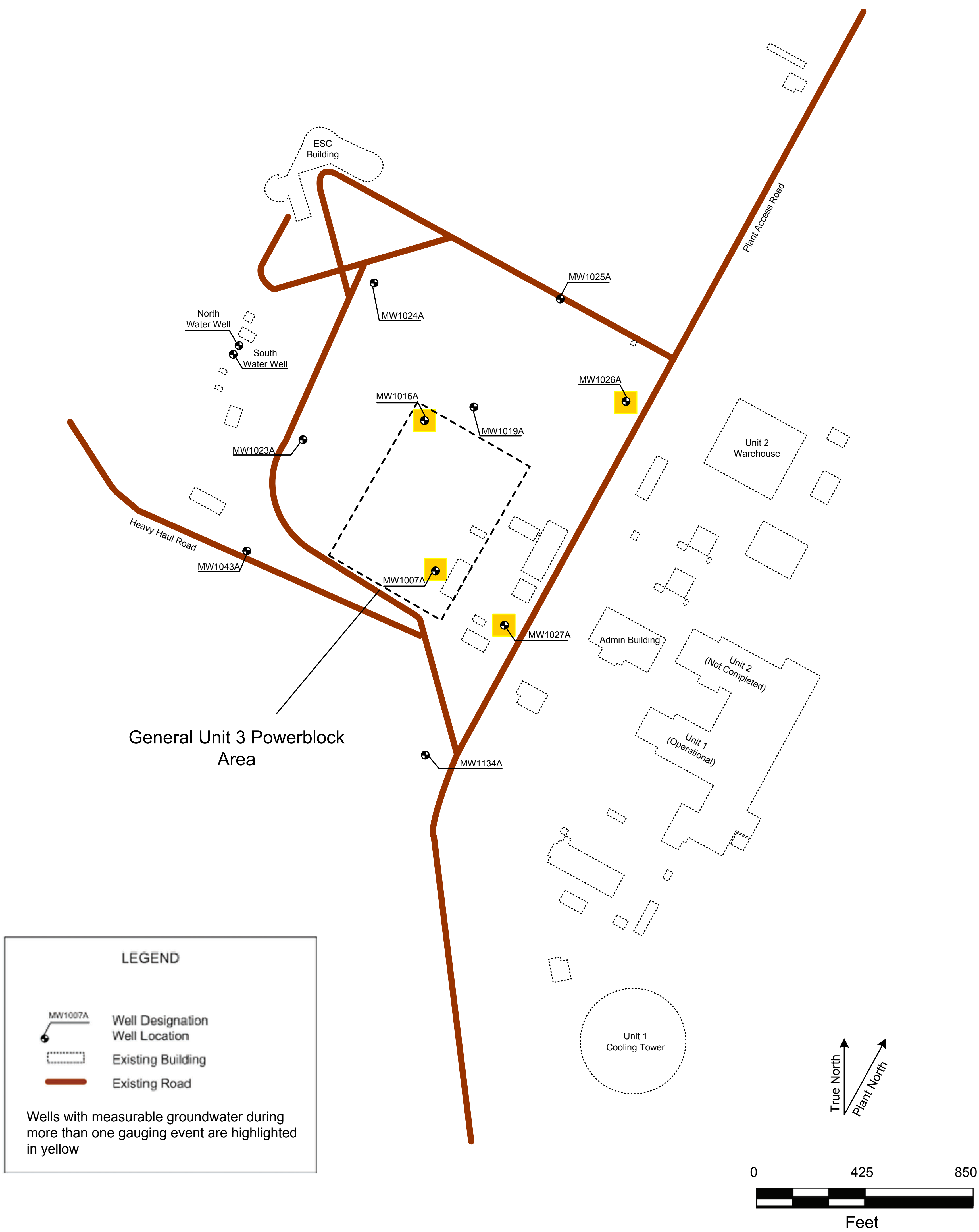


Figure 2.3-204. "A" Wells With Measurable Perched Groundwater

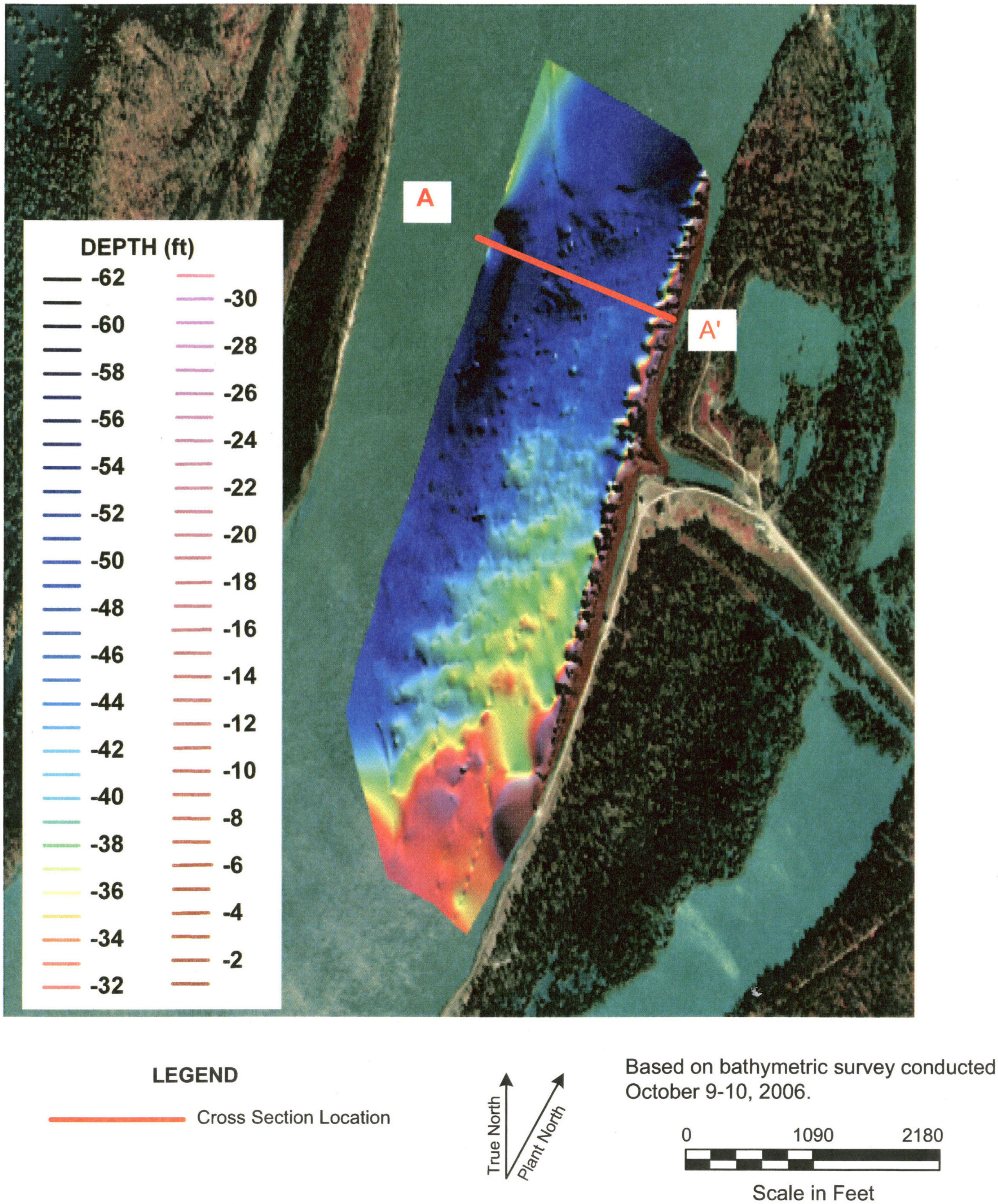
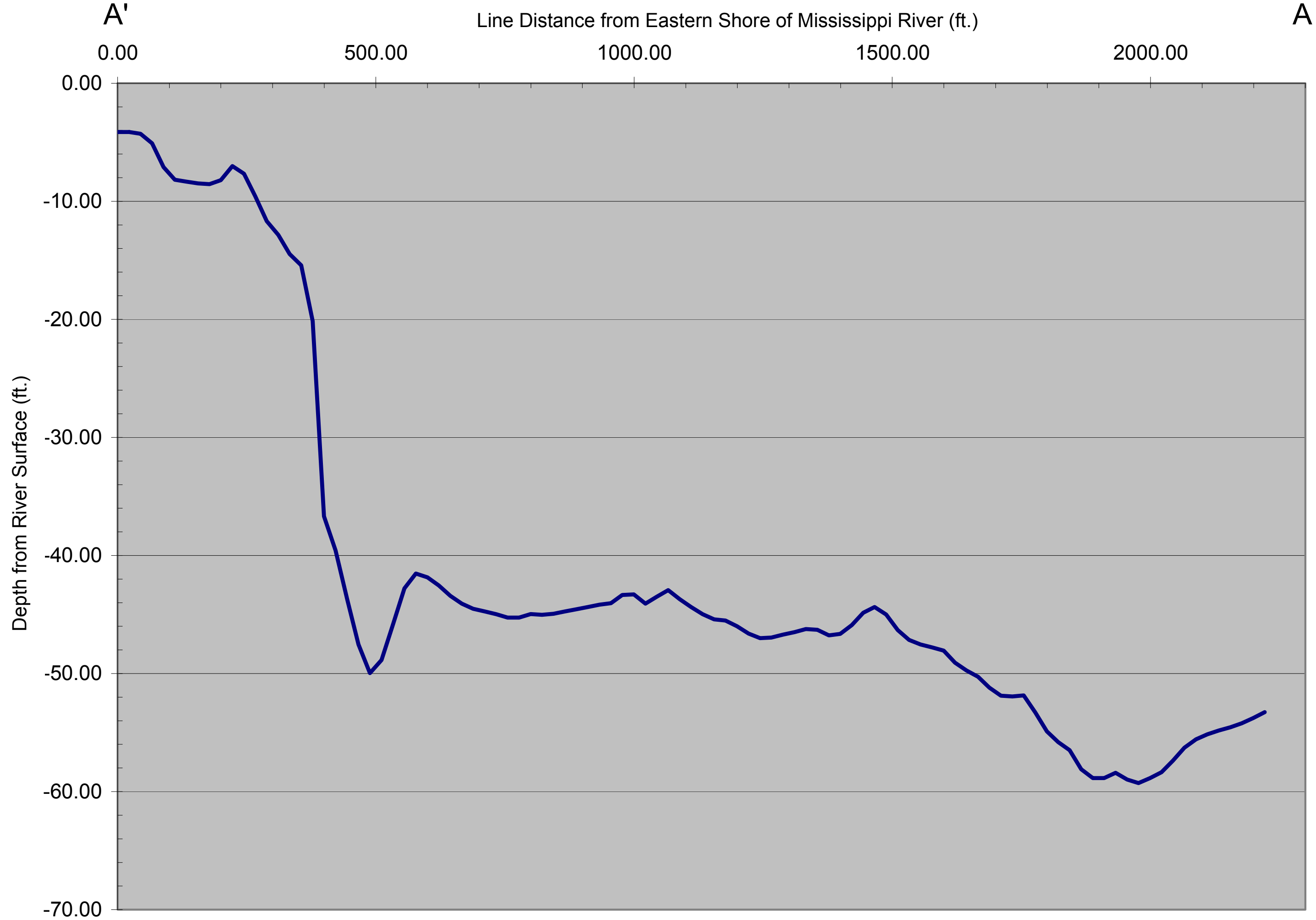


Figure 2.3-205. Mississippi River Cross Section Location For Depth Profile



east-southeast

Based on bathymetric survey conducted October 9-10, 2006. See Figure 2.3-205 for cross-section location.

west-northwest

Note: A' is the measured location closest to the eastern bank of the Mississippi River.

Figure 2.3-206. Mississippi River Cross Section Depth Profile

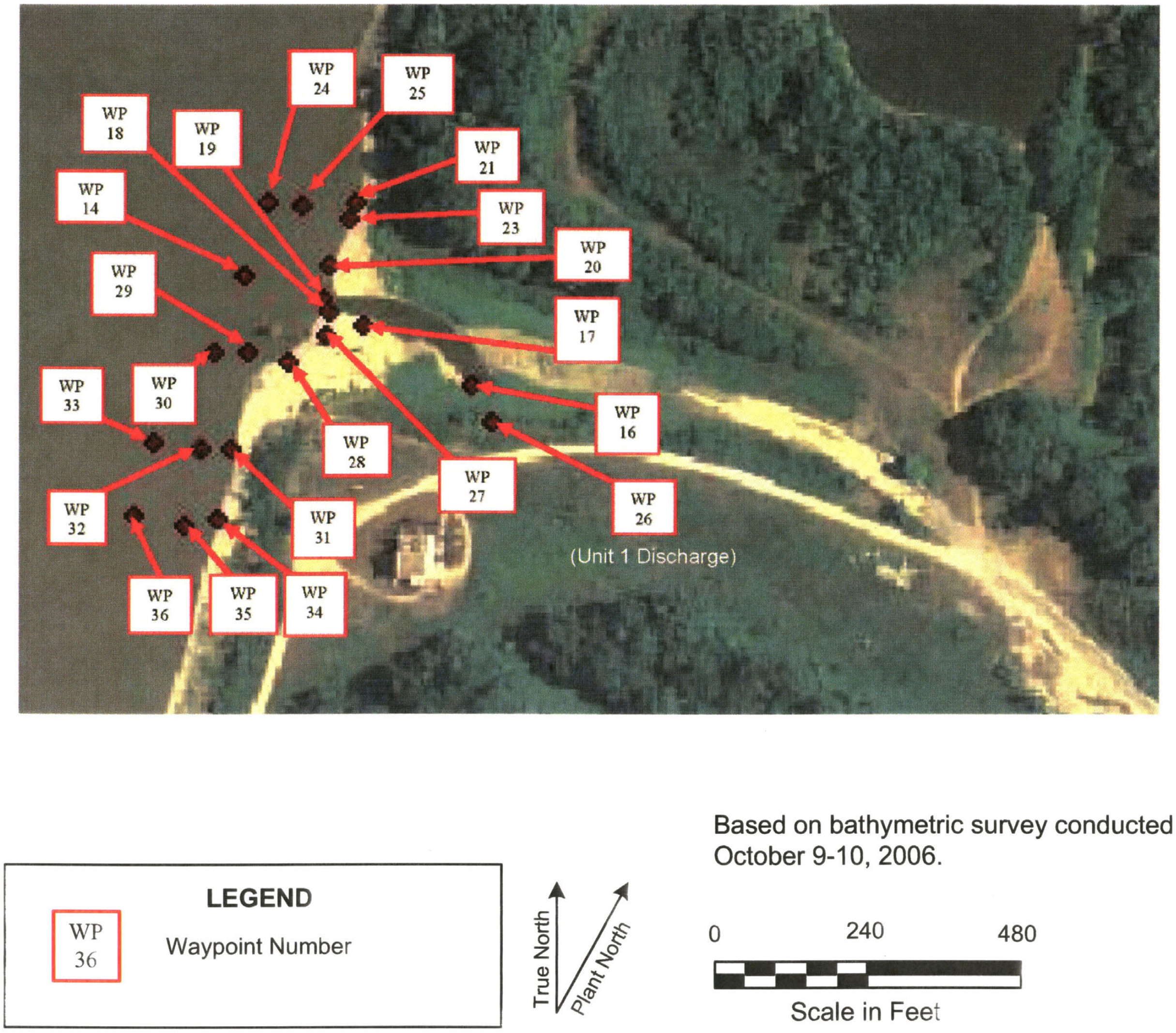


Figure 2.3-207. Mississippi River Waypoint Location Map

2.4 ECOLOGY

The information for this section is provided in the ESP Application Part 3 – Environmental Report Section 2.4. Associated impacts are not fully resolved in NUREG-1817. The following supplemental information is provided.

Certain details of the Unit 3 site layout and construction areas were not known at the ESP stage. The following information is added to describe the existing conditions within the proposed areas of disturbance for Unit 3. Ecological reconnaissance visits to the GGNS site occurred on March 27-29, September 10-13, November 20, December 10-14, 2006, and April 22-27, 2007. These visits were made to survey areas not slated for disturbance at ESP, however are now to be used for either temporary or permanent facilities. The results of these visits are included in appropriate subsections below.

2.4.1 TERRESTRIAL ECOLOGY

The GGNS site is described in NUREG-1817 Subsection 4.4.1.1 as consisting of 2100 ac., based on the original property boundary as described in the Units 1 and 2 Final Environmental Report (FER) from 1973 (Reference 201). The property is now approximately 2015 ac. in size as a result of the loss of approximately 85 ac. due to erosion by the Mississippi River.

2.4.1.1 Terrestrial Habitats

Subjective evaluation of wildlife habitat is based on the assumptions that (a) vegetation structure including species composition and physiognomy (the outward appearance of the stand) is sufficient to define its suitability for wildlife, (b) a positive relationship exists between vegetation diversity and wildlife species diversity, and (c) vegetation species composition and primary productivity directly influence wildlife population density.

Sixty-four percent of the GGNS site remains forested. There are hardwood stands south and west of the existing cooling towers referred to collectively as the “South Woods.” Biodiversity in these stands is enhanced by complex topography that consists of a series of narrow ridges with steep slopes, ravines, and bluffs. More than 20 species of trees occupy this area. Cherrybark oak (*Quercus pagoda*), water oak (*Q. nigra*), Texas oak (*Q. texana*), American elm (*Ulmus americana*), sweet gum (*Liquidambar styraciflua*), bitternut hickory (*Carya cordiformis*), and pecan (*C. illinoiensis*) are all common in the overstory with many trees 30 in. or more in diameter. The GGNS site has been selectively logged in the past as evidenced by the existence of stumps, many of which are of larger diameter than the existing trees.

Mast is plentiful in the South Woods. Mast refers to beechnuts, acorns, and other similar food-stuffs produced by upland hardwood trees. Mast is eaten by a variety of wildlife species.

Dominating the understory are black cherry (*Prunus serotina*), winged elm (*U. alata*), cane (*Arundinaria gigantean*), American beautyberry (*Callicarpa americana*), and pawpaw (*Asimina triloba*). The herb layer is sparse on ridges with loose oat-grass (*Chasmanthium laxum*) and cherokee sedge (*Carex cherokeensis*) common. The latter species is often considered a species of special interest in other areas of the south and southeast, but is relatively common on the GGNS site.

The canopy in ravines and on lower, richer slopes is dominated by beech (*Fagus grandifolia*), tulip poplar (*Liriodendron tulipifera*), and basswood (*Tilia heterophylla*). The most interesting floristic element of the ravines, however, is the abundance of ferns in the understory. Fern colonies include christmas fern (*Polystichum acrostichoides*), mariana maiden fern (*Macrothelypteris torresiana*), southern shield fern (*Thelypteris kunthii*), maidenhair fern (*Adiantum pedantum*), bladder fern (*Cystopteris protrusa*), Japanese net-veined holly fern (*Cyrtomium falcatum*), and spider brake fern (*Pteris multifida*). All of these species are common in the South Woods.

Despite limitations caused primarily by the advanced age of its forests, habitat quality on the GGNS site remains high, especially in the South Woods. At the ESP stage, the South Woods area was within an area that may have been utilized for construction parking and laydown during Unit 3 construction. This has been changed and the South Woods is not expected to be utilized for construction or operations of Unit 3.

On-Site Electrical Transmission Line Right-of-Way

The Unit 3 on-site transmission line right-of-way (ROW) begins at the northeast corner of the proposed new powerblock where it passes through a narrow middle-aged mixed oak (Quercus spp.), hickory (Carya spp.) and basswood and on the south side of Stream A immediately west of the existing water treatment plant (Figure 2.1-201). It then descends a steep slope dominated by kudzu (Pueraria montana) to cross the stream. At the crossing, Stream A is a typical riparian wetland vegetated by black willow (Salix nigra) and cattail (Typha latifolia).

After crossing the main access road to the site, the ROW enters the second forested area of special interest, a mature stand of relatively large cherrybark oak (Quercus pagoda), Texas or Nuttall's oak (Q. texana), bitternut hickory (Carya cordiformis), and pignut hickory (C. glabra) bordering another steep ravine. It continues eastward along a disturbed bluff dominated by honeylocust (Gleditsia triacanthos), a common colonizer of disturbed soil, and grasses before turning southward to again cross Stream A.

South of the stream, the ROW enters the third forested area of interest, a young to middle-aged mixed hardwood stand dominated by water oak and a mixed loblolly pine (Pinus taeda)-oak stand along the western edge of the new switchyard area, the terminus of the ROW. The fact that this vegetation community was not described in the FER for Units 1 and 2 (Reference 201) suggests that the mixed pine-hardwood community was then, as is now, of very limited distribution at the GGNS site.

New Switchyard Area

The new switchyard is located immediately north of and is approximately one-half the size of the existing switchyard. Vegetative cover consists of a mixture of disturbed land, grassy fields, and woodland. The disturbed and grassy areas were used for construction activities associated with the existing unit. The disturbed land ranges from bare soil to weedy areas with exotic clovers (*Trifolium spp.*) and vetches (*Vicia spp*.). The grassy areas are dominated by fescue (*Festuca pratensis*) and sedges (*Carex spp.*).

The wooded portions of this site are second-growth to very young pine and pine-mixed hardwood stands as mentioned above. The young pines have been planted in an effort to partially revegetate the area disturbed during earlier construction. Water oak (*Quercus nigra*), willow oak (*Q. phellos*), cherrybark oak, and loblolly pine are common in the canopy. Black cherry (*Prunus serotina*), black locust (*Robinia pseudoacacia*), and winged elm (*Ulmus alata*) are common in the understory. A mixture of woodland and disturbed-site non-woody species occurs in the ground layer.

Fabrication and Batch Plant Area, Cooling Tower Area and Construction Warehouse Area

The site for the proposed fabrication/batch plant area along with the cooling tower location adjacent to the new powerblock is a graded grassy field that is regularly mowed. It is dominated by exotic grasses and clovers as is most of the proposed construction warehouse area. The latter is also a previously disturbed area used during construction of the existing unit for parking, laydown or other purposes. Cover is now a mixture of gravel, concrete, and grassy surfaces. The dominant vegetation is exotic clovers, thistle (*Cirsium spp.*), fescue, and rye grass (*Lolium perenne*).

Off-Site Electrical Transmission System

The design and location of the new transmission lines proposed for Unit 3 are described in Section 3.7. The transmission line owner, EMI, has not finalized the transmission ROW, and only a possible corridor for the ROW has been identified. Because the proposed transmission line route has not been finalized and is still subject to change, no on-site field studies were performed during the preparation of this ER. A desktop analysis of the categories of land potentially affected by ROW development is presented in Section 2.2 including the details of the analysis protocol. The land ownership/administration categories included in the analysis are:

- National Wetlands Inventory
- Bureau of Indian Affairs
- Bureau of Land Management
- Bureau of Reclamation
- U.S. Department of Defense
- USDA Forest Service

- U.S. Fish and Wildlife Service
- U.S. National Park Service
- Tennessee Valley Authority
- Federal parkways
- All other federal lands not listed above
- State and local parks

Except for the Natchez Trace Parkway, administered by the U.S. National Park Service, no federal lands or state or local parks fall within the proposed corridor for the ROW. The primary terrestrial communities located within the new transmission ROW are agricultural land, deciduous forest, and mixed forest (See Table 2.2-201). Wetlands in Mississippi occur primarily in coastal regions and areas directly adjacent to the Mississippi River and other flowing waters. According to data derived from the U.S. Geological Survey National Land Cover Database, approximately 90 ac. of the transmission ROW overlays areas with wetland characteristics (Reference 202). This represents an estimate of the area within the new ROW which may contain jurisdictional wetlands. This is not a delineation of jurisdictional wetlands as defined by U.S. Army Corps of Engineers regulations.

2.4.1.2 Threatened and Endangered Terrestrial Species

The special terrestrial species of concern on-site are five state-listed plants mentioned in NUREG-1817 as potentially occurring in the area, the federally listed threatened and state-listed endangered Louisiana black bear (*Ursus americanus luteolus*), and the federally listed threatened bald eagle (*Haliaeetus leucocephalus*), which has since been delisted as described below.

The U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) share responsibility under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531-1543) for the conservation and recovery of federally listed threatened and endangered species.

At the state level, the Mississippi Natural Heritage Program (MNHP) has responsibility under the Non-game and Endangered Species Conservation Act (Mississippi Code Ann. 49-5-103 and 49-5-103-119) for the protection of endangered and threatened species not of special concern nationally but which are in imminent danger of extirpation in the state (i.e., endangered), or which are likely to become an endangered species within the foreseeable future (i.e., threatened).

NUREG-1817, Subsection 2.7.1.2 – Threatened and Endangered Terrestrial Species describes the available information on existing terrestrial species of special interest at the GGNS site, including the proposed on-site transmission line ROW. To re-confirm this information, informal consultation by letter with the agencies shown in Table 2.4-201 was re-initiated.

Additionally, by letters dated June 7, 2007 (also listed in Table 2.4-201), the informal consultation process with the USFWS and MNHP was re-initiated concerning listed species that may occupy areas along the proposed corridor for the off-site electrical transmission line. No response had been received at the time of application submittal. Federally listed species within each of the three counties traversed by the proposed off-site transmission system ROW are presented in Table 2.4-202, and state-listed species are listed in Table 2.4-203. None of the species identified in these tables should be presumed to occur within the proposed ROW without additional information provided by the USFWS or on-site ecological surveys. No on-site surveys have been performed to confirm corridor for the ROW; rather, these tables simply provide a list of all of the federally-listed and state-listed species that exist within these counties. Because the proposed transmission line route has not been finalized and is still subject to change, no on-site field studies were performed during the preparation of this ER. See Subsection 2.2.2 for additional detailed discussion of the type and method of the review performed.

Of the federally listed species presented in Table 2.4-202, discussions of the habitat of each terrestrial species are included in NUREG-1817 Subsection 2.7.1.2, with the exception of the pondberry (*Lindera mellissifolia*), an endangered aromatic shrub known to occur seasonally in flooded wetlands, sandy sinks, pond margins, and swampy depressions in Warren County. On-site reconnaissance would be required to confirm the presence of this species within the proposed off-site transmission system ROW. Of the state-listed species presented in Table 2.4-203, discussions of the habitat and likely presence of each terrestrial species are included in NUREG-1817 Subsections 2.7.1.1 and 2.7.1.2, with the exception of the peregrine falcon (*Falco peregrinus*) and the Bewick's wren (*Thryomanes bewickii*). A request for information regarding the potential for state-listed species to occur in the proposed off-site transmission system ROW was requested from the MNHP (Table 2.4-201). Confirmation of the presence of any of the state-listed in the ROW would require on-site reconnaissance after the location of the ROW is determined.

Entergy observes practices and processes intended to provide appropriate, prudent measures for protection of environmentally sensitive areas that could be involved in the planning and construction of transmission lines or substations. These processes include identifying and securing applicable environmental permits related to proposed transmission system construction. These permits would include USACE Section 404 permits for wetland impacts (supported by MDEQ Section 401 water quality certifications), MDEQ NPDES stormwater permits and direct discharge permits, as applicable, including the development of stormwater pollution prevention plans (SWPPPs), silvicultural best management practices (BMPs), and Endangered Species Act consultations and incidental take permits, where applicable. Accordingly, processes in the planning phase include the consideration of crossing rivers, waterbody or wetlands, and crossings, as well as any known or expected threatened or endangered species habitat that may be impacted by ROW and transmission line construction. BMPs are observed during construction as required by these permitting programs, including special care in working in areas near sensitive habitat. Entergy also follows an Avian Interaction Policy to protect migratory birds and minimize power line-related avian mortalities.

2.4.1.2.1 State-listed Plants

The plants listed in NUREG-1817 as potentially occurring on-site are: (1) Allegheny monkeyflower (*Mimulus ringens*), (2) American bittersweet (*Celastrus scandens*), (3) glade fern (*Diplazium pycnocarpon*), (4) hairy waterclover (*Marsilea vestita*) and (5) jug orchid (*Platythelys querceticola*). Additionally, recent reconnaissance revealed the presence of white walnut (*Juglans cinerea*), which is on the MNHP tracking list of plants (Reference 203). The species is known to exist at only 18 sites within the state.

The two areas closely examined on September 10-13, 2006 and April 22-27, 2007 for the presence of these plants are: (1) the proposed water intake/discharge pipeline ROW on the north side of the heavy haul road in the floodplain, and (2) the proposed transmission line ROW connecting the new powerblock to the new switchyard.

<u>Water Pipeline ROW</u>. The proposed width of the pipeline ROW paralleling the Heavy Haul Road is assumed to be 100 ft. The northern edge of the road has been significantly disturbed in the past in connection with original construction of the road and construction and maintenance of an electrical transmission line also located there. Vegetation is now dominated by thickets of invader species such as pepper vine (*Ampelopsis arborea*) and smartweed (*Polygonum lapathifolium*), typical wetland species such as swamp privet (*Forestiera acuminate*), box elder (*Acer negundo*), and black willow, and young sycamore (*Platanus occidentalis*).

Habitat suitable for the bittersweet, fern, and waterclover occurs along the north edge of the existing road ROW. None of these species were observed there. However, the floodplain area has been determined to be a jurisdictional wetland and requires a USACE permit to construct the pipeline adjacent to the maintained road/electrical transmission line ROW.

<u>On-Site Electrical Transmission Line ROW</u>. Although habitat suitable for some of the species of special interest occurs along the proposed ROW, especially on steep slopes and ravines, none were observed while inspecting the forested stands adjacent to Stream A.

<u>South Woods</u>. The lower slopes and deep ravines in this area provide habitat suitable for some of the species of special interest such as the glade fern. In addition, reconnaissance revealed two specimens of white walnut on one of the lower north-facing slopes of a major ravine. One tree was approximately 18 in. in diameter and 80 ft. tall. The other was broken in half approximately 15 ft. up the trunk, possibly by wind or lightning, and was re-sprouting. None of the other state-listed species of interest was found in any of the areas examined during this visit.

2.4.1.2.2 Louisiana Black Bear

The GGNS site offers potential habitat for the Louisiana black bear. Areas in potential upland and bottomland habitats were visually canvassed on December 13-14, 2006 and April 22-27, 2007 at approximately 100-ft. intervals on foot to identify suitable den trees of large diameter. Each large tree was closely examined for cavities and claw marks suggesting possible or potential use by the bear. Diameter at Breast Height (DBH) was measured and the location of each tree greater than or equal to 36-in DBH was recorded with a hand-held GPS. Each tree was identified to species or genus.

Thirty trees greater than or equal to 36-in DBH were tallied within the areas surveyed. Ten were found in the South Woods in the upland, three were found in the mixed hardwood-pine stand bordering the new switchyard in the upland, thirteen were found south of the heavy haul road, and seven were found north of the road in the bottomland. Species included water oak, chinquapin oak (*Quercus muehlembergii*), and other oaks, pecans (*Carya spp.*), and elms (*Ulmus spp.*). These trees meet the criteria established by the USFWS as “candidate trees” important for black bear denning habitat. Only one tree, a 50-in. DBH oak, had an actual cavity. The cavity was open and exposed.

No trees were found with enclosed cavities, claw marks, or any evidence suggesting actual use as a den tree. However, a probable ground den occurred at a location approximately 400 ft. north of the heavy haul road and 3800 ft. east of the river bank. Section 4.3 addresses the implications of the presence of this probable den.

Possible foraging areas consisting of blackberry (*Rubus trivialis*) thickets were also noted. They were scattered but relatively common throughout the entire area. Areas holding shallow water in the bottomland are also possible foraging areas. They were also numerous throughout the area surveyed. Thus, the site appears to contain suitable black bear foraging and denning habitat in both uplands and bottomlands. However, with the exception of the possible ground den in the bottomland, there is no actual evidence of the current use of the site by bears.

2.4.1.2.3 Bald Eagle

The GGNS site offers potential nesting sites and over-wintering habitat for the bald eagle. The bald eagle is now delisted from the federal endangered and threatened species list in the lower 48 states (Reference 204). However, NUREG-1817 left the question as to whether bald eagles could be nesting in the GGNS site vicinity unresolved. Therefore a survey was undertaken to identify potential utilization of the site vicinity by nesting eagle pairs.

On December 11, 2006 a small, outboard-powered boat was employed to cruise at slow speed northbound and along the western or Louisiana shore of the river to inspect riverbank trees on the site with binoculars and a spotting scope upriver as far as the Grand Gulf Military Park, a distance of approximately 1.5 mi. north of the GGNS site. The observers then crossed to the Mississippi side of the river to continue the cruise at slow speed downstream back toward the point of launch at Port Claiborne, approximately 1.25 mi. south of the site.

Observation of potential nests and/or perched eagles was facilitated by deciduous leaf-fall that allowed excellent visibility of the tops of trees silhouetted along the river and of branches that might be used as perches by foraging eagles. Eagles typically construct large diameter nests near the top of sturdy deciduous and evergreen trees. Nests are usually reused and enlarged by the same pair of eagles from year to year. Thus, they are very obvious after leaf-fall as are eagles that might perch on or near them while scanning the river for fish and other food. No eagles were observed scavenging or perched in trees along the river bank.

Generally, trees on the natural levee of the river and visible from the river further inland appear too small and under-developed to support large eagle nests. No nests of a sufficiently large size to be used by eagles occurred in any of the habitat observed on either side of the river. Thus, as with black bear denning habitat, the site appears to contain suitable over-wintering eagle habitat.

However, there is no actual evidence of the current use of the site by eagles and little possibility of nesting due to the generally small stature of the trees along the river.

2.4.2 AQUATIC ECOLOGY

Aquatic resources at the GGNS site are the Mississippi River adjacent to the site, two oxbow lakes (Hamilton and Gin) on-site, a flooded borrow pit in the bottomland, three small upland ponds, and two perennial streams.

Section 3.7 details the proposed route for new transmission lines proposed for Unit 3. Major stream crossings along this route include the Big Black River (two crossings), Fourteen Mile Creek, and Bakers Creek. All of these streams are perennial streams (Reference 202). Federally listed species within each of the three counties traversed by the proposed corridor for the off-site transmission system ROW are presented in Table 2.4-202, and state-listed species are listed in Table 2.4-203. None of the species identified in these tables should be presumed to occur within the proposed ROW without additional information provided by the USFWS. No on-site surveys have been performed to confirm the presence of these species or their habitats; rather, these tables simply provide a list of all of the federally-listed and state-listed species that exist within these counties. Because the proposed transmission line route has not been finalized and is still subject to change, no on-site field studies were performed during the preparation of this ER. See Subsection 2.2.2 for additional detailed discussion of the type and method of the review performed.

Of the federally listed species presented in Table 2.4-202, discussions of the habitat of each aquatic species are included in NUREG-1817 Subsection 2.7.2.2, with the exception of the ringed map turtle (*Graptemys oculifera*), known to exist in the Pearl River in Hinds County where currents are moderate and sandbars exist for basking. On-site reconnaissance would be required to confirm the presence of this species within the proposed corridor for the off-site transmission system ROW. Of the state-listed species presented in Table 2.4-203, discussions of the habitat and likely presence of each aquatic species are included in NUREG-1817 Subsections 2.7.2.1 and 2.7.2.2, with the exception of the pyramid pigtoe (*Pleurobema rubrum*) and the southern redbelly dace (*Phoxinus erythrogaster*). Information regarding the potential for these state-listed species to occur in the proposed corridor for the off-site transmission system ROW was requested from the MNHP (Table 2.4-201). Confirmation of the presence of any of the state-listed species in the ROW would require on-site reconnaissance after the location of the ROW is determined.

The possible occurrence of the fat pocketbook mussel in the Mississippi River at the GGNS site was investigated by performing a mussel survey at the intake and discharge location on November 20, 2006. The survey found no native mussels of any species or live mussels of any exotic species. Dead zebra mussel (*Dreissena polymorpha*) and asiatic clam (*Corbicula fluminea*) shells occurred on the river bank. The latter are introduced species common to the Mississippi River. Because the shells represented dead specimens, their origin is unknown except to note that they probably originated somewhere upriver and were carried to the site by river currents.

Some of the practices and procedures observed by Entergy that are intended to provide appropriate, prudent measures for protection of environmentally sensitive areas that could be involved in the planning and construction of transmission lines or substations are discussed in Subsection 2.4.1.2.

2.4.3 REFERENCES

201 Mississippi Power and Light (MPL). Final Environmental Report for Grand Gulf Nuclear Station, Units 1 and 2, 1973.

202 U.S. Environmental Protection Agency, National Land Cover Data, Website, http://www.epa.gov/mrlc/nlcd.html, Accessed April 30, 2007.

203 Mississippi Museum of Natural Science. Natural heritage program list of plant species of special concern for Warren County. MMNS, 2148 Riverside Drive, Jackson, MS 39202-1353. Website, http://www.mdwfp.com/museum/html/research/query_plants.asp accessed June 13, 2007.

204 U.S. Fish & Wildlife Service, News Release, June 28, 2007, “Bald Eagle Soars Off Endangered Species List, Secretary Kempthorne: The Eagle has Returned,” Website http://www.fws.gov/home/feature/2007/BaldeagleAugust8bulletin.pdf, accessed on August 6, 2007.

TABLE 2.4-201
STATUS OF INFORMAL CONSULTATION WITH FEDERAL AND STATE AGENCIES CONCERNING SPECIES OF SPECIAL INTEREST AT THE GRAND GULF NUCLEAR STATION, CLAIBORNE COUNTY, MS

Agency	Office	Date of Letter	Response
Federal			
National Marine Fisheries Service	St. Petersburg, FL	06/30/06	07/11/06 Phone Call
		07/12/06	None received by the time of application filing
U.S. Fish and Wildlife Service	Jackson, MS	06/30/06	07/21/06
		06/06/07	None received by the time of application filing
	Panama City, FL	07/12/06	None received by the time of application filing
State			
Louisiana Natural Heritage Program	Baton Rouge, LA	06/30/06	None received by the time of application filing
Mississippi Natural Heritage Program	Jackson, MS	06/30/06	08/11/06
		06/06/07	None received by the time of application filing

TABLE 2.4-202
FEDERALLY LISTED THREATENED AND ENDANGERED SPECIES FOR MISSISSIPPI COUNTIES TRAVERSED BY THE PROPOSED TRANSMISSION ROW

Scientific Name	Common Name	Federal Status	Claiborne County	Hinds County	Warren County
Ursus luteolus	Louisiana Black Bear	Threatened	X	X	X
Lindera mellissifolia	Pondberry	Endangered			X
Sterna antillarum	Interior Least Tern	Endangered	X		X
Scaphirhynchus albus	Pallid Sturgeon	Endangered	X		X
Etheostoma rubrum	Bayou Darter	Threatened	X	X	
Graptemys oculifera	Ringed Map Turtle	Threatened		X	
Acipenser oxyrhynchus desotoi	Gulf Sturgeon	Threatened		X	

TABLE 2.4-203
STATE-LISTED THREATENED AND ENDANGERED SPECIES FOR MISSISSIPPI COUNTIES TRAVERSED BY THE PROPOSED TRANSMISSION ROW

Scientific Name	Common Name	State Status	Claiborne County	Hinds County	Warren County
Ursus luteolus	Louisiana Black Bear	Endangered	X		
Scaphirhynchus albus	Pallid Sturgeon	Endangered	X		
Etheostoma rubrum	Bayou Darter	Endangered	X		
Crystallaria asprella	Crystal Darter	Endangered	X		
Mycteria Americana	Wood Stork	Endangered	X		X
Puma concolor coryi	Florida Panther	Endangered	X		
Pleurobema rubrum	Pyramid Pigtoe	Endangered			X
Falco peregrinus	Peregrine Falcon	Endangered			X
Haliaeetus leucocephalus	Bald Eagle	Endangered			X
Phoxinus erythrogaster	Southern Redbelly Dace	Endangered			X
Thryomanes bewickii	Bewick’s Wren	Endangered			X
Sterna antillarum	Interior Least Tern	Endangered			X

2.5 SOCIOECONOMICS

The information for this section is provided in the ESP Application Part 3 – Environmental Report; the following supplemental information is provided. Hurricane Katrina, which made land-fall at the Gulf Coast on August 29, 2005, was an important post-ESP event in Louisiana and Mississippi. Its socioeconomic impacts are potentially relevant to Unit 3 and the surrounding region. Information regarding Hurricane Katrina and its potential impacts are provided in this section as supplemental information, and provides a means of assessing possible impacts of Hurricane Katrina. Updated information (where available) concerning demography and community characteristics has been incorporated into Subsections 2.5.1 and 2.5.2, respectively.

2.5.1 DEMOGRAPHY

The demographic characteristics are evaluated in Subsection 2.8.1 of NUREG-1817; the following supplemental information is provided.

After Hurricane Katrina, the U.S. Census Bureau issued revised population estimates for the affected areas, which included numerous counties within the GGNS region as shown below. For these affected counties, the average population change between July 1, 2005, and January 1, 2006, was a 0.6 percent increase, much less than the Mississippi state average of a 3 percent increase (Reference 201). This does not constitute a significant change in population.

Designated Public Assistance Counties within the Region

Adams County	Hinds County	Simpson County
Amite County	Jefferson County	Warren County
Claiborne County	Lincoln County	Wilkinson County
Copiah County	Madison County	Yazoo County
Franklin County	Rankin County	

(Reference 202)

2.5.2 COMMUNITY CHARACTERISTICS

The community characteristics are evaluated in Subsection 2.8.2 of NUREG-1817; the following supplemental information is provided.

Claiborne County, Mississippi and adjacent counties and parishes were largely unaffected by Hurricane Katrina and experienced no lasting significant socioeconomic impacts. The only indication of impact was Claiborne County's identification as a Designated Individual Public Assistance Area following the hurricane. This designation, reported in July 2006, was valid for the period of September through December 2005. No updates to this status have been reported (Reference 201, Reference 202, and Reference 204).

As of January 1, 2006, the post-Katrina special population estimate for Claiborne County, Mississippi was approximately 10,000 (Reference 204). This was an increase of less than half a percent from the pre-Katrina special population estimate of approximately 9960 on July 1, 2005. It is important to note that the special population estimates are different from the reported 2005 Census estimates because the special population estimates are limited to household population. Group Quarters populations (e.g., populations including correctional institutions, dormitories, and half-way houses) are excluded. As the special population estimates are the only Katrina-specific counts available, they provide a reasonable comparative tool for evaluating pre and post-event populations. Population estimates for counties in Mississippi and parishes in Louisiana that surround Claiborne County, Mississippi show similar slowly increasing population trends (Reference 201).

Overall, based on a review of key socioeconomic features related to this region, it is concluded that Hurricane Katrina resulted in no significant, lasting impact to counties and parishes immediately surrounding the GGNS site.

The tax disposition of GGNS Unit 3 was not known at ESP. GGNS Unit 3 is expected to be a regulated facility. As such, under the assumptions of Subsection 10.4.1.1.1 of this report, the tax structure for GGNS Unit 3 may be similar to that described in NUREG-1817, Subsection 2.8.2.3 for the current operating facility.

2.5.3 HISTORIC PROPERTIES

NUREG-1817, Section 4.6, states that areas identified by the Mississippi Department of Archives and History (MDAH) as potentially containing unrecorded archeological sites is expected to be investigated prior to construction in these areas. A Phase I archaeological survey was conducted between April 24 and May 2, 2007, on two study areas totaling approximately 115 ac. of a well dissected upland landform within the Unit 3 site using a combination of shovel testing and pedestrian survey. Eleven archaeological sites and eight isolated finds/small artifact scatters were identified during this survey. One historic site within the study area was identified as having the potential to be eligible for the National Register of Historic Places (NRHP). The remaining sites were determined to be ineligible for listing on the NRHP.

The Phase I survey findings were submitted to the MDAH for their review in June 2007. In letter dated July 17, 2007, the MDAH concurred with the findings presented in the Phase I survey. The only potentially NRHP-eligible site is in the South Woods area which is not planned for construction. Procedures for unexpected discovery of cultural resources have been developed and are included in the site-wide Excavation and Backfill Work Procedures.

2.5.4 ENVIRONMENTAL JUSTICE

The locations and dispositions of minority and low-income populations were described in Section 2.10 of NUREG-1817. No new and significant information was identified for this section.

2.5.5 REFERENCES

201 U.S. Census Bureau, Special Population Estimates for Impacted Counties in the Gulf Coast Area, Excel spreadsheet, Website, www.census.gov/Press-Release/www/emergencies/gulfcoast_impact_estimates.xls, accessed November 21, 2006.

202 U.S. Census Bureau, 2005 Gulf Coast Area Data Profiles, Website, http://www.census.gov/acs/www/Products/Profiles/gulf_coast/ms.htm, accessed November 21, 2006.

203 Mississippi State University, Extension Service, “Impact of Hurricane Katrina on Mississippi Agriculture,” Website, http://msucares.com/pubs/misc/m1426.pdf, accessed November 21, 2006.

204 Mississippi State University, Extension Service, “2005 / 2006 Annual Report,” Website, http://msucares.com/pubs/publications/p2408.pdf, accessed November 21, 2006.

2.6 GEOLOGY

The information for this section was provided in the ESP Application Part 3 – Environmental Report, Section 2.6, and associated impacts are not fully resolved in NUREG-1817; the following supplemental information is provided.

Section 2.4 of NUREG-1817 indicated that additional site exploration, laboratory testing, and geotechnical analyses would be performed to develop final plant design criteria for the COL phase of the project. A detailed description of the geological, seismological, and geophysical characteristics of the GGNS Site and the ESP Site region (200-mi. radius), vicinity (25-mi. radius), area (5-mi. radius) and the site location (0.6-mi. radius) is provided in Section 2.5 of the Final Safety Analysis Report (Part 2 of this COL Application).

2.6.1 REFERENCES

None.

2.7 METEOROLOGY AND AIR QUALITY

The information for this section is provided in the ESP Application Part 3 – Environmental Report, and associated impacts are resolved in NUREG-1817. The following supplemental information is provided for the reasons discussed below.

In Subsection 5.10.1 of the Environmental Impact Statement (NUREG-1817), the staff stated that atmospheric dispersion (χ/Q) values used in environmental reviews should be based on typical meteorological conditions rather than adverse meteorological conditions. The site specific χ/Q values provided in the ESP Environmental Report were based on adverse conditions which are expected to be exceeded no more than 5 percent of the time. Plant-specific atmospheric dispersion values are required in Section 7.1 to evaluate the environmental impact of accidents for an ESBWR located at the GGNS site. The χ/Q values for typical meteorological conditions suitable for environmental reviews (50 percentile χ/Q values) given in Table 2.7-201 were determined in accordance with the guidance provided in Regulatory Guide 1.145.

2.7.1 REFERENCES

None.

TABLE 2.7-201
50% PROBABILITY-LEVEL χ/Q VALUES (sec/m^3) BASED ON 2002-2003 METEOROLOGICAL DATA

	0 – 2 hr.	0 – 8 hr.	8 – 24 hr.	24 – 96 hr.	96 – 720 hr.
EAB	6.484E-05				
LPZ (3219 m)		8.91E-06	7.79E-06	5.83E-06	3.85E-06

2.8 RELATED FEDERAL PROJECT ACTIVITIES

The information for this section is provided in the ESP Application Part 3 – Environmental Report, Section 2.8, and associated impacts are not fully resolved in NUREG-1817; the following supplemental information is provided.

In accordance with NUREG-1555 Section 2.8, the scope of this review is limited to directly related federal project activities that affect plant siting or transmission line routing, plant water supply, or the need for power.

The NRC staff stated in NUREG-1817 Section 2.11 that related federal activities such as U.S. Federal Energy Regulatory Commission (FERC) transmission-related studies would be evaluated at the COL stage. As discussed in Section 1.1, the Unit 3 would be connected to the transmission system through the existing GGNS switchyard, which is expected to be expanded to support the output generated by Unit 3. New transmission line right-of-way is expected to also be necessary to support Unit 3, as discussed in Section 3.7. The FERC has a mandated oversight role regarding connection of Unit 3 to the existing transmission grid. Transmission line construction and siting of the additional lines requires approval from the MPSC. The FERC and MPSC approval process is discussed in Section 2.2.

No additional directly related federal activities or relevant cooperating agencies that affect plant siting, water supply, or need for power have been identified at this time. The assessment of need for power is discussed in Section 8.4.

2.8.1 REFERENCES

None.

CHAPTER 3 PLANT DESCRIPTION

3.0 PLANT DESCRIPTION

10 CFR 51.50(c)(1)(i) requires that a combined license (COL) application referencing an early site permit (ESP) contain "information to demonstrate that the design of the facility falls within the site characteristics and design parameters specified in the early site permit." As discussed below, the information provided in this section fulfills the requirement for such a demonstration.

The proposed project is described in Section 1.1. The plant design proposed for construction and operation at the Grand Gulf ESP Site is the GE-Hitachi (GEH) ESBWR.

The ESP application submitted for the GGNS site did not specify a particular reactor plant design or vendor. Rather, Part 3 of the ESP application, the environmental report (ER), and associated NRC environmental impact statement (see Subsection 1.1.1 of NUREG-1817) provided an evaluation of environmental impacts on the GGNS ESP site and surroundings considering a set of parameters expected to bound the design characteristics of a reactor or reactors that might be deployed at the site (see Section 3.2 of NUREG-1817). For purposes of preparing the ESP application, a plant parameters envelope (PPE), which included bounding design parameters representative of a number of nuclear plant designs, served as a surrogate for actual facility information. These bounding parameters are presented in the ESP ER PPE tables (ESP ER Tables 3.0-1 through 3.0-9), and are also included in Appendix D, Values of Plant Parameters Considered in the Environmental Review of the Application, Tables D1 through D9, of the Grand Gulf ESP (ESP-002, dated April 5, 2007). Background, assumptions, and methodology regarding the development of the PPE are provided in the ESP Site Safety Analysis Report, Section 1.3.

At the COL stage, if the environmental impacts addressed in NUREG-1817 (based on the bounding ESP parameters) are found to be bounding, no additional analysis of these impacts is required, even if the PPE approach was employed at ESP. Tables 3.0-201 through 3.0-208 provide the complete set of PPE values (ESP Parameters), and provide the demonstration analysis of whether the COL design characteristics of the Unit 3 ESBWR "fall within the design parameters specified in the early site permit," as required by 10 CFR 51.50(c)(1). A definition for each ESP parameter in Table 3.0-201 is provided in Table 3.0-209, including specification as to whether the parameter is a maximum or minimum value for comparison purposes. Table 3.0-201 presents and compares the Unit 3 COL design characteristics with the ESP design parameters established at the ESP stage. Where ESP design parameters are not bounding, Table 3.0-201 provides reference to other sections of this environmental report in which the evaluation of potential impacts based on the Unit 3 COL design characteristic is presented.

The environmental impacts documented in NUREG-1817 are considered bounding when the ESP design parameter bounds the Unit 3 COL design characteristic. Comments are included in Table 3.0-201 to provide clarification or additional information where needed to support the bounding demonstration, or to provide reference to other sections where evaluation of the Unit 3 COL design characteristic (not bounded by the ESP parameter) is provided. In those situations in which a design parameter established at ESP as considered in the environmental review is not bounded by a Unit 3 COL design characteristic, an evaluation is provided; however, per NRC guidance, a request for a variance is not required (Reference 201).

10 CFR 51.50(c)(1) also requires that this environmental report provide information to resolve any significant environmental issue that was not resolved in the ESP proceeding and provide any new and significant information for issues related to the impacts of construction and operation of the facility that were resolved in the ESP proceeding. In compliance with this regulation, and to the extent that the specific description of the Unit 3 facility or related site-specific designs need to be provided, this chapter provides that supplemental design information. This chapter is organized as follows:

- External Appearance and Plant Layout (Section 3.1)
- Reactor Power Conversion System (Section 3.2)
- Plant Water Use (Section 3.3)
- Cooling System (Section 3.4)
- Radioactive Waste Management Systems (Section 3.5)
- Non-radioactive Waste Systems (Section 3.6)
- Power Transmission System (Section 3.7)
- Transportation of Radioactive Material (Section 3.8)

Separate from the environmental impacts review process, the NRC analyzed the safety characteristics of the proposed site and emergency planning information. These safety analyses are documented in safety evaluation report NUREG-1840 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 presented in the ESP application) 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.

"Site characteristics," in general, are not provided in the ESP application environmental report nor in NUREG-1817, except to the extent that they are required to evaluate potential consequences of routine radiological releases (i.e., atmospheric dispersion coefficient (χ/Q) and annual average relative deposition (D/Q) values specific to the site). Therefore, the final safety analysis report, Part 2 of this COL Application, provides the required information to demonstrate that the design of the facility falls within the site characteristics specified in the ESP, to fully satisfy 10 CFR 51.50(c)(1).

3.0.1 REFERENCES

201 W. D. Reckley (NRC) letter to R. Bell (NEI), "Clarification of NRC Guidance on Variances and Departures in COL Applications," dated August 2, 2007.

TABLE 3.0-201 (SHEET 1 OF 15)
COMPARISON OF ESP PLANT PARAMETERS ENVELOPE (PPE) DESIGN PARAMETERS TO UNIT 3 COL DESIGN CHARACTERISTICS

PPE Section[1] / Parameter[2]	ESP Parameter[3]	Unit 3 COL Design Characteristic[4]	ESP Parameter Bounding? (Yes/No)[5]	Comments[4]
1. Structures				
1.1. Building Characteristics				
1.1.2 Foundation Embedment	140 ft. (42.7 m)	65.62 ft. (20,000 mm)	Yes	DCD Tier 2, Table 3.8-13 An embedment depth for COL that is less (deep) than the ESP design parameter is bounded by the ESP design parameter in terms of impacts to the environment (construction impacts – dewatering requirements, sloped excavations requiring larger area, spoils disposal, potential impacts to groundwater during and following construction, etc., are smaller overall).
2. Normal Plant Heat Sink (NHS)				
2.3. Condenser				
2.3.2 Condenser / Heat Exchanger Duty	10.7E+09 Btu/hr	10.43E+09 Btu/hr (main condenser) 0.298E+09 Btu/hr (Plant Svc Wtr) 10.7E+09 Btu/hr (total)	Yes	DCD Tier 2, Table 10.1-1 (Main Condenser) DCD Tier 2, Table 9.2-1 (Plant Service Water) Main condenser heat duty as specified in the ESBWR DCD is less than the ESP Parameter value, and is therefore, bounded. In addition to the main condenser waste heat removed by the NHS cooling towers, heat duty from the plant service water (PSWS) system during normal operations is also included in this Unit 3 COL Design Characteristic value. The total heat duty on the NHS cooling towers during normal operation, considering both the main condenser and the PSWS heat loads, is the same as that evaluated in the ESP application, and therefore, the ESP analyses for impacts are considered bounding for COLA.

TABLE 3.0-201 (SHEET 2 OF 15)
COMPARISON OF ESP PLANT PARAMETERS ENVELOPE (PPE) DESIGN PARAMETERS TO UNIT 3 COL DESIGN CHARACTERISTICS

PPE Section[1] / Parameter[2]	ESP Parameter[3]	Unit 3 COL Design Characteristic[4]	ESP Parameter Bounding? (Yes/No)[5]	Comments[4]
2.4. NHS Cooling Towers – Mechanical Draft (2.4), (or Natural Draft (2.5))[6]				PPE Section 2.4 parameters associated with the NHS cooling towers are based on a site-specific design, with the exception of circulating water system flow which is specified by the ESBWR vendor for the main condenser design. The Unit 3 normal heat sink design will include a single hyperbolic natural draft cooling tower, and an adjacent 12 -cell mechanical draft (helper) cooling tower (see FSAR Figure 2.1-201).
2.4.3 (2.5.3) Blowdown Constituents and Concentrations	See Table 3.0-202	See Table 3.0-202	No	Blowdown constituent concentrations are bounded by the ESP Parameters with the exception of chromium and total suspended solids. The Unit 3 COL design characteristic value for the chromium constituent in the cooling tower blowdown exceeds the ESP parameter in Table 3.0-202; a value for chromium was not given at the ESP stage. 40 CFR 423.13(d)(1) indicates a concentration of 0.2 ppm chromium is to be used to determine the quantity of chromium acceptable in cooling tower blowdown considering the application of best available technology. The concentration of chromium estimated in the cooling tower blowdown is less than 20 percent of the 40 CFR 423 value.

TABLE 3.0-201 (SHEET 3 OF 15)
COMPARISON OF ESP PLANT PARAMETERS ENVELOPE (PPE) DESIGN PARAMETERS TO UNIT 3 COL DESIGN CHARACTERISTICS

PPE Section[1] / Parameter[2]	ESP Parameter[3]	Unit 3 COL Design Characteristic[4]	ESP Parameter Bounding? (Yes/No)[5]	Comments[4]
				Total suspended solids (TSS) in the cooling tower blowdown is higher than the ESP Parameter (by a factor of 12). The higher suspended solids concentration is primarily due to the influent source water quality; water quality data from the Mississippi River used in the analysis indicates an average TSS value of 446 ppm, which exceeds the ESP effluent parameter in Table 3.0-202 of 150 ppm. This river water will be treated by the addition of about 4 ppm flocculant for removal of the majority of the suspended solids. Clarifier effluent is used for cooling tower makeup, and the TSS remaining after clarification is concentrated by a factor of 4 during cooling tower operation (4 cycles of concentration). Blowdown from the cooling tower is then recombined with the clarifier bottoms and returned to the river. TSS concentration in this combined effluent is shown in Table 3.0-202. Section 3.6 provides further discussion of the station water system and blowdown effluent quality. Because the total quantity (by weight) of suspended solids in the discharge is only slightly higher (due to the flocculant addition) than that in the influent, and because the solids discharge will be bounded by a water discharge permit not allowing a violation of state water quality standards for turbidity beyond a mixing zone, the environmental impact is judged to be SMALL.
2.4.4 (2.5.4) Blowdown Flow Rate	12,800 gpm expected- (39,000 gpm max)	7058 gpm	Yes	This blowdown flow is predicated on operation at 4 cycles of concentration for the cooling towers. A lower blowdown flow is bounded as it results in a proportionally smaller thermal plume in the discharge receiving water body, smaller quantities of chemicals discharged, etc.
2.4.5 (2.5.5) Blowdown Temperature	100°F	88°F	Yes	Lower blowdown temperature results in less thermal impact to the discharge receiving water body.
2.4.6 (2.5.6) Cycles of Concentration	4	4	Yes	Cycles of concentration are equal, thus impacts are not changed.

TABLE 3.0-201 (SHEET 4 OF 15)
COMPARISON OF ESP PLANT PARAMETERS ENVELOPE (PPE) DESIGN PARAMETERS TO UNIT 3 COL DESIGN CHARACTERISTICS

PPE Section[1] / Parameter[2]	ESP Parameter[3]	Unit 3 COL Design Characteristic[4]	ESP Parameter Bounding? (Yes/No)[5]	Comments[4]
2.4.7 (2.5.7) Evaporation Rate	35,100 gpm expected (39,000 gpm max)	21,600 gpm	Yes	Lower evaporation means smaller aerial plume extent, less potential for impact to local environment – fogging, humidity, etc.
2.4.8 (2.5.8) Height[7]	60 ft.(475 ft./ 550 ft.)	NDCT – 550 ft. MDCT – 60 ft.	Yes	Cooling tower height impacts are primarily aesthetic; heights for the Unit 3 facility are equal and, therefore, are bounded.
2.4.9 (2.5.9) Makeup Flow Rate	47,900 gpm expected (78,000 gpm max)	28,800 gpm	Yes	Less makeup results in smaller impacts to the water supply source, less water to treat and thus fewer chemicals required and eventually discharged.
2.4.10 (2.5.10) Noise	55 dba @ 1000 ft.	55 dba @ 1000 ft.	Yes	The Unit 3 COL Design Characteristic is considered a not-to-exceed value for noise emissions for procurement design specification to cooling tower vendors. This Unit 3 COL design characteristic is equal to the ESP Parameter and therefore, noise levels will be bounded by ESP analyses using the ESP Parameter value Cooling tower location has moved from that proposed at ESP, and as a result, the cooling towers are over 1000 ft. further from the site boundary. An evaluation of the estimated noise levels provided by a major cooling tower vendor for the selected cooling tower types and configuration, combined with measured sound levels for circulating water pumps at a similar power facility, confirmed that the noise level at 1000 ft. from the cooling towers is less than 55 dba.
2.4.12 (2.5.12) Cooling Water Flow Rate	865,000 gpm	671,000 gpm (~152,000 m3/hr)	Yes	DCD Tier 2, Table 10.4-1 Cooling water flow rate for a closed system has no direct environmental impact, but a lower flow rate results in less evaporation and drift, and thus smaller impacts overall from these parameters.

TABLE 3.0-201 (SHEET 5 OF 15)
COMPARISON OF ESP PLANT PARAMETERS ENVELOPE (PPE) DESIGN PARAMETERS TO UNIT 3 COL DESIGN CHARACTERISTICS

PPE Section[1] / Parameter[2]	ESP Parameter[3]	Unit 3 COL Design Characteristic[4]	ESP Parameter Bounding? (Yes/No)[5]	Comments[4]
3. Ultimate Heat Sink			NA	The atmosphere provides the ESBWR UHS function via IC/PCCS pools. See DCD Tier 2, Sections 9.2.5, 9.1.3.2, 9.1.3.3. Therefore this PPE Section is not applicable to the ESBWR.
3.3. Mech Draft Cooling Towers			NA	Not applicable for the ESBWR.
3.3.4 Blowdown Flow Rate	288 gpm expected (1700 gpm max)	NA	NA	Not applicable for the ESBWR.
3.3.5 Blowdown Temperature	95°F	NA	NA	Not applicable for the ESBWR.
3.3.7 Evaporation Rate	822 gpm expected (1700 gpm max)	NA	NA	Not applicable for the ESBWR.
3.3.9 Makeup Flow Rate	1110 gpm expected (3,400 gpm max)	NA	NA	Not applicable for the ESBWR.
3.3.12 Cooling Water Flow Rate	26,125 gpm (normal) 52,250 gpm (shutdown / accident)	NA	NA	Not applicable for the ESBWR.

TABLE 3.0-201 (SHEET 6 OF 15)
COMPARISON OF ESP PLANT PARAMETERS ENVELOPE (PPE) DESIGN PARAMETERS TO UNIT 3 COL DESIGN CHARACTERISTICS

PPE Section[1] / Parameter[2]	ESP Parameter[3]	Unit 3 COL Design Characteristic[4]	ESP Parameter Bounding? (Yes/No)[5]	Comments[4]
5. Potable Water/Sanitary Waste System				
5.1. Discharge to Site Water Bodies				
5.1.1 Flow Rate	120 gpm expected (210 gpm max)	35 gpm average (200 gpm max)	Yes	Site-specific water use parameter for average usage. DCD Tier 2, Section 9.2.4 indicates the system will supply a minimum demand of 200 gpm for potable water for the ESBWR during the peak demand period; this is considered a maximum requirement for the system site-specific design. All potable water flow is assumed to be processed via the sanitary waste discharge stream as indicated in Figure 3.3-201. Less flow to the discharge water body results in proportionally smaller impacts due to potential chemical and biological discharges, etc.
5.2. Raw Water Requirements (Potable Water/ Sanitary Waste Systems)				
5.2.1 Maximum Use	240 gpm	200 gpm	Yes	DCD Tier 2, Section 9.2.4 indicates the system will supply a minimum demand of 200 gpm for potable water for the ESBWR during the peak demand period; this is considered a maximum requirement for the system site-specific design. Less makeup results in smaller impacts to the water supply source, less water to treat and thus fewer chemicals required and eventually discharged.
5.2.2 Monthly Average Use	180 gpm	35 gpm	Yes	Site-specific water use parameter (Figure 3.3-201). During shutdown operations this usage may increase slightly to 49 gpm; this shutdown value is also bounded by the ESP Parameter for average usage, and by the maximum usage of PPE Section 5.2.1 of 200 gpm. Less makeup results in smaller impacts to the water supply source, less water to treat and thus fewer chemicals required and eventually discharged.

TABLE 3.0-201 (SHEET 7 OF 15)
COMPARISON OF ESP PLANT PARAMETERS ENVELOPE (PPE) DESIGN PARAMETERS TO UNIT 3 COL DESIGN CHARACTERISTICS

PPE Section[1] / Parameter[2]	ESP Parameter[3]	Unit 3 COL Design Characteristic[4]	ESP Parameter Bounding? (Yes/No)[5]	Comments[4]
6. Demineralized Water System (ESBWR Makeup Water System)				
6.1. Discharge to Site Water Bodies				
6.1.1 Flow Rate	220 gpm expected (290 gpm max)	36 gpm expected (146 gpm max)	Yes	Site-specific design parameter (Figure 3.3-201). Less flow to the discharge water body results in proportionally smaller impacts due to reduced chemical and biological discharges, etc.
6.2. Raw Water Requirements				
6.2.1 Maximum Use	1440 gpm	554 gpm	Yes	Site-specific design parameter (Figure 3.3-201). Less makeup results in smaller impacts to the water supply source, less water to treat and thus fewer chemicals required and eventually discharged.
6.2.2 Monthly Average Use	1100 gpm	137 gpm	Yes	Site-specific design parameter (Figure 3.3-201). Less makeup results in smaller impacts to the water supply source, less water to treat and thus fewer chemicals required and eventually discharged.
7. Fire Protection System				
7.1. Raw Water Requirements				
7.1.1 Maximum Use	1890 gpm	1075 gpm	Yes	Flow requirement is specified to meet the objective to refill one of the primary water storage tanks to the DCD minimum volume requirement in 8 hours. Less makeup results in smaller impacts to the water supply source, less water to treat and thus fewer chemicals required and eventually discharged.

TABLE 3.0-201 (SHEET 8 OF 15)
COMPARISON OF ESP PLANT PARAMETERS ENVELOPE (PPE) DESIGN PARAMETERS TO UNIT 3 COL DESIGN CHARACTERISTICS

PPE Section[1] / Parameter[2]	ESP Parameter[3]	Unit 3 COL Design Characteristic[4]	ESP Parameter Bounding? (Yes/No)[5]	Comments[4]
7.1.2 Monthly Average Use	30 gpm	< 30 gpm	Yes	Expected monthly demand is 0 gpm based on system design by the reactor vendor. Periodic testing and flushing will require some small makeup water demand, but this is expected to be much less than 30 gpm average specified as the ESP Parameter. Less makeup results in smaller impacts to the water supply source, less water to treat and thus fewer chemicals required and either discharged to site water bodies or otherwise disposed.
8. Miscellaneous Drain				
8.1. Discharge to Site Water Bodies				
8.1.1 Flow Rate	200 gpm expected (300 gpm max)	17 gpm expected (68 gpm max)	Yes	Site-specific water balance parameter (Figure 3.3-201). During shutdown operations this usage may increase slightly to 68 gpm; this is still bounded by the ESP Parameter. Less flow to the discharge water body results in proportionally smaller impacts due to potential chemical and biological discharges, etc.
9. Unit Vent/Airborne Effluent Release Point				
9.4. Release Point				
9.4.2 Elevation (Normal)	Ground level	Elevated release	Yes	Ground level release provides the most conservative input for dose calculations; therefore, any higher release point, if credited, would be bounded by the ground level release. Calculations that determined dose to the public from airborne release pathways assumed a conservative ground level release as discussed in the ESP Application ER Sections 2.7.4.8 and 2.7.6.2. The plant stack and ventilation systems exhaust points are elevated above ground.
9.4.3 Elevation (Post Accident)	Ground level	Ground level and higher	Yes	Ground level release provides the most conservative input for dose calculations; therefore, any higher release point, if credited, would be bounded by the ground level release.

TABLE 3.0-201 (SHEET 9 OF 15)
COMPARISON OF ESP PLANT PARAMETERS ENVELOPE (PPE) DESIGN PARAMETERS TO UNIT 3 COL DESIGN CHARACTERISTICS

PPE Section[1] / Parameter[2]	ESP Parameter[3]	Unit 3 COL Design Characteristic[4]	ESP Parameter Bounding? (Yes/No)[5]	Comments[4]
9.4.4 Minimum Distance to Site Boundary	0.52 mi. (841 m) exclusion area	0.52 mi. (841 m) exclusion area	Yes	An exclusion area boundary distance of 0.52 mile is defined in the ESP Application SSAR, Section 2.1.2, based on the distance from the outer edge of the ESP powerblock area to the site boundary (see FSAR Figure 2.1-201). The distance from the center point of the reactor containment to the site boundary for Unit 3 is greater than 0.52 mile, based on placement of the reactor within the ESP powerblock area. Calculations for dose at the site boundary for ESP assumed this 0.52-mile distance, and generic calculations presented in DCD Tier 2 Chapter 12 used a 0.50 mile (800 m) distance. Because of the larger distance from reactor to site boundary (i.e., >0.52 mile), dose at the site boundary from airborne releases from Unit 3 will be lower than doses calculated for both the ESP and DCD conditions (calculated at 0.52 mile and 0.50 mile, respectively), and therefore, the Unit 3 COL design characteristic is bounded by the ESP Parameter.
9.5. Source Term				
9.5.1 Airborne Effluents (Normal)	32,699 Ci/yr	4230 Ci/yr (1.56E+08 MBq/yr) See Table 3.0-207	Yes	Individual constituent release parameters shown in Table 3.0-207 are bounded by (less than) the corresponding ESP Parameter constituent values (See Table 3.0-207), and the overall Unit 3 COL design characteristic source term reported here is smaller. Thus overall impacts (dose) are smaller.
9.5.2 Airborne Effluents (Post-Accident) [8]	Based on limiting DBAs.	Based on limiting DBAs.	No	Accident analyses evaluated in the ESP ER were for the ABWR and surrogate AP1000 plant designs. The source terms for the design basis accidents evaluated in DCD Chapter 15 are not bounded by the ESP (See ESP-002 Appendix B) design basis accident source terms in all cases. Using the source terms from the accident analyses reported in DCD Chapter 15, dose calculations were re-performed, with results provided in Section 7.1. Calculated doses shown in Section 7.1 are within limits established in regulatory guidance documents and applicable regulations. Therefore, the environmental impact is SMALL.

TABLE 3.0-201 (SHEET 10 OF 15)
COMPARISON OF ESP PLANT PARAMETERS ENVELOPE (PPE) DESIGN PARAMETERS TO UNIT 3 COL DESIGN CHARACTERISTICS

PPE Section[1] / Parameter[2]	ESP Parameter[3]	Unit 3 COL Design Characteristic[4]	ESP Parameter Bounding? (Yes/No)[5]	Comments[4]
9.5.3 Tritium Airborne Effluent (Normal)	7060 Ci/yr	75.7 Ci/yr (2.80E+06 MBq/yr) See Table 3.0-207	Yes	An ESP Parameter source term for tritium greater than the Unit 3 COL Design Characteristic value is bounding in terms of dose and dose consequences.
10. Liquid Radwaste System				
10.2. Release Point				
10.2.1 Flow Rate	35 gpm (with 12,800 gpm dilution)	35 gpm (with 7000 gpm dilution)	No	A lower dilution flow for the same discharge flow rate will produce higher dose consequences. These discharge flow and dilution flow parameters are input to the calculation for dose from the liquid pathway which also uses the ESBWR source term of PPE Section 10.3.1 below. Section 5.4 provides information related to dose calculated using the source term presented in Table 3.0-208. Resultant doses are presented in Tables 5.4-201 through 5.4-205. The calculated doses are within regulatory limits and criteria; therefore, the environmental impact is SMALL.
10.3. Source Term				
10.3.1 Liquid	0.694 Ci/yr	0.0967 Ci/yr (3.58E+03 MBq/yr) See Table 3.0-208	No	Although the total curie content released via the liquid pathway from the ESBWR is substantially less than (and bounded by) the ESP Parameter source term, the ESBWR source term includes radionuclide isotopes not in the ESP PPE source term, as shown in Table 3.0-208 (See Section 3.5). Appropriate dose calculations are, therefore, re-performed using the ESBWR source term in conjunction with the Unit 3 COL discharge flow rate and the Unit 3 COL dilution (blowdown) flow rate defined in this table. Section 5.4 provides information related to dose calculated using the source term presented in Table 3.0-208. Resultant doses are presented in Tables 5.4-201 through 5.4-205. The calculated doses are within regulatory limits and criteria; therefore, the environmental impact is SMALL.

TABLE 3.0-201 (SHEET 11 OF 15)
COMPARISON OF ESP PLANT PARAMETERS ENVELOPE (PPE) DESIGN PARAMETERS TO UNIT 3 COL DESIGN CHARACTERISTICS

PPE Section[1] / Parameter[2]	ESP Parameter[3]	Unit 3 COL Design Characteristic[4]	ESP Parameter Bounding? (Yes/No)[5]	Comments[4]
10.3.2 Tritium	6200 Ci/yr	14.0 Ci/yr (5.1 E+05 MBq/yr) See Table 3.0-208	Yes	An ESP Parameter source term for tritium greater than the COL Design Characteristic value is bounding in terms of dose consequence.
11. Solid Radwaste System				
11.2.1 Activity	5400 Ci/yr	1718 Ci/yr	Yes	Activity, by isotope, in the estimated solid radwaste (DCD Tier 2, Table 11.4-2) inventory for the ESBWR was determined by the reactor vendor. A smaller total quantity of activity in the solid waste generated by the ESBWR is bounded by the ESP activity parameter.
11.2.2 Principal Radionuclides	See Table 3.0-203	See Table 3.0-203	No	Activity, by isotope, in the estimated solid radwaste (DCD Tier 2, Table 11.4-2) inventory for the ESBWR was determined by the reactor vendor. Some individual isotopes are not bounded by the ESP Parameter value. However, the overall solid radwaste activity is bounded. Solid radioactive waste shipments from the site are controlled by the process control program (PCP) as described in FSAR Section 11.4, and the doses from these shipments will be within regulatory limits.Therefore, the environmental impact is SMALL.

TABLE 3.0-201 (SHEET 12 OF 15)
COMPARISON OF ESP PLANT PARAMETERS ENVELOPE (PPE) DESIGN PARAMETERS TO UNIT 3 COL DESIGN CHARACTERISTICS

PPE Section[1] / Parameter[2]	ESP Parameter[3]	Unit 3 COL Design Characteristic[4]	ESP Parameter Bounding? (Yes/No)[5]	Comments[4]
11.2.3 Volume	18,646 ft^3/yr	16,764 ft3/yr (474 m3/yr)	Yes	DCD Tier 2, Table 11.4-2 The ESP Parameter is for the “total plant” as noted in Appendix D of the ESP; the value for the Unit 3 COL Design Characteristic is for one ESBWR unit, one ESBWR in this case constituting the “total plant.” The evaluation done at the ESP stage provided in the ESP application ER and in NUREG-1817 was based on the total solid waste volume for the site for any new units added. Therefore, the ESP impact evaluations, although based on solid waste for the “total plant,” is bounding for the GGNS COL because the quantity of solid waste for the ESBWR is bounded. No further information or analysis is required. NOTE: The Unit 3 COL Design Characteristic is for total waste generated, not waste shipped (total solid waste shipped is 15,874 ft^3/yr).
13. Auxiliary Boiler System				
13.2 Flue Gas Effluents	See Table 3.0-204	See Table 3.0-204	No	The carbon monoxide emission listed in Table 3.0-204 is not bounded by the ESP Parameter; all other parameters are bounded. Note 6 of Table 3.0-204 provides evaluation and justification for the indicated exceedance, and based on the information provided in Table 3.0-204, Note 6, no further analysis is required for this parameter.

TABLE 3.0-201 (SHEET 13 OF 15)
COMPARISON OF ESP PLANT PARAMETERS ENVELOPE (PPE) DESIGN PARAMETERS TO UNIT 3 COL DESIGN CHARACTERISTICS

PPE Section[1] / Parameter[2]	ESP Parameter[3]	Unit 3 COL Design Characteristic[4]	ESP Parameter Bounding? (Yes/No)[5]	Comments[4]
16. Standby Power System				
16.1. Diesels				
16.1.3 Diesel Flue Gas Effluents	See Table 3.0-205	See Table 3.0-205	Yes	Particulates, carbon monoxide, hydrocarbons, and nitrogen oxides are bounded as shown in Table 3.0-205; the quantities of the constituent in the exhaust emissions are less than the corresponding ESP Parameter. The value for sulfur oxides emissions in Table 3.0-205 is not bounded when considering a fuel with 3 percent sulfur content; however, Note 6 Table 3.0-205 provides evaluation and justification for the indicated exceedance, and based on the information provided in Table 3.0-205, Note 6, no further analysis is required for this parameter.
16.2. Gas Turbines				
16.2.3 Gas-Turbine Flue Gas Effluents	See Table 3.0-206	NA	Yes	ESBWR does not use gas turbines in its standard plant design; diesel generators are employed in the standby AC power system design (See PPE Section 16.1 parameters).

TABLE 3.0-201 (SHEET 14 OF 15)
COMPARISON OF ESP PLANT PARAMETERS ENVELOPE (PPE) DESIGN PARAMETERS TO UNIT 3 COL DESIGN CHARACTERISTICS

PPE Section[1] / Parameter[2]	ESP Parameter[3]	Unit 3 COL Design Characteristic[4]	ESP Parameter Bounding? (Yes/No)[5]	Comments[4]
17. Plant Characteristics				
17.3 Megawatts Thermal	4300 MWt	4500 MWt	No	A higher thermal power has an indirect effect on environmental impacts evaluated at the ESP stage via a number of parameters. Thermal power directly affects waste heat (condenser heat duty), however, as shown above the condenser heat duty is bounded by the ESP Parameter. Thermal power affects source terms used in design basis accident and normal operation dose calculations, and affects calculations (is an input) done to determine the effects of severe accidents. See PPE Sections 9.5 and 10.3 for discussion of normal gaseous and liquid release source terms. Design basis accidents are evaluated in Section 7.1, and severe accidents are evaluated in Section 7.2. Section 5.7 evaluates the effects of higher thermal power on uranium fuel cycle impacts.
17.4 Plant Design Life	60 years	60 years	Yes	DCD Tier 2, Section 3.9.3.1
17.5. Plant Population				
17.5.1 Operation	1160 people	Approx. 400 people	Yes	As stated in the ESP, this ESP Parameter is applicable for the “total plant,” which would encompass two new units on the site and an equivalent operations staff for each. With only one unit proposed at the COL stage for the GGNS ESP site, the staff required for unit operations is estimated to be substantially less than that considered in the ESP application (i.e., total staff for two units) and the NRC evaluations in NUREG-1817. Additionally, due to the synergistic effects of co-locating two similar units on the same site, the number of workers will be less. Fewer people required to operate the facility result in smaller impacts, in general, and therefore, the ESP Parameter is bounding for COL.

TABLE 3.0-201 (SHEET 15 OF 15)
COMPARISON OF ESP PLANT PARAMETERS ENVELOPE (PPE) DESIGN PARAMETERS TO UNIT 3 COL DESIGN CHARACTERISTICS

PPE Section[1] / Parameter[2]	ESP Parameter[3]	Unit 3 COL Design Characteristic[4]	ESP Parameter Bounding? (Yes/No)[5]	Comments[4]
18. Construction				
18.3.1 Noise	76-101 db @ 50 ft	76-101 db @ 50 ft	Yes	No new information is available, the Unit 3 COL Design Characteristic is assumed equal to the ESP Parameter. Construction noise will be controlled in accordance with OSHA requirements, therefore, the ESP stage parameter is assumed valid for COL and no further information or analysis is required.
18.4. Plant Population				
18.4.1 Construction	3150 people max	3150 people	Yes	Estimated construction population for the ESBWR plant is equal to that used as the ESP Parameter (estimated work force for a single unit), therefore this Unit 3 COL Design Characteristic is bounded and no further information or analysis is required.

NOTES:

1. The “PPE Section” numbers assigned to each parameter relate to the PPE Worksheet from which the PPE tables were developed. See ESP Application Part 2, Site Safety Analysis Report, Section 1.3 for a discussion of the basis for the parameters included in this table.
2. A definition for each ESP Parameter in this table is provided in Table 3.0-209, including specification as to whether the parameter is a maximum or minimum value for comparison purposes.
3. “ESP Parameter” values are as given in the ESP ER Table 3.0-1, and in ESP-002 Appendix D, Table D1.
4. “Unit 3 COL Design Characteristic” values are either ESBWR standard plant design characteristics as defined or provided by the reactor vendor, or are design characteristics determined for the site-specific system design, as applicable.
5. An indication that the ESP Parameter is “bounding” (Yes), demonstrates that the Unit 3 COL Design Characteristic for the proposed facility falls within the plant parameters specified in the ESP, Appendix D.
6. Both mechanical draft and natural draft cooling tower alternatives were considered in the ESP Application. The most restrictive parameter for each cooling system, as they relate to environmental impacts, was used in ESP ER Table 3.0-1 (See also NUREG-1817, Appendix I Table 3.0-1, and ESP-002 Table D1, note 1 on page D-4.)
7. For the purposes of environmental (aesthetic) impact in the ESP ER, a natural draft cooling tower height of 550 ft. was assumed as the ESP parameter. The cooling tower plume model discussed in Section 5.3.3.1 of the ESP ER was developed assuming a conservative natural draft cooling tower height of 475 ft., and a mechanical draft cooling tower height of 60 ft. (See ESP Table D1 note 2)
8. Source terms for any given accident are those used by the reactor vendor in its safety analyses in the DCD, Chapter 15. (See ESP-002 Table D1 note 3)

TABLE 3.0-202 (SHEET 1 OF 2)
BLOWDOWN CONSTITUENTS AND CONCENTRATIONS[1, 2, 3]

Constituent	ESP Parameter[3] (ppm)	Unit 3 COL Design Characteristic[4] (ppm)	ESP Parameter Bounding? (Yes/No)[5]	Comments
Chlorine demand	10.1	N/A	Yes	Chlorine demand is not a blowdown constituent, per se. Free available chlorine is the relevant parameter to evaluate in the discharge.
Free available chlorine	0.5	0.4	Yes	
Chromium	--	0.037	No	See Table 3.0-201, PPE Section 2.4.3 (2.5.3)
Copper	6	0.047	Yes	
Iron	3.5	0.93	Yes	
Zinc	0.6	0.448	Yes	
Phosphate	7.2	6.4	Yes	
Sulfate	3500	353	Yes	
Oil and grease	--	--	Yes	
Total dissolved solids	17,000	1788	Yes	
Total suspended solids	150	1779	No	See Table 3.0-201, PPE Section 2.4.3 (2.5.3)
Biological Oxygen Demand (BOD), 5-day	--	--	Yes	BOD is not a typical constituent measured in cooling tower blowdown effluent.

TABLE 3.0-202 (Sheet 2 of 2)
BLOWDOWN CONSTITUENTS AND CONCENTRATIONS[1, 2, 3]

NOTES:

1. See Table 3.0-201, PPE Section 2.4.3 (2.5.3).

2. Assumed cooling tower operation is at 4 cycles of concentration (see Table 3.0-201, PPE Sections 2.4.6 (2.5.6)). This is a site-specific value that is dependent on makeup water source and quality, and chemical and biological treatment parameters.

3. Concentrations are per unit/group of units. The ESP Parameter is as given in the ESP ER Table 3.0-2, and in ESP-002 Appendix D, Table D2. No value was provided for those constituent concentrations indicated with dashes (--).

4. Unit 3 COL Design Characteristics are characteristics determined for the site-specific system's design. No value was provided for those constituent concentrations indicated with dashes (--).

5. An indication that the ESP Parameter is "bounding" (Yes), demonstrates that the Unit 3 COL Design Characteristic for the selected facility falls within the ESP plant parameters specified in the ESP.

TABLE 3.0-203 (Sheet 1 of 3)
PRINCIPAL RADIONUCLIDES IN SOLID RADWASTE[1]

Radionuclide	ESP Parameter[3] (Ci/yr)	Unit 3 COL Design Characteristic[4] (Ci/yr)	ESP Parameter Bounding? (Yes/No)[5]	Comments
Fe-55	1761.37	1003.93	Yes	
Fe-59	1.35	5.19E-02	Yes	
Co-60	395.92	233.66	Yes	
Mn-54	347.22	17.80	Yes	
Cr-51	97.138	1.08E-01	Yes	
Co-58	93.6	1.94	Yes	
Ni-63	279	1.37	Yes	
H-3	1.5	0	Yes	
C-14	0.3	--	Yes	
Nb-95	162	2.28E-03	Yes	
Ag-110m	9	4.02E-01	Yes	
Zr-95	76.45	1.04E-01	Yes	
Ba-140	0.528	1.57E-07	Yes	
Pu-241	0.09	--	Yes	
La-140	0.607	3.32E-65	Yes	
Cs-134	605	12.30	Yes	
Cs-137	507	48.36	Yes	
Sr-90	1.24	9.37	No	See Table 3.0-201, PPE Section 11.2.2
I-131	81.91	5.89E-12	Yes	
Ba-137m	507	0	Yes	
Na-24	0.44	1.11E-174	Yes	
Ru-103	2.18	1.48E-02	Yes	

TABLE 3.0-203 (Sheet 2 of 3)
PRINCIPAL RADIONUCLIDES IN SOLID RADWASTE[1]

Radionuclide	ESP Parameter[3] (Ci/yr)	Unit 3 COL Design Characteristic[4] (Ci/yr)	ESP Parameter Bounding? (Yes/No)[5]	Comments
Ru-106	1.37	1.77	No	See Table 3.0-201, PPE Section 11.2.2
Sb-124	11.29	--	Yes	
I-133	4.55	3.3E-125	Yes	
Ce-141	0.14	4.51E-03	Yes	
Ce-144	0.11	1.38	No	See Table 3.0-201, PPE Section 11.2.2
Gd-153	3.09	--	Yes	
Cs-136	0.0287	5.21E-09	Yes	
Zn-65	25.7	384.54	No	See Table 3.0-201, PPE Section 11.2.2
Sr-89	0.886	0.367	Yes	
Y-90	1.24	1.95E-42	Yes	
Y-91	4.43E-4	3.09E-01	No	See Table 3.0-201, PPE Section 11.2.2
Rh-103m	1.22E-3	0	Yes	
Rh-106	0.0592	0	Yes	
Te-129m	2.31E-5	9.07E-03	No	See Table 3.0-201, PPE Section 11.2.2
Te-129	1.51E-5	--	Yes	
Other	72.858	1.95E-07	Yes	

TABLE 3.0-203 (Sheet 3 of 3)
PRINCIPAL RADIONUCLIDES IN SOLID RADWASTE[1]

Radionuclide	ESP Parameter[3] (Ci/yr)	Unit 3 COL Design Characteristic[4] (Ci/yr)	ESP Parameter Bounding? (Yes/No)[5]	Comments
Total of Above (single unit or group of units)	5052	1718	Yes	
Total (rounded to nearest hundred – two units or groups of units)	5400 (2)	3436	Yes	

NOTES:

1. See Table 3.0-201, PPE Section 11.2.2.
2. This is twice the bounding value for a single unit or group of units, not the total of the bounding quantities above.
3. Individual radionuclide parameters represent data for a single unit or group of units unless otherwise noted. The ESP Parameter is as given in the ESP ER Table 3.0-3, and in ESP-002 Appendix D, Table D3.
4. Unit 3 COL Design Characteristics are standard plant design characteristics as defined by the reactor vendor. Entries with dashes (--) indicates the isotope is not included in the solid radwaste source term.
5. An indication that the ESP Parameter is “bounding” (Yes), demonstrates that the Unit 3 COL Design Characteristic for the selected facility falls within the ESP plant parameters specified in the ESP.

TABLE 3.0-204 (SHEET 1 OF 2)
YEARLY EMISSIONS – AUXILIARY BOILERS[1]

Pollutant Discharged	ESP Parameter [2, 3] (lbs)	Unit 3 COL Design Characteristic[4] (lbs)	ESP Parameter Bounding? (Yes/No)[5]	Comments
Particulates	17,250	1438	Yes	
Sulfur oxides	51,750	515	Yes	
Carbon monoxide	1749	3267	No	See Table 3.0-201, PPE Section 13.2.
Hydrocarbons	50,100	180	Yes	
Nitrogen oxides	19,022	14,374	Yes	

NOTES:

1. See Table 3.0-201, PPE Section 13.2.
2. Emissions are based on 30 days/yr operation.
3. Quantities represent data for a single unit. The ESP Parameter is as given in the ESP ER Table 3.0-4, and in ESP-002 Appendix D, Table D4.
4. Unit 3 COL Design Characteristics are standard plant design characteristics as defined by the reactor vendor.
5. An indication that the ESP Parameter is “bounding” (Yes), demonstrates that the Unit 3 COL Design Characteristic for the selected facility falls within the ESP plant parameters specified in the ESP.

TABLE 3.0-204 (SHEET 2 OF 2)
YEARLY EMISSIONS – AUXILIARY BOILERS[1]

6. Auxiliary Boiler System (ABS) emission values are based on AP-42, Compilation of Air Pollutant Emission Factors, established by the EPA. This document indicates average emission levels emitted by various equipment and industries. Few applications are below all pollutant levels listed in AP-42. The ABS capacity is conservative. It is expected that the design capacity will be reduced during system optimization in the detailed design phase. This, in addition to optimization of other ESBWR integrated operating procedures will reduce the emissions produced during ABS operation.

Emissions from the auxiliary boiler are given in terms of annual quantity of pollutants for each of the constituents in the exhaust. Similar PPE Parameters are provided for the emergency diesel driven generators in Table 3.0-201, PPE Section 16.1.3, and Table 3.0-205, again specified on an annual release basis. These components both utilize the same fuel, with the auxiliary boilers operating an assumed 30 days per year, and the diesel generators 4 hours each per month (both on a single unit basis). The combined CO emissions PPE Parameter for these components is approximately 6350 lbs per year, and the combined Unit 3 COL Design Characteristic is approximately 4350 lbs per year. Considering the combined emissions from these two components is less than the combined PPE Parameter (for both) the impact on air quality is expected to be SMALL, even if the Unit 3 COL Design Characteristic for the auxiliary boiler is not bounded. This conclusion is consistent with the NRC Staff evaluation in NUREG-1817 (Subsection 5.2.2) which states: “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.”

TABLE 3.0-205 (SHEET 1 OF 2)
YEARLY EMISSIONS FROM STANDBY DIESEL GENERATORS[1]

Pollutant Discharged	ESP Parameter[2, 3] (lbs)	Unit 3 COL Design Characteristic[4] (lbs)	ESP Parameter Bounding? (Yes/No)[5]	Comments
Particulates	1230	850	Yes	
Sulfur oxides	4608	21,715	No [6]	See Table 3.0-201, PPE Section 16.1.3
Carbon monoxide	4600	1086	Yes	
Hydrocarbons	3070	1448	Yes	
Nitrogen oxides	28,968	23,162	Yes	

NOTES:

1. See Table 3.0-201, PPE Section 16.1.3.
2. Emissions are based on 4 hrs/month operation for each of the diesel generators.
3. Quantities represent data for a single unit. The ESP Parameter is as given in the ESP ER Table 3.0-5, and in ESP-002 Appendix D, Table D5.
4. Unit 3 COL Design Characteristics are standard plant design characteristics as defined by the reactor vendor.
5. An indication that the ESP Parameter is “bounding” (Yes), demonstrates that the Unit 3 COL Design Characteristic for the selected facility falls within the ESP plant parameters specified in the ESP.
6. The Unit 3 COL Design Characteristic for sulfur oxides is determined by the vendor according to ISO-8178 (Reciprocating internal combustion engines. Exhaust emissions measurement.) or EPA Method 6c (40 CFR Part 60, Standards of Performance for New Stationary Sources, Appendix 4, Instrumental Test Methods), using a sulfur content in the fuel oil of 3 percent by weight. Data from another vendor using fuel with a sulfur content of 0.1 percent by weight gives a sulfur oxide content in the exhaust of 743 lbs, which is bounded by the ESP Parameter. In EPA420-F-06-033 dated

TABLE 3.0-205 (Sheet 2 of 2)
YEARLY EMISSIONS FROM STANDBY DIESEL GENERATORS

April 2006, EPA finalized the Highway Diesel and Nonroad Diesel Rules (see 40 CFR 80), respectively, which will implement more stringent standards for new diesel engines and fuels. The rules mandate the use of lower sulfur fuels in diesel engines beginning in 2007 for nonroad diesel fuel. Grand Gulf Unit 1 utilizes ultra low sulfur diesel (ULSD) in the standby emergency diesel generators, and the new facility would use a ULSD fuel, because ULSD is the only type available commercially. Finally, the COL characteristic parameters are determined based on a diesel generator capacity of approximately 17.1 megawatts; this value will be optimized in the final design, and is expected to be lower. Using the emissions data from 0.1 percent sulfur ULSD fuel and the higher power engine capacity results in a sulfur oxide content of 838 lbs, less than 20 percent of the PPE Parameter value. Thus, it is expected that there would be significantly lower sulfur content in the exhaust emissions using the ULSD fuel. Therefore, given the fuel characteristics used by the diesel vendor (i.e., 3 percent sulfur by weight) do not reflect current regulations requiring the use of ULSD, although the sulfur oxides in the table above are not bounded, the sulfur content in the exhaust for the as-procured diesel engine would be bounded.

TABLE 3.0-206
YEARLY STANDBY POWER SYSTEM GAS TURBINE FLUE GAS EMISSIONS[1]

Not applicable; ESBWR does not use a gas turbine. Therefore, the ESP parameters in ESP Table D6 are bounding.

NOTES:

1. See Table 3.0-201, PPE Section 16.2.3.

TABLE 3.0-207 (SHEET 1 OF 4)
NORMAL OPERATIONS GASEOUS RELEASE SOURCE TERM[1]

Radionuclide	ESP Parameter[2] (Ci/yr)	Unit 3 COL Design Characteristic[3] (MBq/yr)	(Ci/yr)	ESP Parameter Bounding? (Yes/No)[4]
Kr-83m	1.68E-03	3.73E+01	1.01E-03	Yes
Kr-85m	7.20E+01	6.50E+05	1.76E+01	Yes
Kr-85	8.20E+03	4.29E+06	1.16E+02	Yes
Kr-87	5.03E+01	1.45E+06	3.92E+01	Yes
Kr-88	9.20E+01	2.18E+06	5.89E+01	Yes
Kr-89	4.81E+02	1.40E+07	3.78E+02	Yes
Kr-90	6.49E-04	1.25E+01	3.38E-04	Yes
Xe-131m	3.60E+03	1.10E+05	2.97E+00	Yes
Xe-133m	1.74E+02	8.59E+01	2.32E-03	Yes
Xe-133	9.20E+03	3.11E+07	8.41E+02	Yes
Xe-135m	8.11E+02	2.27E+07	6.14E+02	Yes
Xe-135	9.19E+02	2.43E+07	6.57E+02	Yes
Xe-137	1.03E+03	2.90E+07	7.84E+02	Yes
Xe-138	8.65E+02	2.32E+07	6.27E+02	Yes
Xe-139	8.11E-04	1.57E+01	4.24E-04	Yes
I-131	5.19E-01	1.51E+04	4.08E-01	Yes
I-132	4.38E+00	5.89E+04	1.59E+00	Yes
I-133	3.41E+00	4.88E+04	1.32E+00	Yes
I-134	7.57E+00	1.06E+05	2.86E+00	Yes
I-135	4.81E+00	6.14E+04	1.66E+00	Yes
C-14	2.19E+01	3.54E+05	9.57E+00	Yes
Na-24	8.11E-03	5.42E-01	1.46E-05	Yes

TABLE 3.0-207 (SHEET 2 OF 4)
NORMAL OPERATIONS GASEOUS RELEASE SOURCE TERM[1]

Radionuclide	ESP Parameter[2] (Ci/yr)	Unit 3 COL Design Characteristic[3] (MBq/yr)	(Ci/yr)	ESP Parameter Bounding? (Yes/No)[4]
P-32	1.84E-03	1.34E-01	3.62E-06	Yes
Ar-41	1.02E+02	2.85E+02	7.70E-03	Yes
Cr-51	7.03E-02	7.73E+01	2.09E-03	Yes
Mn-54	1.08E-02	1.47E+02	3.97E-03	Yes
Mn-56	7.03E-03	1.07E.00	2.89E-05	Yes
Fe-55	1.30E-02	4.72E+00	1.28E-04	Yes
Co-58	6.90E-02	3.70E+01	1.00E-03	Yes
Co-60	2.61E-02	3.18E+02	8.59E-03	Yes
Fe-59	1.62E-03	1.94E+01	5.24E-04	Yes
Ni-63	1.30E-05	4.74E-03	1.28E-07	Yes
Cu-64	2.00E-02	6.93E-01	1.87E-05	Yes
Zn-65	2.22E-02	2.80E+02	7.57E-03	Yes
Rb-89	8.65E-05	2.01E-02	5.43E-07	Yes
Sr-89	1.14E-02	1.48E-01	4.00E-06	Yes
Sr-90	3.60E-03	7.65E-01	2.07E-05	Yes
Y-90	9.19E-05	3.27E-02	8.84E-07	Yes
Sr-91	2.00E-03	6.72E-01	1.82E-05	Yes
Sr-92	1.57E-03	4.63E-01	1.25E-05	Yes
Y-91	4.81E-04	1.74E-01	4.70E-06	Yes
Y-92	1.24E-03	3.68E-01	9.95E-06	Yes
Y-93	2.22E-03	7.23E-01	1.95E-05	Yes
Zr-95	3.19E-03	4.49E+01	1.21E-03	Yes
Nb-95	1.68E-02	2.44E+02	6.59E-03	Yes

TABLE 3.0-207 (SHEET 3 OF 4)
NORMAL OPERATIONS GASEOUS RELEASE SOURCE TERM[1]

Radionuclide	ESP Parameter[2] (Ci/yr)	Unit 3 COL Design Characteristic[3] (MBq/yr)	(Ci/yr)	ESP Parameter Bounding? (Yes/No)[4]
Mo-99	1.19E-01	1.66E+03	4.49E-02	Yes
Tc-99m	5.95E-04	2.23E-01	6.03E-06	Yes
Ru-103	7.03E-03	1.04E+02	2.81E-03	Yes
Rh-103m	2.22E-04	8.24E-02	2.23E-06	Yes
Ru-106	2.34E-04	1.35E-02	3.65E-07	Yes
Rh-106	3.78E-05	1.35E-02	3.65E-07	Yes
Ag-110m	4.00E-06	5.86E-02	1.58E-06	Yes
Sb-124	3.62E-04	5.37E+00	1.45E-04	Yes
Te-129m	4.38E-04	1.63E-01	4.41E-06	Yes
Te-131m	1.51E-04	5.50E-02	1.49E-06	Yes
Te-132	3.78E-05	1.41E-02	3.81E-07	Yes
Cs-134	1.24E-02	1.78E+02	4.81E-03	Yes
Cs-136	1.19E-03	1.47E+01	3.97E-04	Yes
Cs-137	1.89E-02	2.69E+02	7.27E-03	Yes
Cs-138	3.41E-04	8.50E-02	2.30E-06	Yes
Ba-140	5.41E-02	7.82E+02	2.11E-02	Yes
La-140	3.62E-03	1.29E+00	3.49E-05	Yes
Ce-141	1.84E-02	2.66E+02	7.19E-03	Yes
Ce-144	3.78E-05	1.35E-02	3.65E-07	Yes
Pr-144	3.78E-05	1.35E-02	3.65E-07	Yes
W-187	3.78E-04	1.29E-01	3.49E-06	Yes
Np-239	2.38E-02	8.28E+00	2.24E-04	Yes

TABLE 3.0-207 (SHEET 4 OF 4) NORMAL OPERATIONS GASEOUS RELEASE SOURCE TERM[1]

Radionuclide	ESP Parameter[2] (Ci/yr)	Unit 3 COL Design Characteristic[3] (MBq/yr)	(Ci/yr)	ESP Parameter Bounding? (Yes/No)[4]
Total without Tritium	25,639	1.54E+08	4.15E+03	Yes
Tritium (H-3)	7.06E+03	2.80E+06	7.57E+01	Yes
Total with Tritium	32,699	1.56E+08	4.23E+03	Yes

NOTES:

1. See Table 3.0-201, PPE Sections 9.5.1 and 9.5.3.
2. Composite source term based on highest radionuclide release for all plant types considered. The ESP Parameter is as given in the ESP ER Table 3.0-7, and in ESP-002 Appendix D, Table D7.
3. Unit 3 COL Design Characteristics are from ESBWR DCD Tier 2, Table 12.2-17.
4. An indication that the ESP Parameter is “bounding” (Yes), demonstrates that the Unit 3 COL Design Characteristic for the selected facility “falls within” the ESP plant Parameters specified in the ESP.

TABLE 3.0-208 (SHEET 1 OF 6)
NORMAL OPERATIONS LIQUID RELEASE SOURCE TERM[1]

Radionuclide	ESP Parameter[2] (Ci/yr)	Unit 3 COL Design Characteristic[3] (Mbq/yr)	Unit 3 COL Design Characteristic[3] (Ci/yr)	ESP Parameter Bounding? (Yes/No)[4]	Comments
I-131	2.826E-02	1.55E+02	4.19E-03	Yes	
I-132	5.200E-03	3.03E+01	8.19E-04	Yes	
I-133	2.000E-02	7.77E+02	2.10E-02	No	See Table 3.0-201, PPE Section 10.3.1
I-134	3.400E-03	1.48E+00	4.00E-05	Yes	
I-135	1.503E-02	2.00E+02	5.41E-03	Yes	
H-3	6.200E+03	5.18E+05	1.40E+01	Yes	
C-14	8.800E-04	N/A	N/A	Yes	
Na-24	5.622E-03	1.89E+02	5.11E-03	Yes	
P-32	3.600E-04	1.55E+01	4.19E-04	No	See Table 3.0-201, PPE Section 10.3.1
Cr-51	1.541E-02	4.81E+02	1.30E-02	Yes	
Mn-54	5.200E-03	5.92E+00	1.60E-04	Yes	
Mn-56	7.622E-03	4.81E+01	1.30E-03	Yes	
Co-57	1.438E-04	N/A	N/A	Yes	
Co-58	6.720E-03	1.63E+01	4.41E-04	Yes	

TABLE 3.0-208 (SHEET 2 OF 6)
NORMAL OPERATIONS LIQUID RELEASE SOURCE TERM[1]

Radionuclide	ESP Parameter[2] (Ci/yr)	Unit 3 COL Design Characteristic[3] (Mbq/yr)	(Ci/yr)	ESP Parameter Bounding? (Yes/No)[4]	Comments
Co-60	1.822E-02	3.33E+01	9.00E-04	Yes	
Fe-55	1.162E-02	8.51E+01	2.30E-03	Yes	
Fe-59	4.000E-04	2.59E+00	7.00E-05	Yes	
Ni-63	2.800E-04	N/A	N/A	Yes	
Cu-64	1.503E-02	4.81E+02	1.30E-02	Yes	
Zn-65	8.200E-04	1.67E+01	4.51E-04	Yes	
Br-84	4.000E-05	N/A	N/A	Yes	
Rb-88	5.400E-04	N/A	N/A	Yes	
Rb-89	8.811E-05	N/A	N/A	Yes	
Sr-89	2.200E-04	8.14E+00	2.20E-04	Yes	
Sr-90	7.027E-05	7.40E-01	2.00E-05	Yes	
Y-90	6.216E-06	N/A	N/A	Yes	
Sr-91	1.800E-03	4.44E+01	1.20E-03	Yes	
Y-91	2.200E-04	5.18E+00	1.40E-04	Yes	

TABLE 3.0-208 (SHEET 3 OF 6)
NORMAL OPERATIONS LIQUID RELEASE SOURCE TERM[1]

Radionuclide	ESP Parameter[2] (Ci/yr)	Unit 3 COL Design Characteristic[3] (Mbq/yr)	(Ci/yr)	ESP Parameter Bounding? (Yes/No)[4]	Comments
Y-91m	2.000E-05	N/A	N/A	Yes	
Sr-92	1.600E-03	1.07E+01	2.89E-04	Yes	
Y-92	1.200E-03	4.07E+01	1.10E-03	Yes	
Y-93	1.800E-03	4.44E+01	1.20E-03	Yes	
Zr-95	2.080E-03	7.40E-01	2.00E-05	Yes	
Nb-95	3.820E-03	7.40E-01	2.00E-05	Yes	
Mo-99	1.659E-03	1.11E+02	3.00E-03	No	See Table 3.0-201, PPE Section 10.3.1
Tc-99m	1.600E-03	2.04E+02	5.51E-03	No	See Table 3.0-201, PPE Section 10.3.1
Ru-103	9.860E-03	1.48E+00	4.00E-05	Yes	
Rh-103m	9.860E-03	N/A	N/A	Yes	
Ru-106	1.470E-01	N/A	N/A	Yes	
Rh-106	1.470E-01	N/A	N/A	Yes	
Ag-110	2.800E-04	N/A	N/A	Yes	
Ag-110m	2.100E-03	N/A	N/A	Yes	

TABLE 3.0-208 (SHEET 4 OF 6)
NORMAL OPERATIONS LIQUID RELEASE SOURCE TERM[1]

Radionuclide	ESP Parameter[2] (Ci/yr)	Unit 3 COL Design Characteristic[3] (Mbq/yr)	(Ci/yr)	ESP Parameter Bounding? (Yes/No)[4]	Comments
Sb-124	1.358E-03	N/A	N/A	Yes	
Te-129	3.000E-04	N/A	N/A	Yes	
Te-129m	2.400E-04	3.33E+00	9.00E-05	Yes	
Te-131	6.000E-05	N/A	N/A	Yes	
Te-131m	1.800E-04	3.70E+00	1.00E-04	Yes	
Te-132	4.800E-04	7.40E-01	2.00E-05	Yes	
Cs-134	1.986E-02	2.52E+01	6.81E-04	Yes	
Cs-136	1.260E-03	1.52E+01	4.11E-04	Yes	
Cs-137	2.664E-02	6.66E+01	1.80E-03	Yes	
Ba-137m	2.490E-02	N/A	N/A	Yes	
Cs-138	3.800E-04	N/A	N/A	Yes	
Ba-140	1.104E-02	3.03E+01	8.19E-04	Yes	
La-140	1.486E-02	N/A	N/A	Yes	
Ce-141	2.400E-04	2.59E+00	7.00E-05	Yes	

TABLE 3.0-208 (SHEET 5 OF 6)
NORMAL OPERATIONS LIQUID RELEASE SOURCE TERM[1]

Radionuclide	ESP Parameter[2] (Ci/yr)	Unit 3 COL Design Characteristic[3] (Mbq/yr)	(Ci/yr)	ESP Parameter Bounding? (Yes/No)[4]	Comments
Ce-143	3.800E-04	1.11E+00	3.00E-05	Yes	
Ce-144	6.320E-03	N/A	N/A	Yes	
Pr-143	2.600E-04	3.33E+00	9.00E-05	Yes	
Pr-144	6.320E-03	N/A	N/A	Yes	
W-187	2.600E-04	8.88E+00	2.40E-04	Yes	
Np-239	6.216E-03	4.07E+02	1.10E-02	No	See Table 3.0-201, PPE Section 10.3.1
All Others[1]	4.000E-05	4.62E+01	1.25E-03	No	See Table 3.0-201, PPE Section 10.3.1
Total All w/o Tritium	6.941E-01	3.58E+03	9.67E-02	Yes	
Total Tritium	6.200E+03	5.22E+05	1.41E+01	Yes	

TABLE 3.0-208 (SHEET 6 OF 6)
NORMAL OPERATIONS LIQUID RELEASE SOURCE TERM[1]

NOTES:

1. See Table 3.0-201, PPE Section 10.3.
2. Composite source term based on highest radionuclide release for all plant types considered. The ESP parameter is as given in the ESP ER Table 3.0-8, and in ESP-002 Appendix D, Table D8.
3. Unit 3 COL Design characteristics are from EBSWR DCD Tier 2, Table 12.2-19b. Entries listed as “N/A” are not applicable for (not a constituent of) the EBSWR source term.
4. An indication that the ESP parameter is “bounding” (Yes), demonstrates that the Unit 3 COL Design Characteristic for the selected facility falls within the ESP plant parameters specified in the ESP.
5. ESBWR DCD Tier 2, Table 12.2-19b includes the following nuclides not included individually in Table 3.0-208 above, but the total (see below) Unit 3 COL Design Characteristic release for these nuclides is included in the “All Others” line item in the table above and in the DCD.

	Release	
Nuclide	**MBq/yr**	**(Ci/yr)**
Zn-69m	3.40E+01	9.19E-04
Br-83	3.33E+00	9.00E-05
Ru-105	6.29E+00	1.70E-04
Ba-139	1.48E+00	4.00E-05
La-142	1.11E+00	3.00E-05
Totals	4.62E+01	1.25E-03

TABLE 3.0-209 (SHEET 1 OF 8)
ESP PARAMETERS DEFINITIONS[4]

Parameter	Parameter Units	Definition	Bounding Value Footnotes
1.1 Building Characteristics			
1.1.2 Foundation Embedment	Feet	The depth from finished grade to the bottom of the basemat for the most deeply embedded powerblock structure.	1
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.	1
2.4 (2.5) NHS Cooling Towers (Mechanical Draft or Natural Draft)			
2.4.3 (2.5.3) Blowdown Constituents and Concentrations	ppm	The maximum expected concentrations for anticipated constituents in the cooling water systems blowdown to the receiving water body.	2
2.4.4 (2.5.4) Blowdown Flow Rate	Gallons per minute	The normal (and maximum) flow rate of the blowdown stream from the cooling water systems to the receiving water body for closed system designs.	2
2.4.5 (2.5.5) Blowdown Temperature	^{o}F	The maximum expected blowdown temperature at the point of discharge to the receiving water body.	1

TABLE 3.0-209 (SHEET 2 OF 8)
ESP PARAMETERS DEFINITIONS[4]

Parameter	Parameter Units	Definition	Bounding Value Footnotes
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
2.4.7 (2.5.7) Evaporation Rate	Gallons per minute	The expected (and maximum) rate at which water is lost by evaporation from the cooling water systems.	2
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
2.4.10 (2.5.10) Noise	Decibels	The maximum expected sound level produced by operation of a cooling tower, measured at 1000 feet from the noise source.	1
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
3. Ultimate Heat Sink 3.3 Mechanical Draft Cooling Towers			
3.3.4 Blowdown Flow Rate	Gallons per minute	The normal (and maximum) flow rate of the blowdown stream from the UHS system to receiving water body for closed system designs.	2

TABLE 3.0-209 (SHEET 3 OF 8)
ESP PARAMETERS DEFINITIONS[4]

Parameter	Parameter Units	Definition	Bounding Value Footnotes
3.3.5 Blowdown Temperature	°F	The maximum expected UHS blowdown temperature at the point of discharge to the receiving water body.	1
3.3.7 Evaporation Rate	Gallons per minute	The expected (and maximum) rate at which water is lost by evaporation from the UHS system.	2
3.3.9 Makeup Flow Rate	Gallons per minute	The expected (and maximum) rate of removal of water from a natural source to replace water losses from the UHS system.	2
3.3.12 Cooling Water Flow Rate	Gallons per minute	The total cooling water flow rate through the UHS system.	1
5. Potable Water/Sanitary Waste System 5.1 Discharge to Site Water Bodies			
5.1.1 Flow Rate	Gallons per minute	The expected (and maximum) effluent flow rate from the potable and sanitary wastewater systems to the receiving water body.	2
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 wastewater 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 wastewater systems.	2

TABLE 3.0-209 (SHEET 4 OF 8)
ESP PARAMETERS DEFINITIONS[4]

Parameter	Parameter Units	Definition	Bounding Value Footnotes
6. Demineralized Water System			
6.1 Discharge to Site Water Bodies			
6.1.1 Flow Rate	Gallons per minute	The expected (and maximum) effluent flow rate from the demineralized water processing system to the receiving water body.	2
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

TABLE 3.0-209 (SHEET 5 OF 8)
ESP PARAMETERS DEFINITIONS[4]

Parameter	Parameter Units	Definition	Bounding Value Footnotes
8. Miscellaneous Drain			
8.1 Discharge to Site Water Bodies			
8.1.1 Flow Rate	Gallons per minute	The expected (and maximum) effluent flow rate from miscellaneous drains to the receiving water body.	2
9. Unit Vent/Airborne Effluent Release Point			
9.1 Atmospheric Dispersion (CHI/Q) (Accident)		The atmospheric dispersion coefficients used in the design safety analysis to estimate dose consequences of accident airborne releases.	
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
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 Airborne Effluents (Normal)	Curies per year	The annual activity, by isotope, contained in routine (normal) plant airborne effluent streams.	2

TABLE 3.0-209 (SHEET 6 OF 8)
ESP PARAMETERS DEFINITIONS[4]

Parameter		Parameter Units	Definition	Bounding Value Footnotes
9.5.2	Airborne Effluents (Post-Accident)	Curies	The activity, by isotope, activity contained in post-accident airborne effluents.	1
9.5.3	Tritium Airborne Effluents (Normal)	Curies per year	The annual activity of tritium contained in routine (normal) plant airborne effluent streams.	2
10.	Liquid Radwaste System			
10.2	Release Point			
10.2.1	Flow Rate	Gallons per minute	The flow rate of liquid potentially radioactive effluent streams from plant systems to the receiving water body.	2
10.3	Source Term			
10.3.1	Liquid	Curies per year	The annual activity, by isotope, contained in routine plant liquid effluent streams.	2
10.3.2	Tritium	Curies per year	The annual activity of tritium contained in routine plant airborne effluent streams.	2
11.	Solid Radwaste System			
11.2.1	Activity	Curies per year	The annual activity, by isotope, contained in solid radioactive wastes generated during routine plant operations.	2
11.2.2	Principal Radionuclides	Curies per year	The principal radionuclides contained in solid radioactive wastes generated during routine plant operations.	2

TABLE 3.0-209 (SHEET 7 OF 8)
ESP PARAMETERS DEFINITIONS[4]

Parameter	Parameter Units	Definition	Bounding Value Footnotes
11.2.3 Volume	Cubic feet per year	The expected volume of solid radioactive wastes generated during routine plant operations.	2
13. Auxiliary Boiler System			
13.2 Flue Gas Effluents	Pounds per year	The expected combustion products and anticipated quantities released to the environment due to operation of auxiliary boilers.	2
16. Standby Power System			
16.1 Diesel			
16.1.3 Diesel Flue Gas Effluents	Pounds per year	The expected combustion products and anticipated quantities released to the environment due to operation of the emergency standby diesel generators.	2
16.2 Gas-Turbine			
16.2.3 Gas-Turbine Flue Gas Effluents	Pounds per year	The expected combustion products and anticipated quantities released to the environment due to operation of the emergency standby gas-turbine generators.	1
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.	1
17.4 Plant Design Life	Years	The life for which the plant is designed to operate.	1

TABLE 3.0-209 (SHEET 8 OF 8)
ESP PARAMETERS DEFINITIONS[4]

Parameter	Parameter Units	Definition	Bounding Value Footnotes
17.5 Plant Population			
17.5.1 Operation	Persons	The number of people required to operate and maintain the plant.	2
17.6 Station Capacity Factor	Percent	The percentage of time that a plant is capable of providing power to the grid.	1
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.
4. ESP-002 Appendix D Table D9 also provides the above definitions for the ESP Parameters.

3.1 EXTERNAL APPEARANCE AND PLANT LAYOUT

Information for this section is provided in the ESP Application Part 3 – Environmental Report, Section 3.1; the following supplemental information is provided to describe the selected reactor technology and further describe the site environs, aesthetics, and land use.

The selected Unit 3 design is an ESBWR, a light-water-cooled reactor designed by GE-Hitachi.

The ESBWR standard plant layout is shown in DCD Figure 1.1-1. The locations of the major structures of the new facility on the GGNS ESP site are indicated in Figure 2.1-201.

The Grand Gulf site environs are described in Sections 2.1 and 2.2 of NUREG-1817 and in Chapter 2. Specifically, the site environs are rural, with a low level of industry and primarily an agricultural economy. Therefore, from a visual impact or land use perspective, the operation of Unit 3 has a minimal impact on the areas surrounding the Grand Gulf site.

Aesthetic impacts from operations are described in Subsection 5.5.1.4 of NUREG-1817. There are no unresolved issues related to the external appearance of the site and the plant layout. Aesthetic impacts associated with the addition of Unit 3, as discussed in Section 5.1, are SMALL.

Land use impacts from operations are described in Section 5.1 of NUREG-1817. There are no unresolved issues related to the external appearance of the site and the plant layout. Land use impacts associated with the addition of Unit 3, as discussed in Section 5.1, are SMALL.

3.1.1 REFERENCES

None.

3.2 REACTOR POWER CONVERSION SYSTEM

Information for this section is not provided in the ESP Application Part 3 – Environmental Report, Section 3.2; the following supplemental information is provided.

The proposed plant will consist of a single unit boiling water reactor (BWR) and auxiliaries. The specific design is the ESBWR supplied by GE-Hitachi. The reactor power conversion system is described in Chapter 10 of the ESBWR Design Control Document (DCD). Figure 3.2-201 provides a simplified depiction of the reactor power conversion system.

Table 3.0-201 documents values in the Plant Parameters Envelope (PPE) related to the reactor power conversion system. These parameters are condenser/heat exchanger duty and rated reactor power (megawatts thermal). The design condenser/heat exchanger duty is 3057 MWt (10.43E+09 Btu/hr) and the rated reactor power is 4500 MWt.

The gross electrical rating of the ESBWR is 1600 ± 50 MWe. The net electrical output is approximately 1520 MWe.

The ESBWR core and fuel assembly designs are described in Table 1.3-1 of the DCD. For reload cores, the uranium enrichment will be approximately 4.6 percent U-235. The expected assembly average burnup of discharged fuel is approximately 46,000 MWd/MTU. The total quantity of uranium in the core is approximately 167 metric tons (MTU).

Engineered safety features of the ESBWR are described in DCD Chapter 6; instrumentation and controls for the engineered safety features are described in Section 7.3 of the DCD.

3.2.1 REFERENCES

None.

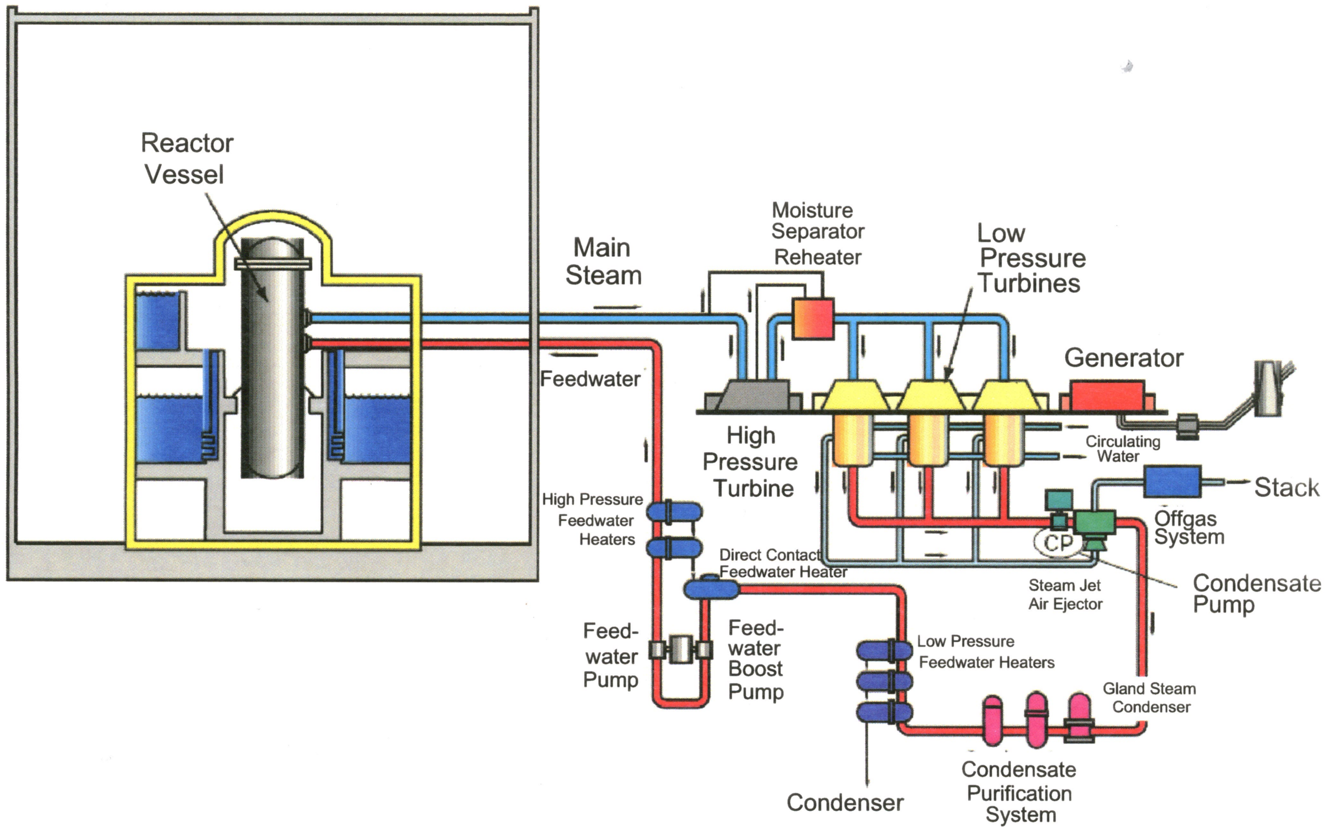


Figure 3.2-201. Simplified Flow Diagram of Reactor Power Conversion System

3.3 PLANT WATER USE

The information for this section is provided in the ESP Application Part 3 – Environmental Report, Section 3.3. Associated impacts are not fully resolved in NUREG-1817; the following supplemental information is provided.

Unresolved issues remain from the evaluation in NUREG-1817 concerning groundwater use and impacts to groundwater quality during construction and operation of Unit 3. The NRC staff indicated that new well(s) in the Catahoula aquifer present the potential for drawdown beyond the capability of the aquifer to recover, thus potentially degrading the overall aquifer water quality. In the ESP ER, initial estimates on usage ranged from 1310 to 3570 gpm, which included potable water, sanitary water use, concrete batch plant use, demineralized water makeup, and fire protection makeup.

NUREG-1817 Subsection 4.3.2 summarized the staff's findings related to water use impacts during construction: "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 2005). 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. … Therefore, the staff concludes that the issue of water-use impacts associated with the construction of a facility at the ESP site is unresolved."

NUREG-1817 Subsection 4.3.3 summarized the staff's findings related to water quality impacts during construction: "Given the information provided in the applicant's environmental report and the NRC staff's independent review, impacts on the Catahoula formation could be SMALL if the proposed withdrawal had little effect on the Catahoula formation or LARGE if the proposed withdrawal were to induce degradation of the water quality of the sole source aquifer. An applicant for a CP or COL referencing an ESP for the Grand Gulf ESP site would need to provide additional information on the ability of the Catahoula aquifer to sustain proposed withdrawals in order for the staff to make a significance determination with respect to this resource. … Therefore, the staff concludes that the issue of water-quality impacts associated with the construction of the proposed Grand Gulf ESP facility is unresolved."

NUREG-1817 Subsection 5.3.2 summarized the staff's findings related to water use impacts during operation: "SERI (2005a) 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). An applicant for a CP or COL referencing an ESP for the Grand Gulf ESP site would need to provide additional information on the ability of the Catahoula aquifer to sustain withdrawals in order for the staff to make a significance determination with respect to this resource. … Based on its review, the staff concludes that the issue of water-use impacts resulting from operational activities on groundwater at the Grand Gulf ESP site is unresolved."

Information regarding the constituents and associated concentrations of chemicals for liquid effluent discharges that address an unresolved effluent water quality issue identified at ESP is contained in Section 3.6. Expected water treatment additives and quantities are included in Table 3.3-201 to support evaluations of the discharge effluents presented in Section 3.6.

Subsequent maturing of system designs and revised estimates for water use show that actual usage, particularly that which is to be withdrawn from groundwater, is expected to be a fraction of the original estimates. Additionally, sources for this groundwater will come from wells installed in the Upland Complex aquifer rather than the Catahoula aquifer as described in ESP ER Section 2.3. The only Unit 3 system that takes its supply from groundwater wells is the potable water system. Water use impacts as a result of the usage of groundwater from the Upland Complex aquifer are discussed in Sections 4.2 and 5.2.

3.3.1 WATER CONSUMPTION

A water balance diagram was developed, using inputs from the reactor vendor (DCD) and from site-specific design and calculations, to depict the water usage and effluent streams for Unit 3. This water use diagram addresses those systems that interface with the environment (surface water and groundwater), and is shown in Figure 3.3-201. Water use is described based on plant operational modes of normal operation and shutdown, along with flows during conditions of no discharge via the liquid radioactive waste processing systems, and conditions with effluent discharge from liquid radwaste systems.

3.3.1.1 Potable and Sanitary Water Systems

Potable water is provided to the water treatment system by freshwater wells that draw water from the Upland Complex aquifer. The potable and sanitary water systems (PWS) are designed to provide potable water supply and sewage treatment necessary for normal plant operation and shutdown periods. A description of these systems is provided in FSAR Subsection 9.2.4. The PWS is designed to supply up to 200 gpm of potable water during peak demand period with a monthly average usage of 35 gpm as depicted in Figure 3.3-201.

Groundwater usage from the Upland Complex aquifer during construction activities is expected to be a monthly average of 90 gpm for sanitary waste, dust suppression, testing and a concrete batch plant. The largest portion of this volume, 52 gpm, will be for concrete batch plant usage and dust suppression.

3.3.1.2 Demineralized Water

The makeup water system is described in FSAR Subsection 9.2.3. The required flow for makeup water to the demineralization system is expected to be a monthly average of 137 gpm, with short term maximum flow expected to be 554 gpm during outages. This makeup water is supplied from the clarifiers by the station water system (SWS) as depicted in Figure 3.3-201.

3.3.1.3 Fire Protection

Fire protection water is provided to the system from on-site storage tanks that have makeup supplied from the station water system. After the system is initially filled, system usage will average less than 30 gpm monthly as depicted in Figure 3.3-201.

3.3.2 WATER TREATMENT

Several water treatment systems are used in Unit 1 operations. Water treatment systems for Unit 3 would employ similar designs, treatment technologies, chemicals and methods for the necessary water supplies. The expected water treatment methods are described in the following subsections. Similar to treatment schemes for Unit 1, water treatment is not expected to vary on a seasonal basis for Unit 3. The values for the various chemicals included in Table 3.3-201 are for the normal operation mode of the facility; quantities of chemicals required for treatment during shutdown would be less.

3.3.2.1 Station Water System

The station water system (SWS) draws water from the Mississippi River, the only surface water source of makeup to the plant. The water is pumped to clarifiers for removal of suspended solids by use of a coagulant and flocculant. Clarified water is provided to the circulating water system (CIRC) for makeup to the normal power heat sink (NPHS) cooling tower basin, and to the plant service water system (PSWS) for makeup to the auxiliary heat sink (AHS) cooling tower basin. Additional water treatment is provided via granular filters in the supply to the makeup water system and the supply to the firewater storage tanks (see Figure 3.3-201). FSAR Subsection 9.2.10 and FSAR Figure 9.2-203 provide additional detail regarding SWS design and operation. Water treatment chemistry for the SWS is provided in Table 3.3-201.

3.3.2.2 Circulating Water System

The circulating water system provides cooling water for removal of the power cycle heat from the main condensers and transfers this heat to the NPHS. System chemistry control is provided by the incorporation of an injection system that introduces a biocide, algaecide, pH adjuster, corrosion inhibitor, and scale inhibitor. Chemical injection occurs in the return to the cooling towers spray headers, and chemicals are injected directly into the cooling tower basin ahead of the main circulating pumps suction point as shown in FSAR Figures 10.4-201, 10.4-203, and 10.4-204. Quantities and identification of these various chemicals are shown in Table 3.3-201.

3.3.2.3 Plant Service Water System

The plant service water system (PSWS) is described in FSAR Subsection 9.2.1 and a simplified flow diagram is provided in DCD Figure 9.2-1. Water treatment chemistry is provided in Table 3.3-201. During normal operation of the PSWS, cooling (heat removal) is provided by circulating the PSWS flow through the NPHS cooling towers. As a result, water treatment is provided by the treatment process for the NPHS cooling water during normal operation. During shutdown, when the PSWS operates independently to cool the shutdown heat loads (when the NPHS is not operating), chemical treatment is provided directly to the PSWS basins. The quantity of chemicals used for treatment of the NPHS during normal operation bound the requirements for the PSWS during shutdown, and PSWS chemicals are not listed separately.

3.3.2.4 Potable and Sanitary Water Systems

The potable water system is described in Subsection 3.3.1.1. Water from the potable water wells would be treated with sodium hypochlorite before pumping to the on-site storage tank. Water treatment chemistry is provided in Table 3.3-201. The Unit 1 sanitary waste system consists of a prefabricated, aerobic, digestion-type sewage treatment plant, which would be modified to be capable of treating up to 160,000 gallons per day of sewage water with the combined effluent being discharged to Stream A, thence to Hamilton Lake.

3.3.2.5 Makeup Water System (Demineralized Water)

As indicated in FSAR Subsection 9.2.3, prior to transfer to the demineralized water storage tank, the clarified and filtered water from the SWS is processed through a vendor supplied mobile water treatment system. Demineralizer ion exchange resins will not be regenerated on-site; therefore, there will be no on-site treatment for the makeup water system that would result in chemical discharges to surface water bodies, on- or off-site, from this system.

3.3.3 REFERENCES

None.

TABLE 3.3-201
CHEMICAL ADDITIVES FOR WATER TREATMENT

System	Chemical	Usage
Circulating Water / Plant Service Water	Biocide /Algaecide – Sodium Hypochlorite	500 gal/day
Circulating Water / Plant Service Water	Biocide / Algaecide – Dispersant – PCL 401	300 gal/day
Circulating Water / Plant Service Water	Sulfuric Acid pH Adjuster	Metered to maintain a slightly alkaline state
Circulating Water / Plant Service Water	50% Zinc Chloride – Corrosion Inhibitor	15 gal/day
Circulating Water / Plant Service Water	50% Phosphate – Scale Inhibitor	30 gal/day
Potable Water	Sodium Hypochlorite	0.6 gal/day
Station Water System	Polyelectrolyte Coagulant (Suspended Solids Removal)	1-2 ppm Metered based on flow
Station Water System	Polyelectrolyte Flocculant (Suspended Solids Removal)	1-4 ppm Metered based on flow

APPENDIX A
WATER BALANCE
GRAND GULF NUCLEAR STATION - UNIT 3

GGNS-CD-Y41-DWG-M-0002A-02

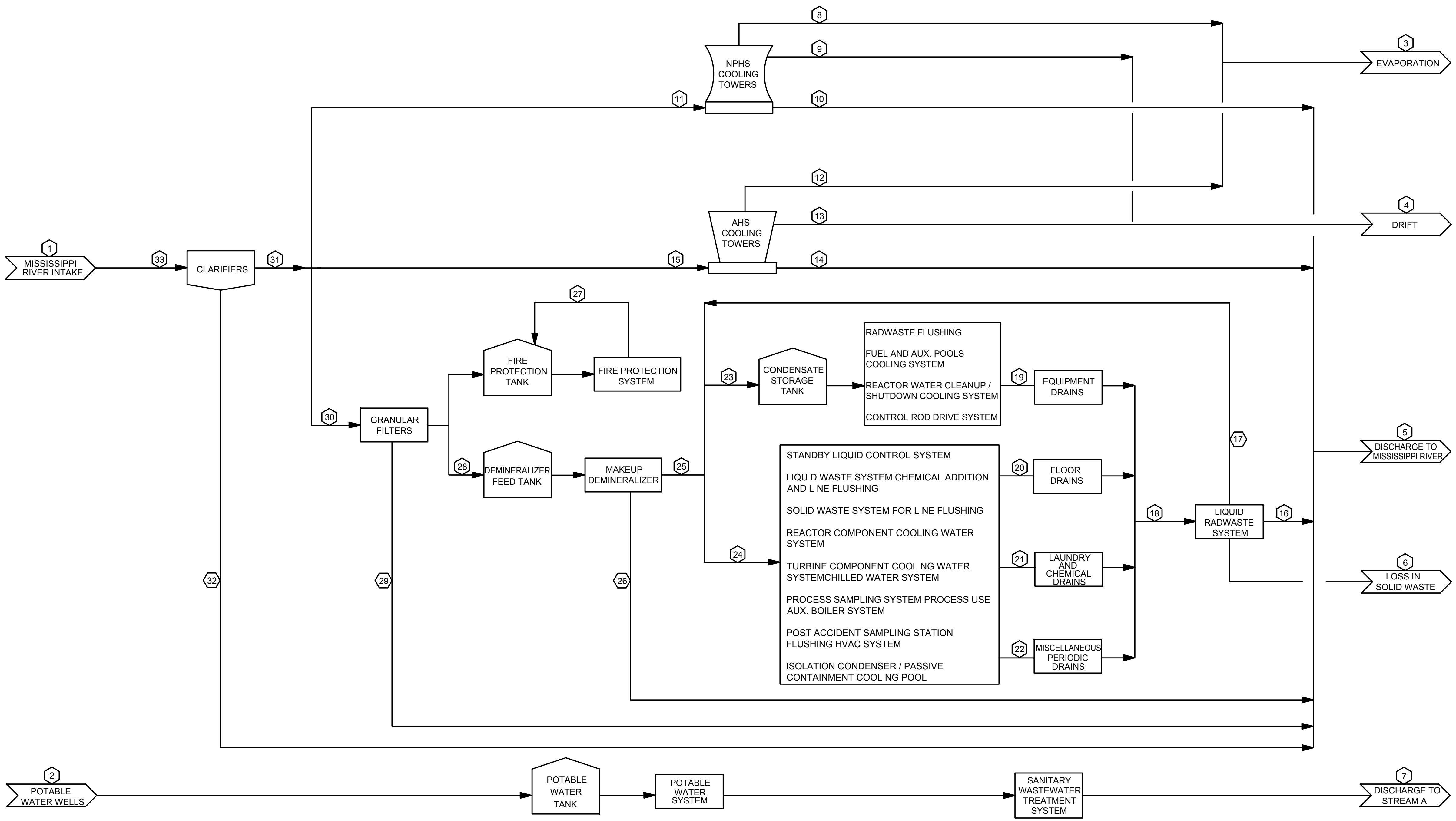


Figure 3.3-201. Simplified Water Usage Chart (Sheet 1 of 2)

NUMBER	DESCRIPTION	NORMAL POWER OPERATIONS FLOW WITH LRW* DISCHARGED (GPM)	NORMAL POWER OPERATIONS FLOW WITH LRW* RECYCLED (GPM)	SHUTDOWN OPERATIONS FLOW WITH LRW* DISCHARGED (GPM)	SHUTDOWN OPERATIONS FLOW WITH LRW* RECYCLED (GPM)
1	WATER SUPPLY FROM MISSISSIPPI RIVER	29,227	29,092	1,495	945
2	WATER SUPPLY FROM POTABLE WATER WELLS	35	35	49	49
3	TOTAL EVAPORATION LOSSES	21,600	21,600	694	694
4	COOOLING TOWER DRIFT	142	142	8	8
5	DISCHARGE TO MISSISSIPPI RIVER	7,482	7,347	783	236
6	LOSS IN SOLID WASTE	2	2	8	8
7	DISCHARGE TO STREAM A	35	35	49	49
8	EVAPORATION FROM NPHS COOLING TOWERS	21,600	21,600	0	0
9	DRIFT FROM NPHS COOLING TOWERS	142	142	0	0
10	BLOWDOWN FROM NPHS COOLING TOWERS	7,058	7,058	0	0
11	MAKEUP TO NPHS COOLING TOWERS	28,800	28,800	0	0
12	EVAPORATION FROM AHS COOLING TOWERS	0	0	694	694
13	DRIFT FROM AHS COOLING TOWERS	0	0	8	8
14	BLOWDOWN FROM AHS COOLING TOWERS	0	0	223	223
15	MAKEUP TO AHS COOLING TOWERS	0	0	925	925
16	LIQUID RADWASTE WASTEWATER	98	0	400	0
17	RECYCLED LIQUID RADWASTE	0	98	0	400
18	LIQUID RADWASTE SYSTEM INFLUENT	101	101	408	408
19	EQUIPMENT DRAINS	54	54	216	216
20	FLOOR DRAINS	8	8	32	32
21	LAUNDRY AND CHEMICAL DRAINS	23	23	92	92
22	MISCELLANEOUS PERIODIC DRAINS	17	17	68	68
23	MAKEUP TO CONDENSATE STORAGE TANK	54	54	216	216
24	VARIOUS DEMINERALIZED WATER USES - CONTINUOUS	47	47	192	192
25	DEMINERALIZED WATER PRODUCED	101	3	408	8
26	WASTEWATER FROM MAKEUP DEMINERALIZER SYSTEM	33	1	135	3
27	EFFLUENT FROM FIRE PROTECTION TANK	30	30	30	30
28	INFLUENT TO MAKEUP DEMINERALIZER SYSTEM	134	4	543	11
29	WASTEWATER FROM GRANULAR FILTERS	3	0	11	0
30	INFLUENT TO GRANULAR FILTERS	137	4	554	11
31	EFFLUENT FROM CLARIFIERS	28,937	28,804	1,480	936
32	WASTEWATER FROM CLARIFIERS	289	288	15	9
33	INFLUENT TO CLARIFIERS	29,227	29,092	1,495	945

NOTES: All Flows are Gallons per Minute
*LRW is Liquid Radioactive Waste

Figure 3.3-201. Simplified Water Usage Chart (Sheet 2 of 2)

3.4 COOLING SYSTEM

The information for this section is provided in the ESP Application Part 3 – Environmental Report, Section 3.4. Associated impacts are resolved in NUREG-1817, with additional supplemental information provided as follows.

The location for the Unit 3 cooling towers has been moved from its original ESP location north of the powerblock to a location west of the powerblock as shown in Figure 2.1-201.

NUREG-1817 Section 5.3 evaluated water-use and water-quality impacts for the Grand Gulf ESP. NUREG-1817 Subsection 5.3.1 summarized the staff's findings relative to hydrological alterations: “The NRC staff concludes that the impact of hydrological alterations from operation would be SMALL, and additional mitigation would not be warranted.”

NUREG-1817 Subsection 5.3.3 evaluated water-quality impacts for the Grand Gulf ESP. NUREG-1817 Subsection 5.3.3.1 summarized the staff's evaluation of the cooling system discharge outfall on the Mississippi River: “The NRC staff concludes, therefore, that the impact of the thermal plume on the Mississippi River would be small and localized.“

NUREG-1817 Section 7.5 stated the following with respect to cumulative aquatic impacts, specifically related to compliance with Section 316(b) of the Clean Water Act: “SERI's 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 ft/s). Based on these design plans, impingement and entrainment during operation of the proposed facility would be minimal.”

Unit 3 will withdraw its cooling systems makeup water from the Mississippi River through a new intake structure to be constructed at the existing barge canal. To accommodate the intake structure, associated intake piping and screens, the canal profile will have to be modified by dredging. An unresolved issue exists in NUREG-1817 Subsection 4.1.1 regarding land use impacts resulting from the deposition of the spoils from those dredging activities that states: “Based on its review, the staff concludes that additional information on (1) the planned disposition of dredge spoils and the use of borrow… is needed in order to determine the impacts associated with construction on land use at the site and vicinity. Therefore, the staff concludes that this issue is unresolved.” Additional details for the intake system are provided in this section, and these land use impacts are addressed in Chapter 4.

3.4.1 DESCRIPTIONS AND OPERATIONAL MODES

3.4.1.1 Circulating Water System

The circulating water system (CIRC) provides cooling water during startup, normal plant operations, and shutdown for removal of power cycle heat from the main condensers and rejects this heat to the normal plant heat sink (NPHS). The main plant condensers contribute the majority of the heat to the NPHS, with additional heat load (less than 3 percent of the total) introduced by the plant service water system (PSWS) during normal operation. The total heat removal requirements for sizing the cooling towers are indicated in Table 3.0-201. The NPHS is comprised of both a hyperbolic natural draft cooling tower (NDCT), and mechanical draft cooling tower (MDCT). (See FSAR Section 10.4.) The NDCT would be similar in design and construction as the existing Unit 1 NDCT, utilizing low clog high performance fill and drift eliminators to maximize efficiency and minimize drift. The MDCT will be similar in design and construction to the existing Unit 1 MDCT, with the slightly larger individual cells arranged in an octagonal pattern (rather than linear) for Unit 3 because of space limitations. Operation of the two towers will vary seasonally, with the MDCT operating during periods of high ambient temperature to ensure the design water temperature and unit electrical output can be maintained. The MDCT is designed to accommodate approximately 30 percent of the heat load during design ambient conditions and normal full power operation. During cooler periods, MDCT flows will vary by reducing and/or stopping flow to the MDCT. Full circulating water system flow can be accommodated by the NDCT if the MDCT is not operating.

Makeup to the NPHS and the PSWS cooling systems is provided by the station water system. Blowdown from the circulating water and service water cooling systems of Unit 3 would be discharged to a blowdown outfall structure located at the shoreline of the Mississippi River, at a temperature no greater than 100°F and a flow rate of approximately 7058 gpm based on 4 cycles of concentration operation (see Table 3.0-201).

3.4.1.2 Plant Service Water System

The PSWS provides cooling water to the turbine building component cooling heat exchangers and the reactor building component cooling heat exchangers and rejects the heat back to the NPHS during normal power operations. The PSWS is described in FSAR Subsection 9.2.1 and a simplified flow diagram is provided in DCD Figure 9.2-1. During shutdown operations, when the NPHS is not operating, the PSWS utilizes mechanical draft wet cooling towers to remove the heat from served loads, with makeup to the enclosed PSWS cooling tower basin directly from the station water system (SWS). Figure 3.3-201 provides flow requirements for makeup to the PSWS for normal operation and shutdown conditions, and provides blowdown flow expected during operation in shutdown conditions.

3.4.1.3 Ultimate Heat Sink

The Unit 3 ESBWR design has no separate emergency cooling water system. The “ultimate heat sink” function is provided by safety systems integral and interior to the reactor plant. This system ultimately uses the atmosphere as the eventual heat sink. These systems have no cooling towers, basins, or cooling water intake / discharge structures external to the reactor plant.

3.4.2 COMPONENT DESCRIPTIONS

3.4.2.1 Intake System

The SWS draws river water from an embayment (Figure 3.4-201) on the eastern shore of the Mississippi River through fixed strainers (screens) located below the extreme low water level to ensure proper system operation under all expected river level conditions. Two dry-pit type vertical pumps are located in an intake structure on the north shoreline of the embayment (see ESP ER Figure 5.3-2). Single pump operation provides 100 percent makeup flow to the plant, and the second pump is kept in standby, not operating. The suction lines are provided with automatic valves and are interconnected to allow the operating pump to draw water from either strainer.

The intake screens, represented conceptually in Figure 3.4-202, are sized to allow a maximum flow of approximately 35,300 gpm with a corresponding maximum screen slot velocity of 0.50 ft/s.This intake screen maximum design flow exceeds the expected total Unit 3 SWS makeup flow (slightly over 29,200 gpm) required from the Mississippi River. Thus, the screen slot velocity at the maximum SWS makeup flow requirement will be approximately 0.4 ft/s, which meets the United States Environmental Protection Agency requirements (0.50 ft/s) found in regulations implementing Clean Water Act Section 316(b) (Reference 201). Variations in final design for screen flow and approach velocity may occur; however, Reference 201 requirements for an approach velocity less than 0.50 ft/s will be adhered to.

A comparative review of the drawings for the River Bend intake pumping station and the conceptual design for the Grand Gulf intake pumping station indicate that the two systems are very similar in configuration. Both systems draw water from the Mississippi River through intake strainers (screens) with redundant pumps located in an intake structure close to the river bank.

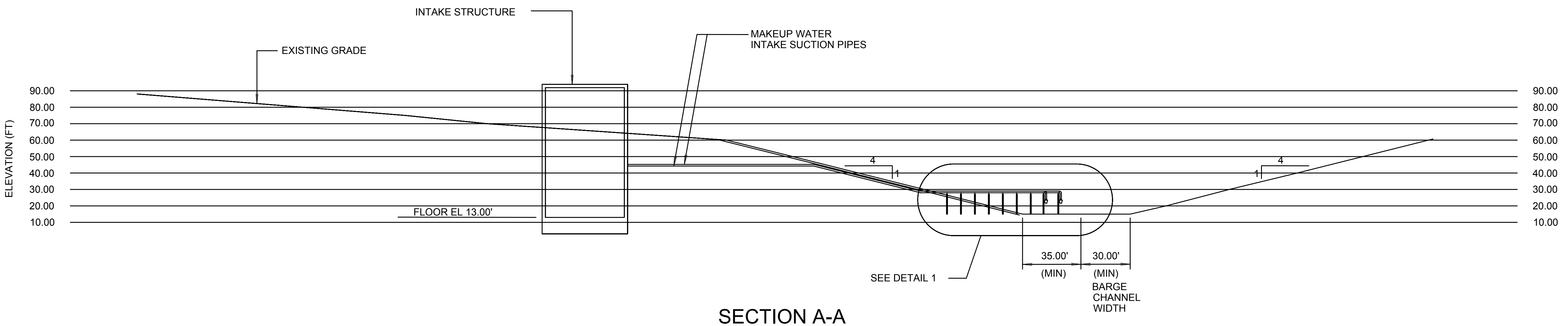
3.4.2.2 Heat Dissipation System

The heat dissipation system (NPHS) is described in Subsection 3.4.1.1. The circulating water system provides cooling water during startup and shutdown evolutions, and during normal plant operations, for removal of power cycle heat from the main condensers and from the PSWS heat loads, and rejects this heat to the NPHS. The NPHS cooling towers are located west of the main powerblock as shown in Figure 2.1-201. During shutdown, heat is removed from loads served by the PSWS via redundant mechanical draft wet cooling towers as described in Subsection 3.4.1.2.

3.4.3 REFERENCES

201 40 CFR Parts 9, 122, et al., “Regulations Addressing Cooling Water Intake Structures for New Facilities.”

Figure 3.4-201. Embayment and Intake Details (Sheet 1 of 2)



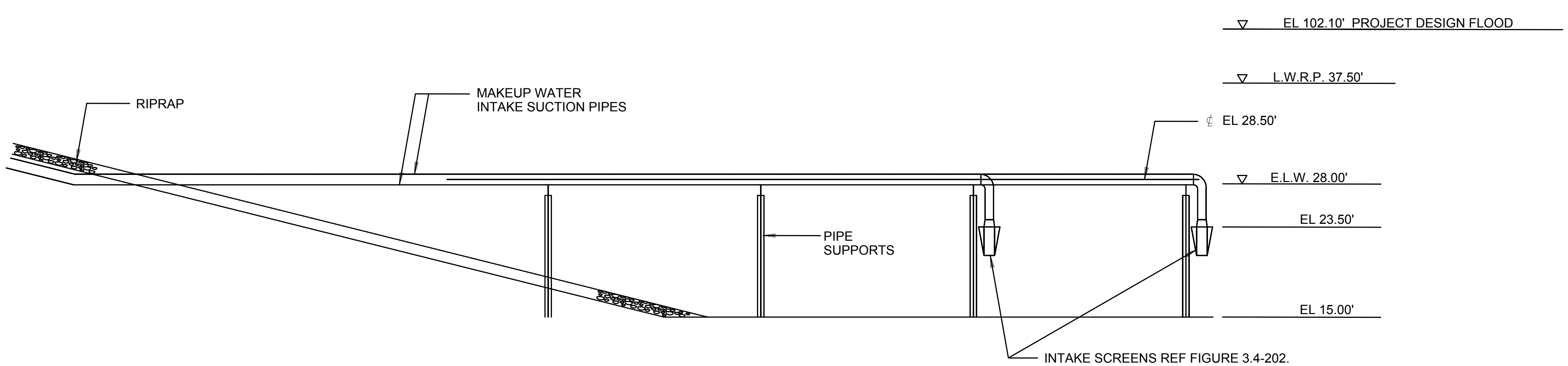
SECTION A-A

N.T.S.

LEGEND

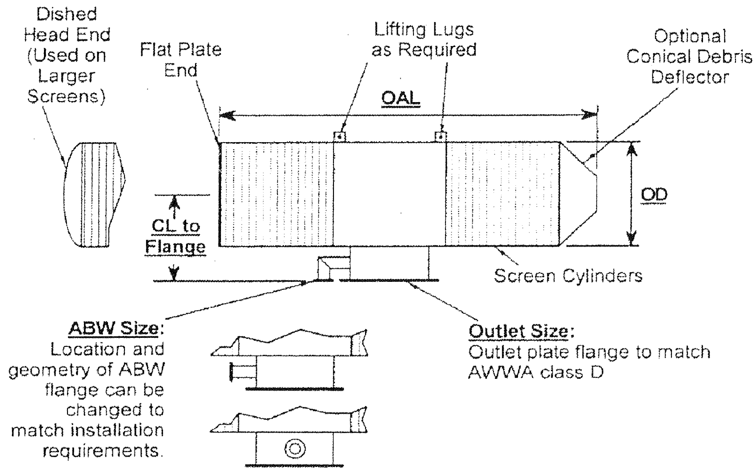
L.W.R.P. = LOW WATER REFERENCE PLANE

E.L.W. = EXTREME LOW WATER



DETAIL 1

Figure 3.4-201. Embayment and Intake Details (Sheet 2 of 2)



Dimension/Sizes	Value	Unit	Comments
OD	78.00	In	Nominal See note 1
OAL	300.00	In	Nominal See note 1
CL to Flange	78.00	In	Nominal See note 1
Outlet Connection Size	54PS		
ABW Connection Size	12PS		
Weight	11162	Lbs	
Left End Closure	Cone		
Right End Closure	Dish		

Screen Specifications			
Slot Opening	0.125	In	
Open Area Percentage	58.41%		
Wire Type	93		

Flow Capacities			
Flow/Screen	35.294	GPM	
Maximum Slot Velocity	0.50	Fps	
Average Slot Velocity	0.43	Fps	
Estimated DP/Screen	0.0034	Psi	Thru clean screen surface only
Estimated DP/Assy	0.2754	Psi	Thru entire clean assembly

Note: (1) Dimensions shown are nominal

Figure 3.4-202. Conceptual Intake Screen Details

3.5 RADIOACTIVE WASTE MANAGEMENT SYSTEMS

The information for this section is provided in the ESP Application Part 3 – Environmental Report, Section 3.5. Impacts associated with normal operations effluent releases from radioactive waste management systems are resolved in NUREG-1817.

Radioactive waste management system descriptions are provided in DCD Chapter 11, Radioactive Waste Management. Descriptions of the liquid, gaseous, and solid radioactive waste management systems are provided in DCD Section 11.2, DCD Section 11.3, and DCD Section 11.4, respectively. The radioactive waste management systems are designed to keep the exposure to plant personnel “As Low As Reasonably Achievable” (ALARA) during normal operation and plant maintenance, in accordance with RG 8.8.

Process radiation monitoring systems designed to limit the potential release of radioactive materials to the environment if predetermined radiation levels are exceeded in major process/ effluent streams are described in Section 11.5 of the DCD. Ventilation systems and their release points and associated monitoring equipment are described in DCD Section 9.4.

NUREG-1817 Subsection 5.9.3 evaluated the health impacts to the public from routine gaseous and liquid radiological effluent releases. NUREG-1817 Subsection 5.9.3.3 summarized the staff's findings that there would be no observable health impacts on the public from normal operation of new nuclear units, and the health impacts would be SMALL. However, as indicated in Table 3.0-201, PPE Section 10.3.1, and Table 3.0-208, the liquid effluent release source term for Unit 3 is not bounded by that used in the ESP analyses. Although the total curie content released via the liquid pathway from Unit 3 is less than (and bounded by) the ESP parameter source term, the liquid effluent source term, as shown in Table 3.0-208, includes radionuclides not in the ESP PPE source term. Subsection 5.4.2.1 provides results of dose calculations using the Unit 3 source term of Table 3.0-208.

3.5.1 REFERENCES

None.

3.6 NON-RADIOACTIVE WASTE SYSTEMS

The information for this section is provided in the ESP Application Part 3 – Environmental Report, Section 3.6. Unresolved issues remain from the evaluation in NUREG-1817 Subsections 5.3.3.1 and 5.3.3.2, specifically concerning chemical constituents contained in plant effluent pathways during operation and the resulting impacts on surface water quality of the Mississippi River and in Streams A and B that course the site.

NUREG-1817 Subsection 5.3.3.1 summarized the staff's findings related to water quality impacts for the Mississippi River: “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 for sources other than the cooling water blowdown. Consequently, this issue is not considered to be resolved.”

NUREG-1817 Subsection 5.3.3.2 summarized the staff's findings related to water quality impacts for Streams A and B: “SERI stated that discharges to Streams A and B from the Grand Gulf ESP facility would include sanitary wastewater, stormwater, and sump drains. SERI did not provide information in the environmental report defining the bounds of concentrations of chemical effluents to be discharged to Streams A and B (SERI 2005a). Consequently, this issue is not considered to be resolved. An applicant for a CP or COL referencing an ESP for the Grand Gulf ESP site would need to provide information on the concentrations of chemicals in effluents to the NRC. The allowable concentrations and volumes of such effluents to Streams A and B would be regulated by the MDEQ.”

NUREG-1817 Subsection 5.3.3.4 summarized the staff's overall findings related to water quality: “SERI did not provide PPE values for non-radioactive liquid discharges other than the blowdown. Although the impact to surface water quality would be SMALL if discharges were within the limits of the existing GGNS NPDES permit, the staff cannot rely on assumed compliance with a permit in order to reach a conclusion regarding the magnitude of impact. Additional information regarding the constituents and associated concentrations for all liquid effluent sources is needed in order to determine the impacts of operation on surface water quality to the Mississippi River and Streams A and B. Therefore, the issue of impacts to surface water quality resulting from operational activities at the Grand Gulf ESP facility is not resolved.”

Based on these unresolved water quality issues, the following information is provided.

The chemical concentrations in the effluent for Unit 3 were determined considering the following: 1) water quality of the Mississippi River as the makeup source, 2) the Unit 3 blowdown, clarifier effluent and other wastewater streams from the water usage diagram of Figure 3.3-201, at the indicated flow rates, and, 3) the chemical additives used for water treatment in the quantities given in Table 3.3-201. Results of the analysis are as shown in Table 3.6-201. It should be noted that of all the chemicals listed in Table 3.6-201, only zinc is required to be monitored in the Unit 1 blowdown effluent (by the current NPDES permit), and the Unit 3 effluent concentration reported is less than the current NPDES permit limit. Subsection 3.6.1 gives a description of the systems contributing to the Unit 3 effluent.

3.6.1 EFFLUENTS CONTAINING CHEMICALS OR BIOCIDES

3.6.1.1 Circulating Water System

The circulating water system (CIRC) provides cooling water for removal of the power cycle heat from the main condensers and transfers this heat to the normal power heat sink (NPHS). wastewater from this system in the form of blowdown, taken from the discharge weir of the cooling tower, is discharged to the plant outfall diffuser. Blowdown constituent concentrations are bounded by the ESP Parameters with the exception of chromium and total suspended solids. See Table 3.0-201, PPE Section 2.4.3. Chemical treatment of the system is discussed in Subsection 3.3.2.

3.6.1.2 Plant Service Water System

The plant service water system (PSWS) provides cooling water for the reactor component cooling water system (RCCWS) and the turbine component cooling water system (TCCWS) heat exchangers. During the shutdown mode of operation, mechanical draft cooling towers operate to remove heat from PSWS loads. wastewater from this system in the form of blowdown is discharged to the plant outfall diffuser via the NPHS blowdown during normal operation, and from the PSWS basin blowdown line during shutdown operation (see Figure 3.3-201). Chemical treatment of the system is discussed in Section 3.3.

3.6.1.3 Station Water System

The station water system (SWS) draws water from the Mississippi River for cooling systems makeup. The water is pumped to clarifiers for removal of suspended solids by use of a coagulant as discussed in Section 3.3. The clarified water is provided to the CIRC for makeup to the NPHS cooling tower basin, and to the plant service water system (PSWS) for makeup to the auxiliary heat sink (AHS) cooling tower basin. Filtered clarified water is also supplied to various other systems as shown in Figure 3.3-201.

Underflow from the clarifiers is collected in a sludge dilution tank. Raw river water from the SWS pump discharge is mixed with the clarifier underflow and the slurry is pumped to the cooling tower blowdown line where it combines with and is diluted by the blowdown flow from the NPHS cooling towers, and then flows to the plant outfall diffuser for discharge to the river.

3.6.1.4 Makeup Water System

Backwash water from the demineralizer makeup system granular prefilters is directed to the plant outfall diffuser along with the cooling tower blowdown flow. Demineralizer ion exchange resins will not be regenerated on-site; therefore, there will be no waste regenerant chemicals in the plant effluent from the makeup water system.

3.6.2 SANITARY SYSTEM EFFLUENTS

Sanitary waste will be processed by the existing Unit 1 sewage treatment facility that will be modified to accommodate the capacity required for the additional Unit 3 sanitary wastewater. As such, the sanitary effluent quality from Unit 3 is assumed to be the same as the sanitary effluent quality from Unit 1. The combined Unit 1 and Unit 3 wastewater is discharged to Stream A. Constituents of the discharge effluent are provided in Table 3.6-202. The concentrations of the different constituents in the sanitary discharge water are from the Unit 1 data as reported to the U.S. EPA. Daily maximum and monthly average values reported over the time for which the data is available (August 2003 to March 2007) are presented in Table 3.6-202 along with the associated Unit 1 NPDES permit limits.

3.6.3 OTHER EFFLUENTS

Impacts related to air quality from gaseous emission pathways were evaluated in the ESP Application Part 3 – Environmental Report and in NUREG-1817, Subsection 5.2.2 and Section 5.11. There are no unresolved issues associated with air quality. However, the carbon monoxide emission listed in Table 3.0-204 for the auxiliary boiler is not bounded by the ESP Parameter. See Table 3.0-201, PPE Section 13.2. Additionally, the diesel generator exhaust emission values for sulfur oxides in Table 3.0-205 are not bounded. However, considering the requirement for use of only ULSD fuels, the exhaust emissions for the sulfur oxide component are fully expected to be bounded, as stated in Note 6 of Table 3.0-205.

Stormwater and runoff drainage does not communicate with any of the plant systems and therefore would not contain any chemical constituents from those systems. Stormwater runoff is captured by an integrated series of catch basins and various other natural and manmade drainage swales and ditches around the building periphery, a portion of which is discharged into Stream B, and a portion into Stream A. (See Subsection 4.2.1)

3.6.4 REFERENCES

None.

**TABLE 3.6-201
NON-RADIOACTIVE WASTE EFFLUENT FROM UNIT 3
CONSTITUENTS IN THE COMMON PLANT OUTFALL**

Constituent	Concentration (ppm)
Silica	58
Calcium	210
Sodium	153
Magnesium	70
Bicarbonate	675
Sulfate	353
Phosphate	6.4
Nitrate	39
Chloride	197
Fluoride	2.7
Chromium	0.037
Copper	0.047
Iron	0.93
Zinc	0.448
Total Dissolved Solids	1788
Total Suspended Solids	1779

TABLE 3.6-202
CONSTITUENTS OF EFFLUENTS FROM THE SANITARY WASTE SYSTEM

Constituent	Unit 1 NPDES Permit (MS0029521) Limits		Historic Concentrations[1]	
	Monthly Avg.	Daily Max.	Monthly Avg.	Daily Max.
5-Day Biological Oxygen Demand (BOD_5)	30 mg/l	45 mg/l	9.9 mg/l	11.7 mg/l
Total Suspended Solids (TSS)	30 mg/l	45 mg/l	29 mg/l	38 mg/l
Total Residual Chlorine (TRC)	Report (mg/l)	0.5 mg/l	0.18 mg/l	0.35 mg/l
Fecal Coliforms (Colonies per 100 ml)	2000/100ml	4000/100ml	9/100ml (272/100ml)	80/100ml (3700/100ml)

NOTES:

1. Data taken from U. S. EPA Water Discharge Permits (PCS) Detailed Reports for Entergy MS Inc., Grand Gulf Nuclear Station, Permit Number MS0029521 (data available through 25 May 2007).

3.7 POWER TRANSMISSION SYSTEM

The information for this section is provided in the ESP Application Part 3 – Environmental Report, Section 3.7; the following supplements are provided.

The ESP ER indicated that the existing transmission and distribution system for Unit 1 could accommodate an additional 1311 MWe without need for evaluation of environmental impacts. As indicated in Section 1.1, the proposed project includes construction and operation of an ESBWR nuclear power plant with gross electrical output of approximately 1600 ±50 MWe. Unit 3 is anticipated to generate approximately 1520 MWe net. The Applicant has conducted additional analyses of the existing transmission system and concluded that a new transmission line will be required.

NUREG-1817, Subsection 4.1.2, contained the following unresolved issue:

> “Based on its review, the staff concludes that additional information on the precise routing of any planned transmission service needed to deliver power from a proposed ESP facility is needed in order to determine the construction impacts to off-site land use. Therefore, the staff concludes that the issue of off-site land use impacts associated with construction of a proposed ESP facility is unresolved.”

NUREG-1817, Subsection 4.4.1.2, contained the following unresolved issue:

> “An applicant for a CP or COL referencing an ESP for the Grand Gulf ESP site would need to provide additional information on the location and nature of environmental impacts associated with construction of any transmission system improvements. Therefore, the issue of construction impacts on wildlife habitat along the transmission line rights-of-way is unresolved.”

The unresolved issues associated with transmission line construction focused on the fact that the existing network is inadequate to accommodate the added net electrical output. At issue was the concern over additional right-of-way required for new transmission corridors.

NUREG-1817, Subsection 5.8.3, contained the following unresolved issue:

> “SERI (2005a) 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 EMFs and this issue is not considered to be resolved.”

NUREG-1817, Subsection 5.8.4, contained the following unresolved issue:

> "The NIEHS concludes that ELF-EMF [extremely low frequency-EMF] 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, therefore, is routinely 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 exposures. The NIEHS does not believe that other cancers or non-cancer health outcomes provide sufficient evidence of a risk to currently warrant concern."
>
> This statement is not sufficient to cause the staff to consider the potential impact as significant to the public. However, because conclusive information is not available, this issue is not considered to be resolved."

The unresolved issue is that SERI did not assert at ESP that the new addition to the transmission and distribution system will be designed to meet 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.

Based on its review, the staff concluded that additional information on the precise routing of any planned transmission service needed to deliver power from a proposed ESP facility is needed and that the impacts of transmission system improvements are unresolved. In NUREG-1817 Section 3.3, the staff assumed "the Grand Gulf ESP facility connection with the transmission system would be similar to the GGNS Unit 1 facility connection and would make use of existing transmission line rights-of-way to the extent possible. Additional land might be required, if only to widen existing rights-of-way." Based upon that assumption, the staff concluded in NUREG-1817 Subsection 4.1.2 that "impacts on land use in the transmission line rights-of-way and off-site areas could be SMALL if the existing rights-of-way are determined to be the preferred routing of any new transmission lines that may be needed to deliver power from a proposed ESP facility."

Subsequent maturing of system design and a proposed new transmission line corridor address these unresolved issues.

Following is information relative to the proposed transmission system upgrades in support of the proposed project.

The application for interconnection to the transmission system is described in Section 2.2. As part of its application for an interconnect approval to the Entergy Mississippi Inc. (EMI) system, a System Impact Study (SIS) was performed by the Southwest Power Pool - Independent Coordinator of Transmission (SPP-ICT) to determine what upgrades, if any, are required for EMI to allow the interconnection and transmission of the energy output from the plant to the grid. This report has identified the system improvements which will be required to maintain grid integrity and system stability while accepting the anticipated injection from Unit 3. It is important to note that the SIS is based not only on the anticipated contributions from Unit 3, but also on all other new generation capacity and other system alterations planned (by any party known to SPP-ICT) between the commissioning of the SIS and expected on-line date of the facility being studied.

The SIS evaluates 1594 MWe net output to the grid in the determination of impacts. The output of Unit 3 is bounded by this parameter. The SIS evaluates a new 500 kV line from the GGNS 500 kV switchyard to the Ray Braswell 500 kV switchyard.

3.7.1 TRANSMISSION LINE RIGHT-OF-WAY AND CONSTRUCTION

The power transmission and off-site power system for Unit 3 will be connected to the GGNS 500 kV switchyard. The GGNS 500 kV switchyard will be expanded to the north and reconfigured to support the generation output and off-site power connections for Unit 3. The existing GGNS-Baxter Wilson extra high voltage (EHV) bus connection will be modified to move the point of connection to the new expanded switchyard section. The bus connection in the GGNS 500 kV switchyard previously used for the GGNS-Baxter Wilson line will be reused to connect a new line, which will extend to the Ray Braswell 500 kV switchyard. The existing 500 kV GGNS-Franklin line and existing 115 kV GGNS-Port Gibson line will not be modified.

The new GGNS-Ray Braswell EHV line will consist of a single-circuit 500 kV transmission line, traversing Claiborne, Warren, and Hinds counties. The conductor size is 954 kcmil ASCR with a 3 bundle conductor. The new line will require the construction of approximately 300 transmission towers, and will be used to connect the GGNS 500 kV switchyard to the existing Ray Braswell 500 kV switchyard located near Clinton, MS.

The proposed route of the new GGNS-Ray Braswell EHV line is shown in Figure 2.2-201. The GGNS-Ray Braswell route consists of two sections. The first section is an undeveloped new single line right-of-way from the GGNS 500 kV switchyard which runs in a northerly direction to a convergence with the existing Baxter Wilson-Ray Braswell EHV right-of-way. The convergence with the Baxter Wilson-Ray Braswell EHV right-of-way is southeast of Vicksburg, MS. The second section of the GGNS Ray Braswell route runs to the south of and parallels the existing Baxter Wilson-Ray Braswell EHV right-of-way, effectively widening the right-of-way. A natural gas pipeline right-of-way constructed in 2007 lies in between the Baxter Wilson-Ray Braswell EHV right-of-way and the proposed new right-of-way for the majority of the east-west route. The right-of-way along the new north-south corridor will be 200 ft. in width, and will be within a previously procured but undeveloped right-of-way. For the purposes of estimating environmental impacts, it was assumed that the existing right-of-way for the east-west corridor will be widened by a maximum of an additional 200 ft. for the new line right-of-way to run along the existing corridor. An estimate of total land use for the route is described in Subsection 2.2.2 and is detailed in Table 2.2-201. The same method is used to estimate that the north-south portion of the route is approximately 30 miles long, and the east-west portion of the route is approximately 25 miles long. The environmental impact of land use is discussed in Section 4.1.

Surveying, design, and construction of the new route are performed by EMI. The transmission towers will have an average height of 110 ft., with a 120-ft.maximum height unless crossing obstacles. The minimum line to ground clearance varies from 32 ft. for areas accessible to pedestrians only, to 45 ft. over cultivated farmland. The minimum clearance is calculated based upon maximum sag for a conductor temperature of 212 ºF. A typical tower construction is shown in Figure 3.7-201.

3.7.2 CONFORMANCE TO STANDARDS

Design standards for the transmission and distribution system meet or exceed NESC (Reference 201) design criteria, and modifications to the existing system will comply with the relevant local, state, and industry standards including NESC and various American National Standards Institute/ Institute of Electrical and Electronics Engineers standards. The standards include the rules in Sections 23, 25, and 26 of the NESC.

3.7.3 ENVIRONMENTAL EFFECTS OF TRANSMISSION LINE OPERATION

There are two categories of electrical environmental effects of power transmission lines: corona effects caused by electrical stresses resulting in air ionization, and field effects caused by induction to objects in proximity to the line. Corona-produced audible noise and ground level electric field effects are the primary concerns.

Audible noise is typically at its maximum during or following rain. This is due to the corona effect on a wet conductor. A predicted audible noise profile for a representative 500 kV transmission line with a wet conductor is provided in Figure 3.7-202. The maximum noise level, which is less than 50 dB at the center of the right-of-way (measured from an X coordinate of zero in the figure), is below the level which would result in a probable number of complaints (52.5 dB per Reference 202).

Ground level electric field effects of overhead power transmission lines relate to the possibility of exposure to electric discharges from objects in the field of the line. A typical electric field profile at ground level for a power transmission line is shown in Figure 3.7-203 (the X coordinate in the figure corresponds to the center of the right-of-way). The value will vary depending on line sag, three phase current balance, and line current. The likely range of maximum vertical electric field for 500 kV is 5-9 kV/m (Reference 202).

The impacts of maintenance activities in the right-of-way are discussed in Subsections 5.6.1 and 5.6.2. The effect of electromagnetic fields is discussed in Subsection 5.6.3.

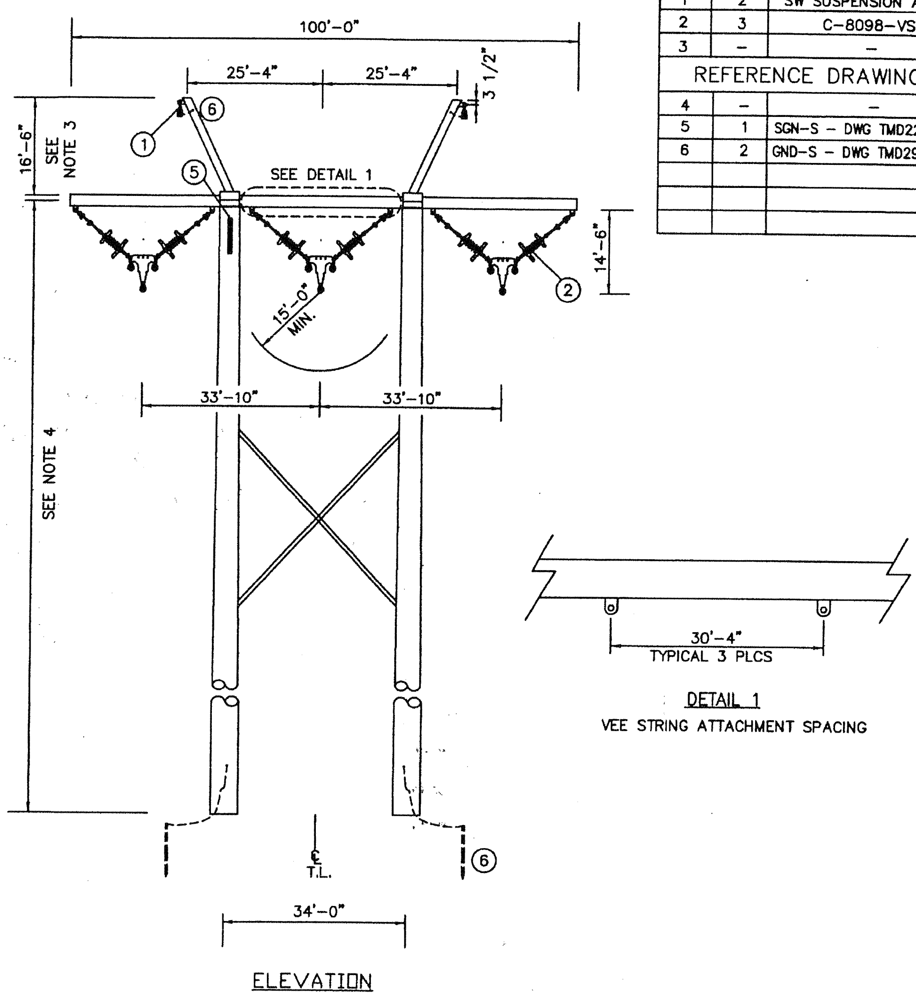
3.7.4 REFERENCES

201 Institute of Electrical and Electronics Engineers, Inc. (IEEE) National Electrical Safety Code (NESC), New York, 2007.

202 Fink, D. G., and H. W. Beaty, eds., Standard Handbook for Electrical Engineers, 13th ed., McGraw-Hill, New York, 1993.

0°–2°, VEE STRING, TANGENT H-FRAME
SINGLE CIRCUIT, POLYMER, STEEL 500kV

ASSEMBLY LIST		
ITEM	QTY.	ASSEMBLY/DRAWING
1	2	SW SUSPENSION ASSY
2	3	C-8098-VS1
3	–	–
REFERENCE DRAWINGS		
4	–	–
5	1	SGN-S – DWG TMD227A2
6	2	GND-S – DWG TMD296A0



NOTES:

1) All dimensions are to Centerline of attachment.
2) Refer to Assembly drawings for part details.
3) Dimension from centerline of bolt holes in Static mast bracket base to top of mast.
4) Structure reference height is from bottom of shaft to centerline of crossarm.
5) Refer to drawing SK1 for loads.

HA2-X-SUS-V-S 500

ENTERGY LOUISIANA, INC.
500 KV H-FRAME – TYPE "A"
500KV TRANSMISSION STANDARD
0° TO 2° LINE ANGLE

JOB NO.	NONE	SCALE:	NONE
Entergy	No. STD – 1		
	PLOT 1=1	SH. 1 OF 1	

NO.	DATE	REVISION	BY	CHK	APPR

Figure 3.7-201. Typical 500 kV Transmission Line Tower (Sheet 1 of 4)

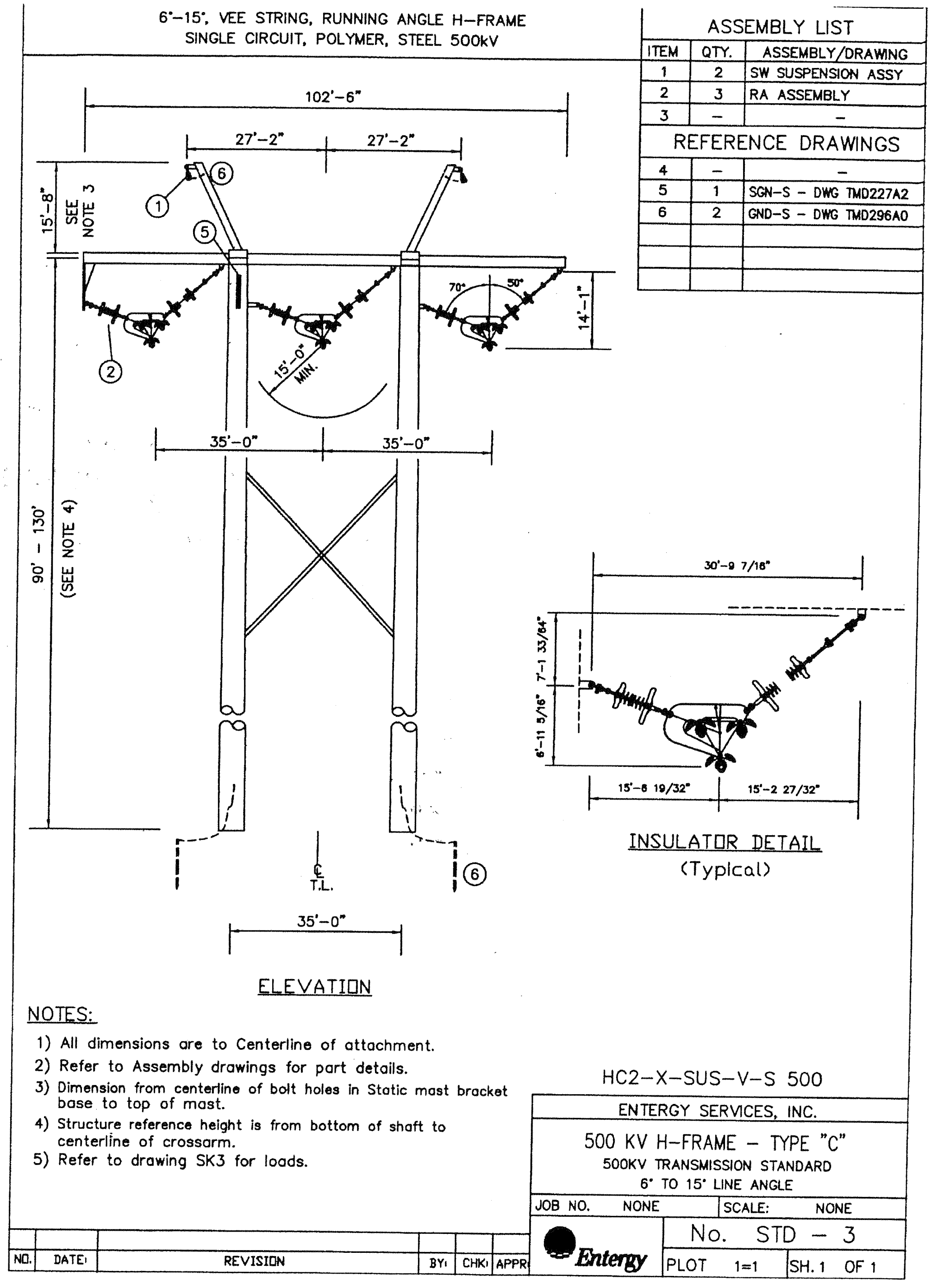


Figure 3.7-201. Typical 500 kV Transmission Line Tower (Sheet 2 of 4)

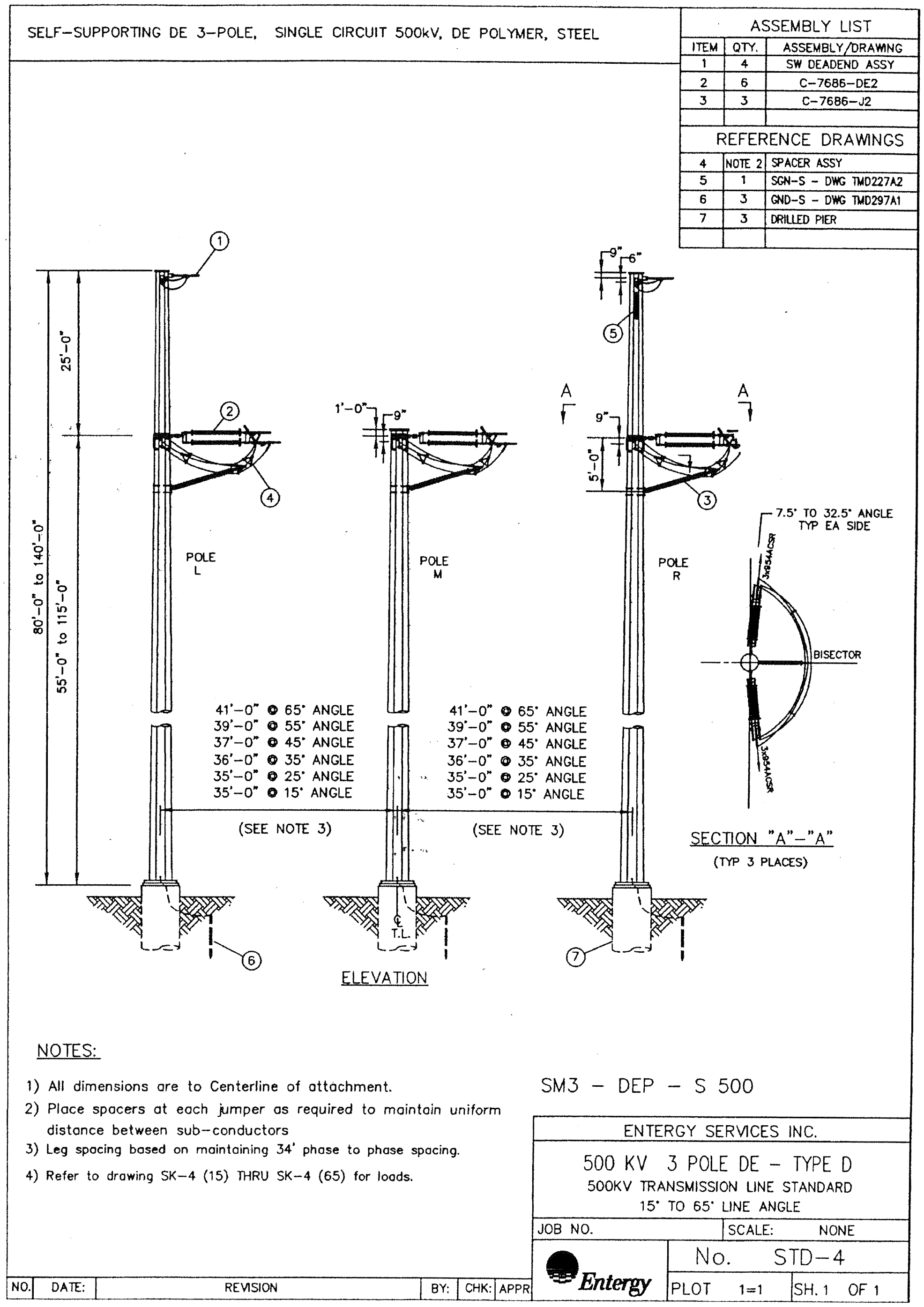


Figure 3.7-201. Typical 500 kV Transmission Line Tower (Sheet 3 of 4)

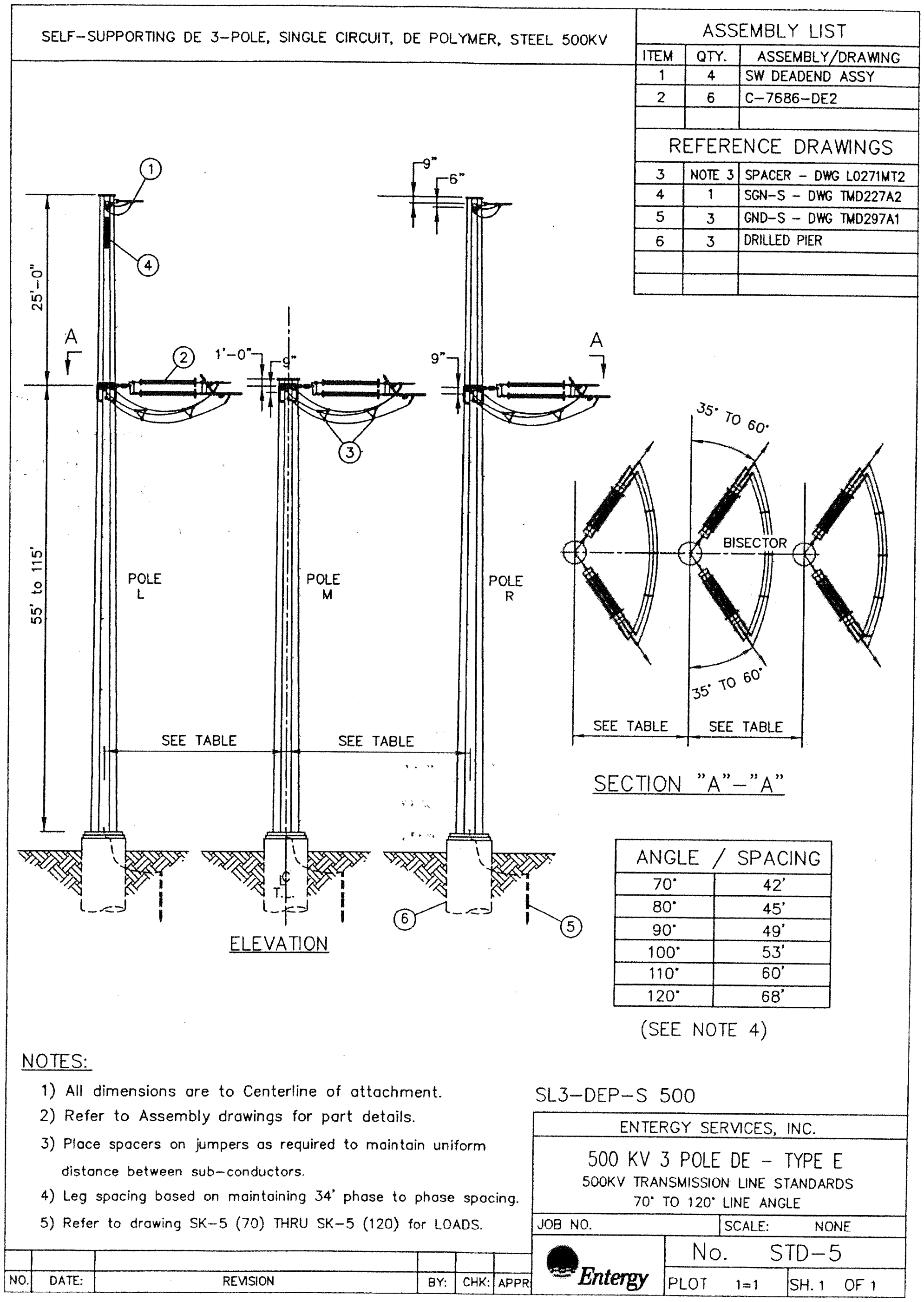


Figure 3.7-201. Typical 500 kV Transmission Line Tower (Sheet 4 of 4)

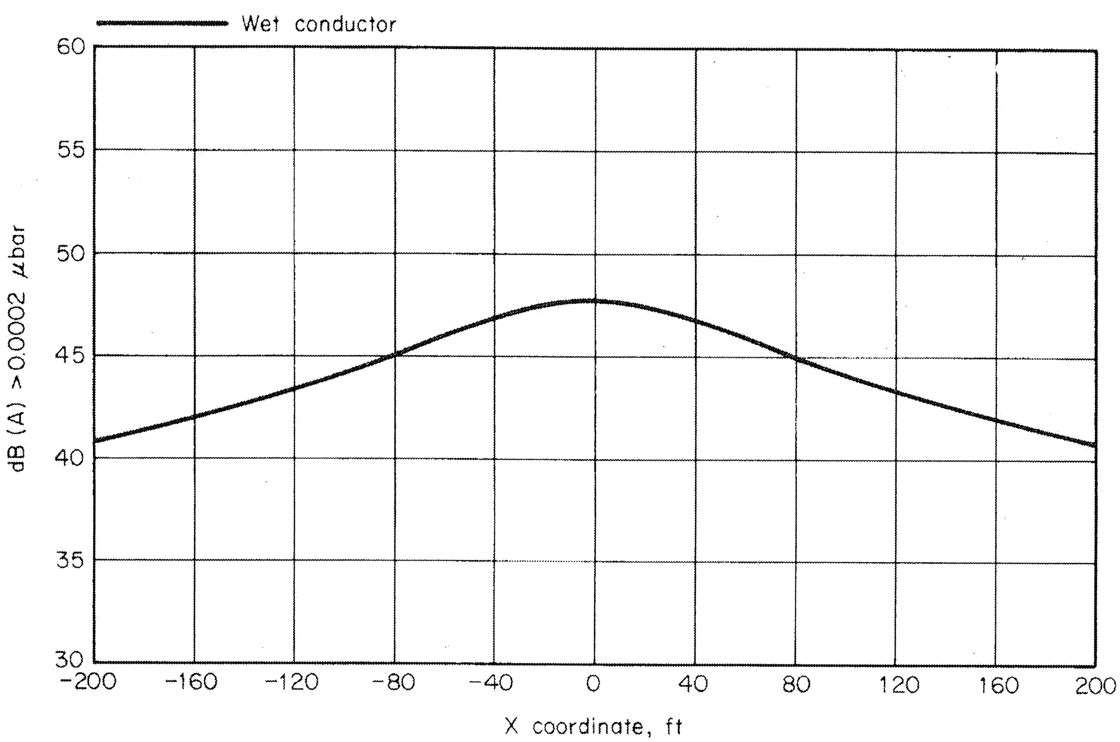


Figure 3.7-202. 500 kV Transmission Line Audible Noise Profile

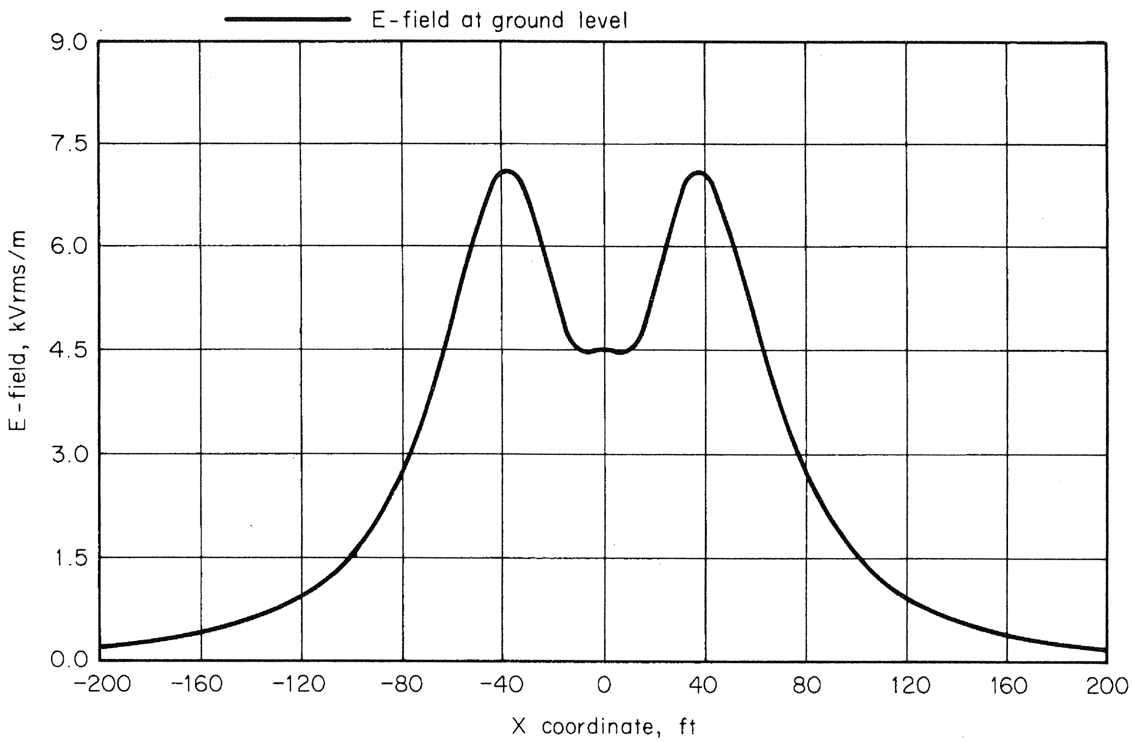


Figure 3.7-203. 500 kV Transmission Line Electric Field Profile

3.8 TRANSPORTATION OF RADIOACTIVE MATERIAL

The information for this section is provided in the ESP Application Part 3 – Environmental Report, Section 3.8. Associated impacts are not fully resolved in NUREG-1817; the following supplemental information is provided.

NUREG-1817 Section 6.2 evaluated 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 off-site disposal facilities. NUREG-1817 Subsection 6.2.4 summarized the staff's findings: “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." However, NUREG-1817 Subsection 6.2.2.2 stated that “the impacts of crud and activation products on spent fuel transportation accident risks are not resolved and would need to be examined at the CP or COL stage.” These impacts were not resolved due to the absence of a selected reactor design and its associated operating parameters. The following provides additional information to address this unresolved issue.

According to NUREG/CR-6672 (Reference 201), a bounding value for crud surface activity for boiling water reactor (BWR) fuel rods is 595×10^{-6} Ci/cm^2 (2.20×10^{7} Bq/cm^2). This value is based on measurements taken from operating BWRs. Because ESBWR operational parameters are similar to operating BWRs, this bounding value is appropriate for the ESBWR. Furthermore, based on previous operational experience, the ESBWR design incorporates provisions to minimize crud buildup, which further justifies use of this bounding value.

The crud surface activity used for the analysis in NUREG-1817 was 1.01×10^{14} Bq/MTU. Using ESBWR bounding fuel rod dimensions, uranium loading, and the 595×10^{-6} Ci/cm^2 bounding crud surface activity from NUREG/CR-6672, the ESBWR crud surface activity is calculated to be 1.48x1013 Bq/MTU, more than a factor of six less than that used in NUREG-1817. Therefore, the impacts of crud and activation products on spent fuel transportation accidents are enveloped by the analysis in NUREG-1817 and can be considered as SMALL.

3.8.1 REFERENCES

201 U.S. Nuclear Regulatory Commission, *Reexamination of Spent Fuel Shipment Risk Estimates*, NUREG/CR-6672, Washington, DC, 2000.

CHAPTER 4 ENVIRONMENTAL IMPACTS OF CONSTRUCTION

Chapter 4 presents the potential environmental impacts of construction of Unit 3 at the Grand Gulf ESP Site. In accordance with 10 CFR 51, impacts are analyzed, and a single significance level of potential impact is assigned to each resource (i.e., SMALL, MODERATE, or LARGE) consistent with the criteria that the NRC established in 10 CFR 51, Appendix B, Table B-1, Footnote 3. Unless the significance level is identified as beneficial, the impact is adverse, or in the case of "small," may be negligible. The definitions of significance 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. For the purposes of assessing radiological impacts, the Commission has concluded that those impacts that do not exceed permissible levels in the Commission's regulations are considered small.
- MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize any important attribute of the resource.
- LARGE – Environmental effects are clearly noticeable and are sufficient to destabilize any important attributes of the resource.

This chapter is divided into six sections:

- Land-Use Impacts (Section 4.1).
- Water-Related Impacts (Section 4.2).
- Ecological Impacts (Section 4.3).
- Socioeconomic Impacts (Section 4.4).
- Radiation Exposure to Construction Workers (Section 4.5).
- Measures and Controls to Limit Adverse Impacts during Construction (Section 4.6).

These sections present potential ways to avoid, minimize, or mitigate adverse impacts of construction to the maximum extent practical. For some of the impacts related to construction activities, mitigation measures that would be applied are referred to as best management practices (BMPs). BMPs are designed to address the specific types of activities that are to be performed.

4.1 LAND-USE IMPACTS

The information for this section is provided in the ESP Application Part 3 – Environmental Report, and associated impacts are not fully resolved in NUREG-1817; the following supplemental information is provided.

4.1.1 THE SITE AND VICINITY

The land-use impacts of Grand Gulf Nuclear Station (GGNS) Unit 3 construction on the site and vicinity were evaluated in NUREG-1817, Subsection 4.1.1. The assessment of the construction impacts on land use, specifically dredge spoils, borrow, and rail service, was unresolved. The following provides additional information to address these unresolved issues. Section 2.2 provides a description of land use at the Unit 3 site.

An estimated 234 acres (ac.) of the 2100-ac. GGNS site would be affected by construction of a new facility. Including the intake structure laydown, an estimated 132 ac. are to be overlain by permanent structures. Acreage not containing permanent structures amounts to 102 ac. and is expected to be reclaimed to the maximum extent possible. Table 4.3-201 describes the Unit 3 plant structures and acreages to be cleared or otherwise disturbed during the new construction. Unit 3 structures and construction laydown areas, as well as the construction disturbance areas proposed in the ESP, are illustrated in Figure 2.1-201.

On-site excavations, grading and dredging activities create construction spoils and borrows. However, it is expected that the grade elevations in the parking, laydown, and batch plant areas can be adjusted to balance the cut and fill volumes as much as possible, resulting in a net excess cut volume of approximately 1.61 million cubic yards. Excess material is anticipated to be disposed in an upland location to the south of the plant area in accordance with appropriate soil management and stormwater control practices. The disposal areas are situated such that they drain into existing site drainage features. Therefore, the land use impact is anticipated to be SMALL due to a small net excess of spoils materials and proper upland disposal.

No rail service is required for the construction of the ESBWR unit at the GGNS site, and no restoration of rail service to the site is currently planned. Consequently, no land use impacts to the site and vicinity are anticipated due to construction or restoration of rail service.

4.1.2 TRANSMISSION CORRIDORS AND OFF-SITE AREAS

The transmission corridor right-of-way (ROW) is described in detail in Section 3.7 and Subsection 2.2.2. The matter of transmission corridor upgrades was an unresolved issue at the time of the ESP. Calculated acreages of land use categories located within the transmission ROW are reported in Section 2.2. NUREG-1817 Subsection 4.1.2 states, “Land use impacts could be MODERATE if the preferred routing of any new transmission lines would convert significant tracts of previously undeveloped land not adjacent to the existing rights-of-way.” The impacts of construction of transmission corridors are anticipated to be MODERATE due to the placement of the corridors through previously undisturbed land. Land use impacts are expected to be mitigated by using best management and standard industry practices, and following applicable laws and regulations pertaining to ground-disturbing activities, such as forest and wetlands protection and stormwater controls. Based on the evaluation described in Section 2.2, the proposed transmission line ROW is expected to have no impact on urban areas, state parks, or federally-designated wetland areas. Except for the Natchez Trace Parkway, administered by the U.S. National Park Service, no federal lands fall within the corridor ROW.

4.1.3 HISTORIC PROPERTIES

Section 4.6 of NUREG-1817 resolved the impacts of plant construction on historic properties as SMALL, provided that the Applicant develops procedures that include immediate stop work orders for inadvertent discovery of cultural resources during construction activities, and that the Applicant conducts cultural resource surveys in areas recommended by the Mississippi Department of Archives and History (MDAH) prior to construction. Procedures for inadvertent discovery have been developed and are included in the site-wide Excavation and Backfill Work Procedures. These procedures apply to on-site activities.

In addition, a Phase I Cultural Resource Survey was performed for areas recommended by the MDAH, as described in Section 2.5. Based on the results of this survey, a site considered to be potentially eligible for the National Register of Historic Places (NRHP) was identified in the South Woods area as described in Section 2.4.1.1, which is not planned for construction. The potentially eligible site will be avoided according to an appropriate avoidance plan developed by the Applicant and approved by the MDAH. Therefore, no historic properties are affected by the proposed on-site construction activities, and the impacts of plant construction remain SMALL as stated in NUREG-1817.

As described in Section 2.2, consultation letters have been submitted to the MDAH and area tribal representatives concerning the proposed transmission line ROW. Any concerns identified as a result of these consultations will be considered in the final ROW siting process, and additional consultations are anticipated to be performed as required so as to minimize or avoid off-site transmission line impacts to historic properties. This approach regarding identifying and properly minimizing or avoiding impacts to possible historic properties that might be associated with the proposed off-site transmission line ROW is consistent with the Staff's evaluation as discussed in NUREG-1817 Section 4.6.

Based on these efforts to minimize or avoid off-site transmission line impacts to historic properties, construction impacts to off-site historic properties are expected to be SMALL.

4.1.4 REFERENCES

None.

4.2 WATER-RELATED IMPACTS

The information for this section is provided in the ESP Application Part 3 – Environmental Report Section 4.2, and associated impacts are not fully resolved in NUREG-1817. The following corrections and supplements are provided.

NUREG-1817 Section 4.3 identified required permits, certificates, and determinations that regulate water use and water quality. Additional consultations and interface with appropriate agencies in preparation for this COL stage report are discussed in the following subsections, where applicable.

4.2.1 HYDROLOGIC ALTERATIONS

The NRC staff concluded in NUREG-1817 Subsection 4.3.1 that the impact of hydrological alterations from construction is SMALL, and additional mitigation measures are not warranted.

Unit 3 is planned for construction due west of, and adjacent to, the operating Unit 1 and abandoned Unit 2 (see Figure 2.1-201). A description of the Unit 3 location and construction site, on-site and off-site transmission corridors, and surrounding region is presented in Section 2.2. The discussion of land use impacts from construction is presented in Section 4.1.

As discussed in Section 3.7, Unit 3 design uses new and existing transmission line ROW to tie the plant to the regional electric grid. The proposed Unit 3, and new ROW construction activities and their potential impacts on hydrological alterations, are discussed below.

4.2.1.1 Site Preparation and Station Construction

The planned locations of the Unit 3 cooling towers and other support facilities, such as laydown areas, utilized during plant construction shown in Figure 2.1-201 are different from the locations discussed at the ESP stage. However, the location for construction of the cooling towers and construction laydown areas remains within the ESP evaluated construction areas, and does not substantially alter hydrologic features at the site in terms of area drainage or stormwater runoff. That is, drainage continues to be directed to Stream A and Stream B. Although increased intensity of stormwater discharges may occur during construction due to increased impervious surface areas or decreased vegetative cover, standard engineering stormwater management practices pursuant to the site's NPDES stormwater management program would adequately mitigate any potential adverse impact, and would be in concurrence with the conclusions of NUREG-1817, Subsection 4.3.1. Therefore, the anticipated impact of hydrologic alterations due to relocation of facilities on-site is SMALL, and does not warrant further mitigation measures.

4.2.1.2 Transmission Facilities

The ESP Application states that no new transmission line ROWs are planned for a new facility on the GGNS ESP site. However, Unit 3 design now requires construction of new on-site and off-site transmission line ROW and distribution facilities. Transmission systems are described in Section 3.7. A review of the plans for the new on-site construction of generator leads and line support towers reveals that the drainage continues to be directed to Stream A and Stream B, and any potential new hydrologic alterations are similar in scope and impact to those already evaluated at the ESP stage.

4.2.1.3 Off-Site Construction

The ESP ER Subsection 4.2.1.3 addressed off-site construction of roads and bridges associated with Unit 3 station construction. No new road construction which could cause hydrologic alterations was considered necessary. The ESP Application does not discuss potential impacts to floodplains or wetlands that might occur due to new off-site transmission line ROWs. Section 4.3 of this report addresses these impacts. Hydrological alterations would be minimized by routing selection and engineering design to avoid construction in streams or wetlands, and the construction would avoid alteration of general drainage characteristics where possible. Figure 2.2-201 shows existing and proposed new transmission corridor ROW locations. Increase in runoff intensity resulting from any temporary foliage removal or clearing and grading associated with these new off-site transmission line ROWs would be mitigated using standard engineering stormwater management practices. No hydrologic alterations are anticipated due to new off-site transmission line ROW construction.

A construction stormwater permit would be required for construction along the ROW for the new off-site transmission lines. Construction would be managed in accordance with the stormwater management program and engineering BMPs established for that portion of the project. A Clean Water Act Section 404 permit would be required from the U.S. Army Corps of Engineers (USACE), supported by a Mississippi Department of Environmental Quality (MDEQ) Section 401 Water Quality Certification, prior to construction within any jurisdictional floodplain and wetland areas, and would regulate and specify avoidance, minimization and mitigation of the impacts of any construction activities along the route of the transmission line ROW.

Policy procedures manage acquisition, ROW and facility siting, vegetative management practices, and land disturbance. These procedures include requirements for written planning documents and work permits whenever earthwork or land disturbance is anticipated, spanning of “navigable” waters of the U.S. is required, or when any work that is involved within the 100-year floodplain or near wetlands is planned. Established environmental protection engineering and environmental protection practices would be used to mitigate any potential adverse impacts due to transmission line construction. Therefore, the off-site hydrological alteration impacts due to construction of new off-site transmission and distribution facilities would be SMALL.

4.2.2 WATER-USE IMPACTS

The NRC concluded in NUREG-1817, Subsection 4.3.2 that the characterization of the Catahoula aquifer was inadequate at the ESP stage review to determine the impact of groundwater utilization. Because of the limited number of borings into the Catahoula Formation, limited hydraulic conductivity measurements, and limited long-term pump tests at the time of the ESP, the staff was unable to assess reliably the impact of a significant increase in the groundwater withdrawal at the site. Given the information provided in the ESP Application, the NRC concluded the impacts on the Catahoula Formation, could be SMALL if the proposed withdrawal had little effect on the Catahoula Formation, or MODERATE if the proposed withdrawal were to adversely affect current water withdrawals elsewhere in the aquifer.

Consequently, the construction impacts on water use were not resolved at ESP. The following supplemental information is provided to address this issue.

4.2.2.1 Surface Water

The use of surface water is not expected for construction of the Unit 3, as noted in NUREG-1817, Subsection 4.3.2.

4.2.2.2 Groundwater

The ESP ER Subsection 4.2.2.2 states the construction of Unit 3 would use additional wells installed in the Catahoula Formation. The ESP Application also states that the water wells supporting current Unit 1 operations are completed in the Catahoula Formation. The NRC concluded in NUREG-1817, Subsection 4.3.2 that there was not enough information provided by the ESP Application to support a conclusion that impact on the Catahoula Formation is insignificant, particularly given the significance of the aquifer for local domestic water supplies and its designation by EPA as a sole-source aquifer.

As part of the COL application site characterization, a review of existing information, site geology, and groundwater was performed from February 2006 through July 2007 during the site hydrogeologic investigations. These investigations were undertaken to evaluate site conditions in terms of adherence to ESBWR design characteristics.

As discussed in Subsection 2.3.1, an extensive database of groundwater characterization information supports the evaluation of impacts for this COL application. Significant investigations were completed to support the Unit 1 construction permit and operating license. Also, in ESP ER Subsection 2.3.1, additional characterization of vicinity and regional geologic, hydrologic, hydrogeologic, and water quality information was developed for the ESP. As discussed here, this information was reviewed and expanded upon during the COL site characterization investigations.

As discussed in Section 2.3, a refined site conceptual model revealed that the existing water wells providing potable water for Unit 1 operations are actually completed in the Pleistocene sand and gravel deposits of the Upland Complex, and not the underlying Miocene Catahoula Formation. Well installation records for the existing water wells indicate they are screened in sand and gravel above the Catahoula. (This is a correction to the ESP ER.) The Upland Complex consists of loess overlying deposits similar to the Mississippi River Alluvium – lenticular deposits of sand, gravel, silt, and clay. The characteristics of the Upland Complex and the Mississippi River Alluvium are described in the ESP application and NUREG-1817. Additional aquifer characteristics and monitoring data are provided in Section 2.3.

Groundwater utilization during Unit 3 construction would be limited to:

- Construction dewatering from the Upland Complex for the Unit 3 powerblock excavation, and during excavations for installation of the surface water intake and discharge pipelines.

- Withdrawal of groundwater from the Upland Complex for Unit 3 concrete batch plant operations, and to supply potable and sanitary water for the workers associated with construction of Unit 3 facilities.
- Continued withdrawal of groundwater from the Upland Complex for Unit 1 potable water, fire protection, sanitary water, and maintenance needs.
- Continued radial well (Ranney well) withdrawal of groundwater from the Mississippi River/Alluvium for Unit 1 cooling water makeup and service water.

Water resource utilization anticipated during construction is presented in Table 4.2-201. The bounding water use estimates for the ESP application plant parameter envelope (PPE) are provided in Table 4.2-201 for comparison with COL application construction use estimates anticipated during construction of Unit 3.

Water use is discussed in NUREG-1817, Subsection 2.6.2. Unit 1 currently pumps existing site water wells intermittently to fill various storage tanks on-site. The two primary existing wells are shown as “North Water Well” and “South Water Well” on Figure 2.3-201. During construction of Unit 3, potable water for Unit 1 operations will continue to be obtained from these existing wells along the bluff east of the Mississippi River floodplain. The existing potable water wells alone, in their current locations, are insufficient to simultaneously meet Unit 3 construction needs and Unit 1 operational needs during refueling outages (see Subsection 2.3.2.2). Installation of two or more new water wells is anticipated in the same area along the bluff area between Stream A and Stream B, or in the Mississippi River Alluvium, as described below.

The cooling water intake system for Unit 1 withdraws groundwater from radial (Ranney) collector wells located beneath, adjacent to, and hydraulically connected to the Mississippi River.

Additional groundwater wells are required for Unit 3 construction activities, such as concrete batch plant operation, dust suppression, potable water, and sanitary needs. Average construction water use estimates for Unit 3 are shown in Table 4.2-201. Construction activities (concrete batch plant operation, dust suppression, potable water, and sanitary water supply) for the Unit 3 facilities are expected to require water amounts between approximately 129,600 gpd and 162,000 gpd, or between approximately 90 gpm and 115 gpm.

Water for construction of Unit 3 is expected to be provided by the withdrawal of groundwater from wells installed in the Upland Complex aquifer or the Mississippi River Alluvium, both of which overly the Catahoula Formation (see FSAR Figures 2.5.4-217 and 2.5.4-218). It is anticipated that two or more new wells may be required to provide water for the concrete batch plant operation, dust suppression, and potable water supply for construction site workers. Installation of the new wells is anticipated in the Upland Complex in the locality of the existing three wells along the bluff area, but the wells may be sited within the Mississippi River Alluvium west of the bluff if adequate aquifer thickness is not available in the Upland Complex. Plant construction plans do not require groundwater withdrawal from the Catahoula Formation.

As discussed below, off-site impacts to groundwater users are not anticipated.However, the following potential impacts to groundwater use have been evaluated and are discussed in more detail below:

- The radius of influence (ROI) surrounding each potential groundwater withdrawal (i.e., existing Unit 1 potable wells along the bluff, new potable water wells, and excavation dewatering) has been evaluated considering potential overlapping drawdown effects.
- Upland Complex aquifer drawdown has been evaluated for dewatering impacts during construction that may reduce the groundwater available for the Unit 1 potable water wells needed for continued Unit 1 operations during Unit 3 construction.
- Unit 3 construction requires additional potable water capacity beyond that of the existing Unit 1 potable water wells. Upland Complex aquifer drawdown from dewatering during construction has been evaluated for potential impacts on the placement of new wells in the Upland Complex for construction water supplies.
- New wells installed in the Upland Complex to provide Unit 3 potable/sanitary water, concrete batch plant and dust suppression water, and miscellaneous water needs may reduce the water available for the existing Unit 1 water wells, if installed close enough to cause an overlapping drawdown. Conversely, Unit 1 well drawdown of the Upland Complex aquifer may restrict siting of new water wells to support Unit 3 construction.
- Relocation of potable water wells west of the bluffs in the Mississippi River Alluvium aquifer has been evaluated for impacts.
- The combined drawdown of the Upland Complex has been evaluated for impact to off-site uses, or to the underlying Catahoula Formation.

Dewatering Impacts

NUREG-1817, Subsection 4.3.2 concludes that construction dewatering impacts would be SMALL, temporary, and localized. Historic information on dewatering revealed that dewatering for construction of Unit 1 did not impact the regional water table (Reference 201). An evaluation of dewatering for Unit 3 is provided in FSAR Subsection 2.5.4.

Construction dewatering is anticipated to pump about 420 gpm (most likely estimate) during excavations to construct Unit 3, based on most likely estimates of horizontal hydraulic conductivity for the Upland Complex. Dewatering is anticipated to extend over a period lasting up to about two years. Dewatering is necessary to achieve approximately 15 – 20 ft. of drawdown in the Upland Complex water table in the area of the excavation. The ROI in the Upland Complex water table surrounding the excavation is estimated to extend to approximately 600 ft. from the excavation, with a predicted drawdown of essentially zero (about 1 in.) at that distance. Construction dewatering has the potential to reduce the available groundwater yield of the existing three Unit 1 potable water wells. The overlapping drawdown due to additional wells installed along the bluff combined with the dewatering drawdown in the Upland Complex is expected to have the potential to further reduce available potable water supply for Unit 1.

Based upon the estimated drawdown due to construction dewatering, Unit 1 can continue to use its existing wells, although maximum potential yield will be reduced. During Unit 1 outages that coincide with the Unit 3 dewatering, additional potable water supply may be required. This water will be provided either from the additional wells along the area of the bluff west of the Unit 3 construction, or from the Mississippi River Alluvium.

Potential Impacts from Groundwater Well Withdrawal

It is anticipated that additional potable water will be needed during construction of Unit 3. The preferred siting of new groundwater wells is along the bluff between the planned concrete batch plant and the existing ESC building. Withdrawal in this location has been evaluated for potential adverse impact to the existing Unit 1 wells. The evaluation developed estimates of the potential ROI and drawdown cones of depression for new and existing wells to determine Upland Complex aquifer groundwater availability and impacts. Overlapping ROI of a well with the ROI of other wells is considered acceptable if the combined drawdown does not exceed desired yield for total needs. Table 4.2-202 provides a summary of the ROI calculated for a defined pumping rate of up to 200 gpm at a well pumping in the Upland Complex. A transmissivity of 12,300 ft^2/day has been used based on a pump test completed during the COL investigations in the sand and gravel unit at the base of the Upland Complex, as described in Section 2.3.

Based on the results of a well siting study, placement of one or two new groundwater supply wells along the bluff area pumping from the Upland Complex aquifer is feasible. Excavation dewatering for Unit 3 construction is expected to cause a drawdown that may overlap the Unit 1 water wells, but not so much as to preclude their continued use. Dewatering will also reduce the yield of any new wells installed along the bluff area. The actual drawdown during dewatering will be monitored. Monitoring of drawdown during construction is described in Section 6.3.

Based on estimates of needed pumping rates and ROI surrounding on-site wells, the only potential impact to identified groundwater users during construction activities is to Unit 1 potable water wells. The ROI due to groundwater withdrawals does not extend beyond the GGNS property boundaries.

The Upland Complex shows indications of braided-stream channel deposition, resulting in varying thicknesses of sand and gravel deposits. There is a potential that adequate well spacing cannot be achieved for all the required water wells needed during construction due to this depositional heterogeneity. Therefore, actual well installation and placement is dependent upon confirmation that the thickness and aquifer characteristics of the Upland Complex at the sites selected for the new water well installation are appropriate to supply adequate volumes of water for construction.

If necessary, wells for Unit 3 construction can be placed in the Mississippi River Alluvium aquifer. If necessary, potable water may be withdrawn from the Upland Complex, and water for the concrete batch plant and dust suppression can be pumped from the Mississippi River Alluvium aquifer. Evaluation of potential impacts of groundwater withdrawal from the alluvium west of the bluffs at the GGNS site has been completed at an assumed pumping rate of 200 gpm, and using an average transmissivity of 12,300 ft^2/day.

The potential availability of groundwater in the Mississippi River Alluvium aquifer is less likely to be affected by construction dewatering. Because the radius of drawdown does not extend beyond the GGNS property boundaries, there are no nearby withdrawals of groundwater from the Mississippi River Alluvium aquifer, and flow of groundwater in the alluvium is toward the river, no impact to off-site users is anticipated. Table 4.2-202 provides support for this determination. Based on evaluations of groundwater availability in the Mississippi River Alluvium aquifer, relocation of some or all of the potable water supply wells to the Mississippi River Alluvium is feasible; although, water quality may not be as good due to bacteria, low dissolved oxygen, and increased dissolved solids. If used for potable water, additional treatment may be required for water pumped from the Mississippi River Alluvium aquifer.

Conclusions Related to Potential Groundwater Withdrawal Impacts

Water rights and allocations of groundwater are regulated by the Mississippi Department of Environmental Quality (MDEQ) Regulation LW-2 (Reference 202). Because potable and sanitary water for station construction and operations is provided by groundwater resources, the demand, supply, and impact of additional groundwater withdrawal has been evaluated. The impacts of construction dewatering have also been evaluated to consider the potential impact on both the existing water supply wells, and those proposed for Unit 3 construction. The results of that evaluation indicate that it is feasible to obtain satisfactory quantities of groundwater for Unit 3 construction without adversely affecting Unit 1 station operations, and therefore the impact to Unit 1 operations is expected to be SMALL.

The existing Unit 1 groundwater withdrawals are regulated by a groundwater allocation permit program by the MDEQ. These permits are MS-GW 14989 and 15026. The Unit 1 MDEQ permits were granted considering their identified potential impact on other uses in the area, and considering those withdrawals in the recharge area of the underlying Catahoula Formation. The ESP ER states the existing wells are completed in the Catahoula Formation. This conclusion was based on a review of the MDEQ permits at the time of the ESP Application. As discussed above, a refined site conceptual model revealed that the existing water wells providing potable water for Unit 1 operations are actually completed in the Upland Complex, and not the underlying Catahoula Formation. As stated in Subsection 2.3.3.2, the MDEQ has recognized and concurs that the Unit 1 potable water wells are not screened in the Catahoula Formation. The existing wells are considered to have SMALL or negligible impact on the Catahoula Formation.

MDEQ has been contacted regarding the anticipated withdrawals for Unit 3 construction, and those anticipated for combined Unit 3 and Unit 1 operations. Groundwater withdrawal at the site is in accordance with applicable MDEQ groundwater use and protection regulations (see Reference 202 and 203). Necessary permits will be obtained from MDEQ prior to installation of groundwater withdrawal wells.

Construction activities resulting in utilization of water include potable water supply, water for the concrete batch plant operations, dust suppression, and sanitary water needs. The potential impact to water use is limited to on-site withdrawals, as the ROI surrounding all withdrawals during construction is not expected to extend beyond the GGNS site property boundaries. Additional pump tests were performed during the COL investigations to develop additional information on Upland Complex aquifer thicknesses and aquifer characteristics such as flow, transmissivity, hydraulic conductivity, potential yield, and drawdown resulting from withdrawals.

Based on available information, the installation of additional wells installed in the Upland Complex aquifer is not anticipated to adversely impact off-site users. Because of the impermeable nature of the Catahoula Formation underlying the Upland Complex, no significant impacts are expected to the Catahoula Formation as a result of additional withdrawals from the Upland Complex. Therefore, the impact on the Catahoula Formation is SMALL. Mitigation measures are not necessary.

Water-Use and Potentially Affected Federal Projects

The Applicant is participating in a Department of Energy (DOE) government/industry cost-shared project and is receiving funds in support of this COL application process. As a project that is receiving federal financial assistance and that has the potential to contaminate a designated sole source aquifer, GGNS is subject to review by the Environmental Protection Agency (EPA).

The U.S. Department of Agriculture (USDA) Rural Development Office (Mississippi Office) initially screens such projects before referring them to the EPA Sole Source Aquifer Program. Consultation with the USDA was completed during COL application development. Based on anticipated consultation responses with the USDA and EPA, the dewatering and other groundwater withdrawals are expected to have a SMALL impact on the Catahoula. During construction of the new facility, appropriate measures applicable under the Clean Water Act (such as Spill Protection, Control, and Countermeasures (SPCC) Plan implementation) are expected to be taken to prevent the introduction of contaminants into the Catahoula Formation and the Southern Hills Regional Sole Source Aquifer.

No other federal projects have been identified that have an impact, from a water-use standpoint, on the construction of Unit 3 or overall operations of GGNS. The construction of Unit 3 is not expected to have an impact on any federal projects.

4.2.2.3 Aquatic Biota and Wetlands

Groundwater use in the Mississippi River Alluvium aquifer is not expected to have an adverse impact on aquatic or terrestrial ecological communities. Section 4.3 provides information relating to ecological effects associated with construction of the new facility.

4.2.2.4 Water-Use Impact Conclusion

The area of impact due to Unit 3 construction water use is limited to the site property and is not expected to affect off-site water use or water users. All of the potential water use impacts in floodplain and wetlands areas are anticipated to be managed as described in Subsections 4.2.1 and 4.2.2 above, and impacts are expected to be SMALL.

Based upon estimated drawdown due to Unit 3 construction dewatering, Unit 1 would be able to continue use of existing potable water wells during Unit 3 dewatering. Groundwater used for construction purposes will be withdrawn from the Upland Complex or the Mississippi River Alluvium aquifer and not the Catahoula Formation. Groundwater withdrawals for Unit 3 construction would have SMALL impact on Unit 1 potable water wells. Based on the above, the potential impact of Unit 3 construction activities on water use and users is SMALL, and additional mitigation measures are not warranted.

4.2.2.5 Potential Water Use Impacts on Water Quality

Potential Water Quality Impacts from Groundwater Withdrawal

In NUREG-1817, Section 4.3, the NRC determined that some of the construction activities at the GGNS site were not known at the ESP stage, so the staff's analysis was not performed to the depth warranted for actual construction. Based on the information provided at the ESP stage, the NRC stated in NUREG-1817, Subsection 4.3.3 that the impacts on the Catahoula Formation could be SMALL if the proposed withdrawal had little effect on the Catahoula Formation, or LARGE if the proposed withdrawals were to induce degradation of the water quality of the sole source aquifer. NUREG-1817 Subsection 4.3.3 included a need for the Applicant to provide additional information on the ability of the Catahoula aquifer to sustain proposed withdrawals in order for the staff to make a significance determination with respect to this resource.

Potential Groundwater Utilization

As stated in previous sections, utilization of groundwater is anticipated for construction of Unit 3, along with the continued utilization of groundwater to support Unit 1 operations. The withdrawal of groundwater from the Catahoula Formation is not anticipated for construction of Unit 3, as discussed in Subsection 4.2.2. Construction utilization of groundwater resources at GGNS is from the Upland Complex aquifer and/or from the Mississippi River Alluvium aquifer, both of which overly the Catahoula Formation. As discussed in the following paragraphs, withdrawal of groundwater from these overlying aquifers is not expected to have any significant effect on the Catahoula Formation, and therefore has a negligible or SMALL water quality impact on that sole source aquifer.

4.2.2.6 Potential Catahoula Formation Water Quality Impacts

As described in Subsection 4.2.2.2 above, the potential impacts of groundwater utilization are limited to the GGNS site. Those potential impacts are limited to the Upland Complex aquifer, and/or the Mississippi River Alluvium aquifer. Neither existing or future groundwater withdraws are from the regional sole source Catahoula Formation. None of the existing utilization of groundwater, or those anticipated for Unit 3 construction, withdraw groundwater directly from the regional sole source Catahoula Formation.

Based on the data developed during COL site characterization investigations, the Catahoula Formation underlying the Upland Complex aquifer shows characteristics of being semi-confined in its upper zones beneath the powerblock area for Unit 3, and locally hydraulically separated from the overlying Upland Complex aquifer (see Section 2.3). This determination is based on the results of water level monitoring of wells completed in both formations that show different hydraulic potentiometric elevations in each formation. Pump test results in both the Upland Complex and the upper Catahoula Formation support a conclusion of limited communication between the Upland Complex and the Catahoula Formation.

As discussed in the ESP ER Section 2.3, the primary recharge of the Catahoula Formation lies north of GGNS in Warren and Hinds Counties, although some limited recharge may occur near the site. The investigations of groundwater occurrence and characteristics of water bearing units beneath GGNS indicate limited recharge occurs directly at the site, and thus groundwater withdrawal for station construction is not expected to impact the Catahoula Formation.

Therefore, the potential impact of Unit 3 construction activities on Catahoula Formation water quality is SMALL, and mitigation measures are not warranted.

4.2.2.7 Potential Upland Complex Water Quality Impacts

As stated in Subsection 4.2.2.2 above, the greatest potential impact to water use in the Upland Complex aquifer is due to continued use by Unit 1 operations, and the construction of Unit 3 facilities. These impacts are limited to GGNS site users. Groundwater withdrawal for all proposed uses at GGNS is from the Upland Complex or Mississippi River Alluvium. These uses include Unit 1 potable water, fire protection, and maintenance consumption; Unit 3 powerblock area dewatering during construction; and Unit 3 construction batch plant and potable water use. Baseline pre-GGNS water quality conditions were developed for the license application for Unit 1 and presented in the ESP ER Section 2.3. Additional water quality monitoring has been performed since the commercial startup of Unit 1, including samples collected from the existing Unit 1 potable water wells. Water quality information is provided in the ESP ER Section 2.3, and is further discussed in Section 2.3 of this report.

Unit 1 potable water wells, the planned withdrawals for Unit 3 construction water supply, and powerblock excavation dewatering are located downgradient of Unit 1. There are no known impacts to groundwater quality that affect on-site use. Unit 1 monitoring programs are in place and provide a water quality baseline for Unit 3 pre-construction and pre-operation impacts. Section 6.3 provides the description of the pre-construction, construction, and post-construction monitoring, and operational hydrological monitoring programs.

Based on the above information, the potential impact of Unit 3 construction activities on Upland Complex water quality is SMALL, and additional mitigation measures are not warranted.

4.2.2.8 Potential Impact to Mississippi River Alluvium Aquifer Water Quality

Water quality of the Mississippi River and the Mississippi River Alluvium aquifer was discussed in ESP ER Section 2.3. The Unit 1 radial well system withdraws groundwater that is in direct hydraulic communication with the Mississippi River. Potential utilization of groundwater in the Mississippi River Alluvium is limited to that which may be withdrawn for Unit 3 concrete batch plant operations, dust control, and potable/sanitary water, and temporary dewatering of pipeline trenching excavation for construction of the Unit 3 cooling water intake pipeline and discharge pipeline. Groundwater withdrawal from the alluvium would have negligible impact on alluvium water quality.

Based on the above information, the potential impact of Unit 3 construction activities on the Mississippi River Alluvium aquifer is SMALL, and additional mitigation measures are not warranted.

4.2.2.9 Potential Impact to Surface Water Quality

Limited and temporary surface water quality impacts may occur due to erosion and sediment from runoff during construction activities associated with new transmission line ROWs. Potential surface water quality impacts resulting from construction activities associated with construction of Unit 3 facilities not addressed in the ESP Application are identified in Subsection 4.2.1. All effluents generated during construction of Unit 3 will be managed and discharged in accordance with the provisions of the COL, and applicable state and federal discharge limitations as set by MDEQ and EPA, and in accordance with the USACE Clean Water Act Section 404 permit program. Potential impacts to surface water quality resulting from construction are also discussed in the GGNS ESP ER Section 4.2. The NRC concluded in NUREG-1817, Section 4.3 that the impacts to water quality in surface waters due to Unit 3 construction would be SMALL.

The licensee is anticipated to obtain permits for construction activities, including the following:

- NPDES Permit for stormwater discharges related to construction activities. Construction activities directly related to this type of permitting include construction of the new plant structures, construction of on-site and off-site transmission lines, construction of the makeup water and discharge pipelines, construction of the new embayment and intake structure, and construction of the new discharge structure.

- U.S. Army Corps of Engineers Section 404 Permit for construction in wetland areas. Construction activities directly related to this type of permitting include land clearing and leveling, trenching, and placement of fill material.

- MDEQ 401 water quality certification for construction in wetland areas, and for any other construction that may cause a discharge into waters of the U.S. This state certification is required for any such activity that requires a federal license or permit. The certification program requires compliance with all state water quality standards during construction and operation of the federally-permitted activity. Conditions of the certification become enforceable conditions of the correlative federal permit.

4.2.3 REFERENCES

201 GGNS Unit 1 Updated Final Safety Analysis Report, June 2007.

202 Mississippi Commission on Environmental Quality, Regulation LW-2, Surface Water and Groundwater Use and Protection, amended January, 2006, Website, <http://www.deq.state.ms.us/MDEQ.nsf/pdf/Main_LW_2/$File/LW-2%20%20FINAL%20REGULATION%20%20MDEQ.pdf?OpenElement>, accessed October 3, 2007.

203 Mississippi Commission on Environmental Quality, Regulation WPC-2, Water Quality Criteria for Intrastate, Interstate and Coastal Waters, June 2003, Website, <http://www.deq.state.ms.us/newweb/MDEQRegulations.nsf/RN/WPC-2>, accessed October 3, 2007.

TABLE 4.2-201
WATER UTILIZATION DURING CONSTRUCTION

	Construction Water Source							
	ESP Stage Estimates[1]				COL Stage Estimates[2]			
Construction Activity	Mississippi River/ Alluvium Groundwater Use	Surface Water Use	Groundwater Use – Catahoula Formation	Groundwater Use – Upland Complex	Mississippi River/ Alluvium Groundwater Use	Surface Water Use	Groundwater Use – Catahoula Formation	Groundwater Use – Upland Complex (Average)
Concrete Batch Plant Operations, Dust Suppression, Testing	None	None	350 gpm	None	May be Option	None	None	56 gpm[3]
Potable/Sanitary Use	None	None	7 gpm	None	May be Option	None	None	35 gpm[3,4]
Power Block Construction Dewatering	None. Only the Upland Complex will require dewatering.	None. No surface water overlies dewatering area.	None. Excavation will not extend to depth of the Catahoula.	Estimated Similar to Unit 1	None. Only the Upland Complex will require dewatering.	None. No surface water overlies dewatering area.	None	420 gpm
Unit 1 Cooling Water Utilization	21,332 gpm	None	None. Unit 1 does not withdraw water from the Catahoula.	None. Unit 1 withdraws water from Ranney wells in Mississippi River Alluvium.	21,332 gpm	None	None	None. Unit 1 withdraws water from Ranney wells in Mississippi River Alluvium.
Unit 1 Potable/Sanitary Water	None	None	122 gpm	None	May be Option	None	None	122 gpm

1. SERI ESP Application, SSAR Section 2.4.12, ESP ER Section 4.2; SSAR Table 1.3-1 (above quantities do not include demineralization & fire protection water)
2. All utilization rates are average
3. Based on estimates for 50 weeks per year, 5 days per week, 24-hour days. Maximum water use is assumed to be approximately 125% of average use.
4. See also Table 2.3-204.

TABLE 4.2-202
ESTIMATED WITHDRAWAL IMPACT

	Potential Impacts To On-site Use			Potential Impacts if Potable Water Wells Relocated to Mississippi River Alluvium		
Groundwater Withdrawals During Construction	Formation of Use	Anticipated Drawdown	Potential Radius of Influence	Formation of Use	Anticipated Drawdown	Potential Radius of Influence
Concrete Batch Plant Use[1]	Upland Complex	3 ft.	200 ft.	Mississippi River Alluvium	3 ft.	200 ft.
Potable/Sanitary and Miscellaneous Use[1]	Upland Complex	3 ft.	200 ft.	Mississippi River Alluvium	3 ft.	200 ft.
Dewatering[2]	Upland Complex	15–20 ft.	600 ft.	Upland Complex	NA[3]	NA
Unit 1 Potable/Sanitary/Fire Protection Use	Upland Complex	Unknown[4]	<200 ft.	Relocated to Mississippi River Alluvium	2 ft.	200 ft.
Unit 1 Cooling/Service Water Use	Mississippi River Alluvium	NR	NR	Mississippi River Alluvium	NR	NR

NOTES:

1. Assumes maximum pumping rate of 200 gpm (see Subsection 2.3.2.2)
2. Assumes dewatering rate of 420 gpm
3. If potable water wells are moved to the Mississippi River Alluvium, dewatering in the Upland Complex on the bluffs will have no impacts on the potable water wells.
4. While some information is available for Unit 1 potable water wells, specific data related to drawdown is currently unavailable.

NR – Not relevant to evaluation, since radial wells are in direct communication with river.

4.3 ECOLOGICAL IMPACTS

The information for this section is provided in the ESP Application Part 3 – Environmental Report, Section 4.3, and associated impacts are not fully resolved in NUREG-1817; the following supplemental information is provided.

4.3.1 TERRESTRIAL ECOSYSTEMS

The NRC concluded in NUREG-1817 Subsection 4.4.1.5 that impacts on terrestrial ecosystems were not resolved, and that additional information is needed describing (1) potential utilization of the site by the Louisiana black bear, (2) the extent of wetland impacts resulting from the construction of the intake structure and associated pipeline, and (3) the location and nature of environmental impacts on terrestrial ecosystems associated with the construction of Unit 3 transmission system improvements. The following subsections provide the information needed to address this unresolved issue. In addition, new information regarding temporary and permanent facility layouts which have changed since ESP are presented and impacts evaluated.

4.3.1.1 Vegetation

The analysis of impacts to vegetation reported in NUREG-1817, Subsection 4.4.1.1 concludes that new construction at the GGNS site would disturb a total of about 395 acres (ac.) of the site: 340 ac. in uplands and 55 ac. in bottomlands. Additionally, NUREG-1817 states that about 125 ac. or 31 percent of the total disturbed acreage would be occupied by permanent structures and facilities 100 ac. in uplands and 25 ac. in the bottomland.

Based on analysis of the proposed Unit 3 site layout showing both temporary and permanent facilities (see Figure 2.1-201 and Table 4.3-201), the proposed site plan reduces the overall area to be disturbed by about 161 ac., or 41 percent of the original total, to a total of approximately 234 ac. This estimated disturbed area includes 217 ac. in uplands and 17 ac. in the bottomland. Of this area, permanent facilities would occupy about 132 ac.), or 56 percent of the disturbed area, also indicating a reduction in areas used only temporarily during construction.

The NRC also estimated in NUREG-1817, Subsection 4.4.1.1 that the distribution of disturbance in uplands among cover types would be 43 percent, 31 percent, and 26 percent, for upland forests, upland fields, and previously disturbed areas, respectively. Based on analysis of the proposed Unit 3 footprint, the distribution now is 30 percent, 9 percent, and 54 percent for the same cover types, respectively. This distribution substantially reduces the need to alter natural upland habitats by increasing the use, both temporarily and permanently, of previously disturbed areas.

None of the upland forest to be cleared occurs in the South Woods portion of the site (described in Subsection 2.4.1.1) where biodiversity is high. This attribute is enhanced by complex topography that consists of a series of narrow ridges with steep slopes, ravines, and bluffs as described in Subsection 2.4.1. The oak-elm-hickory stands found there, while a valuable wildlife habitat, are common in the general area.

Clearing upland forest to accommodate construction parking areas (28 ac.) and the new on-site transmission line and new switchyard (38 ac). account for 94 percent of the loss of forested cover. Most of these stands occur along the margins of areas that were previously disturbed or cleared during construction of Unit 1. This results in a relatively small loss of the total amount of high quality upland forest habitat on the site. This loss represents a negligible impact regionally, and a SMALL impact on the overall quality of upland habitat on the site.

The extent of new off-site transmission line construction is described in Section 3.7. Figure 2.2-201 is a map of the proposed ROW. Terrestrial habitats impacted by new and expanded ROW construction based on current alignments are described in Table 2.2-201. The NRC staff concluded in NUREG-1817 Subsection 4.4.1.2 that doubling the existing Baxter-Wilson and Franklin transmission corridors would result in MODERATE impacts to terrestrial habitats, and that creation of one or more new corridors could range from MODERATE to LARGE impacts. The proposed new transmission line construction includes creating a new 200-ft. corridor for the north-south portion of the line and expanding existing ROW width by 200 ft. along the east-west portion of the new line. Therefore, the NUREG-1817 conclusion of MODERATE to LARGE impacts to wildlife habitat is appropriate for the proposed new lines.

4.3.1.2 Wetlands

An unresolved item in NUREG-1817, Subsection 4.4.1.1, concerns the width and centerline location of the proposed new water intake pipeline ROW and the extent to which the ROW encroaches into wetlands in the bottomland. As shown in Table 4.3-201, recent delineation of the wetlands within the 100-ft. wide pipeline ROW and the expanded intake structure area on the bank of the river revealed that construction of these facilities is expected to impact about 17 ac. of wetland habitat. Within this area, 5 ac., or 31 percent are palustrine forested wetland, 0.6 ac., or 4 percent are palustrine shrub-scrub wetland, and 10.9 ac., or 65 percent are palustrine emergent wetland. The 17 ac. of wetlands impacts, when compared to the over 995 ac. of total wetlands within the GGNS site boundary, are considered to be SMALL. Authorization to construct within wetlands is expected to be obtained from the USACE under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act. Mitigation of permanent wetland losses is expected to be a condition of this authorization. BMPs to prevent and mitigate impacts to the aquatic ecosystem also are expected to be required by the MDEQ in that agency's water quality certification of the USACE permit.

Wetland habitats potentially affected by new transmission line construction are estimated to be 90 ac. or about 7 percent of the total ROW created as a result of Unit 3. This estimate is based on a GIS analysis of land use types within the proposed new ROW that are likely to contain wetlands as described in Section 2.2. No field delineation of wetlands in the ROW has been made as part of this estimate. Actual impacts to wetlands resulting from transmission line construction are primarily associated with the construction of tower foundations as may be required in wetland areas. Thus the impacts would be limited to the tower footprint in emergent and shrub-scrub wetlands. Construction in forested wetlands would result in complete loss of these wetland habitats due to the need to permanently clear the ROW for maintenance access. Usually the forested wetlands are converted to emergent or shrub-scrub wetlands, however these are considered inferior to forested wetlands when considering relative function and values of wetland types. USACE permits are required for any discharge of fill material in jurisdictional wetlands and appropriate mitigation is expected to be a condition of these permits, typically resulting in no net loss of wetlands. BMPs are expected to be required by the MDEQ as a condition of the water quality certification of any wetland permits issued by the USACE. Loss of wetland function and value resulting from transmission line construction is considered to be SMALL to MODERATE depending on the ultimate final routing of the line and the resulting wetland types affected.

4.3.1.3 Wildlife

An unresolved item in NUREG-1817, Subsection 4.4.3.1, concerns the potential occupation of the site by the Louisiana black bear. This item is resolved by the completion of a black bear habitat survey; the results of which are discussed in detail in Subsection 2.4.1. The survey indicates that about one-third of the 31 trees found on the site that meet the criteria of the U.S. Fish and Wildlife Service (USFWS) as “candidate trees” for potential black bear dens occur in the South Woods. Seven more and a possible ground den are located north of the heavy haul road and the new water intake pipeline corridor. One candidate tree occurs in the area of the new switchyard.

Loss of candidate trees by clearing reduces the potential carrying capacity of the site for bears. The acres of potential black bear habitat lost to temporary construction activities and permanent structures are reduced from those presented at ESP as a result of changes in proposed site layout planning. While any forested areas could be utilized, bottomlands are the most likely habitats to be occupied by the black bear. Forested upland and bottomland losses are shown in Table 4.3-201. No trees were found with enclosed cavities, claw marks, scat, or any other evidence suggesting actual use as a den tree. Accordingly, loss of these trees represents a SMALL impact on the local bear population, because there is little evidence other than the possible ground den of current use of the site by bears and no recent observations by on-site personnel or others of any bears in the project area. In NUREG-1817, Subsection 2.7.1.3, the NRC staff recommends a pre-construction monitoring program be developed in consultation with the USFWS. The appropriate consultations will be initiated and associated monitoring programs undertaken prior to beginning any construction activity in or adjacent to potential black bear habitat.

4.3.1.4 Avian Mortality

The information for this subsection is provided in the ESP Application Part 3 – Environmental Report, Subsection 4.3.1.4., and associated impacts are considered to be negligible in NUREG-1817, Subsection 4.4.1.4. No new and significant information has been identified.

4.3.1.5 Species of Special Interest

Consultation was initiated with appropriate state and federal agencies concerning the potential presence of threatened and endangered species within the proposed Unit 3 construction areas and along the proposed transmission line ROW, as summarized in Table 2.4-201. Agency response concerning the transmission line ROW is pending but not anticipated before application submittal. Based on review of the most recent threatened and endangered species listing, besides the removal of the bald eagle from the list, there is no reason to believe that there are any other changes to the threatened and endangered species listing with regards to Unit 3. Therefore, the NUREG-1817 Subsection 4.4.3.3 conclusion that the impacts of construction on federally-listed species would be SMALL remains valid. No new and significant information has been identified.

Additionally, as discussed in Subsection 2.4.1.2.1, field reconnaissance revealed no presence on site of any terrestrial plant species of special interest with the exception of two examples of the white walnut (*Juglans cinerea*), which is listed as a species of concern in Warren County. The observations were made in an unaffected area of the South Woods. Accordingly, construction of the proposed facilities would have a negligible impact on any of these species.

4.3.2 AQUATIC ECOSYSTEMS

The information for this section is provided in the ESP Application Part 3 – Environmental Report, Subsection 4.3.2, and associated impacts are resolved as SMALL in NUREG-1817, Subsection 4.4.2 based on the expectation that System Energy Resources Inc. (SERI) is expected to work with the appropriate state and federal agencies to minimize impacts from construction of the new transmission line at river and stream crossings. Figure 2.2-201 depicts the proposed route of the new 200 ft. ROW necessary to connect Unit 3 to the regional grid. Section 2.4 defines the stream crossings which are expected to take place. It is expected that the final design of the proposed new transmission lines is to span any aquatic ecosystems and that construction of towers is expected to be limited to terrestrial rather than aquatic locations. ROW clearing can occur in the area adjacent to aquatic ecosystems. Entergy Mississippi Inc. (EMI) is expected to be required by MDEQ to prepare a Storm Water Pollution Prevention Plan (SWPPP) to minimize transport of eroded materials to the aquatic environment. The SWPPP is to contain BMPs to ensure proper site conditions are maintained during the construction of the line. Should any activities take place within the boundaries of waters of the U.S., EMI is expected to obtain authorization from the USACE with water quality certification from the MDEQ prior to initiating any covered activities. Appropriate mitigating measures are expected to be taken that can minimize impacts to the aquatic ecosystems in question and these measures are expected to be conditions in any permits issued for the work activities. No new and significant information has been identified which alters the expectation that impacts to aquatic ecosystems from transmission line construction are SMALL.

4.3.3 REFERENCES

None

TABLE 4.3-201 (Sheet 1 of 2)
ACREAGE OF COVER TYPES TO BE CLEARED OR OTHERWISE DISTURBED DURING NEW CONSTRUCTION AT THE GRAND GULF NUCLEAR STATION, CLAIBORNE COUNTY, MS

Plant Feature	Estimated Size	Previously Cleared/ Developed	Upland		Bottomland (Wetlands)		
			Forest	Field	Forested	Shrub-Scrub	Emergent
Construction							
Construction Overflow Parking	36.4		18.2	18.2			
Construction Parking	29.8	19.9	9.9				
Construction Laydown	26.6	26.6					
Aggregate Stock Pile	5.1	5.1					
Office and Warehouses	3.2	3.2					
Batch Plant	1.2	1.2					
Sub-total	102.3	56.0	28.1	18.2			
Operation							
On-Site Transmission Lines	35.1	5.3	26.7	3.1			
Powerblock	29.7	29.7					
Switchyard	19.3	8.0	11.3				
Water Pipeline ROW	16.6	9.1	1.1		5.2	0.6	0.6
Cooling Towers/Clarifier	12.8	12.8					

TABLE 4.3-201 (Sheet 2 of 2)
ACREAGE OF COVER TYPES TO BE CLEARED OR OTHERWISE DISTURBED DURING NEW CONSTRUCTION AT THE GRAND GULF NUCLEAR STATION, CLAIBORNE COUNTY, MS

Plant Feature	Estimated Size	Previously Cleared/ Developed	Upland		Bottomland (Wetlands)		
			Forest	Field	Forested	Shrub-Scrub	Emergent
Water Intake/Barge Dock	12.4	2.1					10.3
Enlarge Entry	3.3	0.5	2.8				
Support Buildings	2.3	2.3					
Sub-total	131.5	69.8	41.9	3.1	5.2	0.6	10.9
Total	233.8	125.8	70.0	21.3	5.2	0.6	10.9
% of Total	100.0	53.8	29.9	9.1	2.2	0.3	4.7

4.4 SOCIOECONOMIC IMPACTS

The information for this section is provided in the ESP Application Part 3 – Environmental Report Section 4.4, and associated impacts are resolved in NUREG-1817; no supplements are provided.

4.4.1 PHYSICAL IMPACTS

NUREG-1817 Subsection 4.5.1 resolved that physical impacts from construction in the vicinity of the ESP facility would be SMALL. No new and significant information has been identified.

4.4.2 SOCIAL AND ECONOMIC IMPACTS

NUREG-1817 Subsection 4.5.3 resolved that the social and economic impacts of construction would be SMALL with a possible MODERATE beneficial impact in Warren County, Mississippi, and a LARGE beneficial impact in Claiborne County, Mississippi. No new and significant information has been identified.

4.4.3 ENVIRONMENTAL JUSTICE IMPACTS

The impacts of construction on Environmental Justice were resolved in NUREG-1817 Section 4.7 as SMALL for environmental impacts, and as LARGE beneficial to MODERATE adverse for socioeconomic impacts. No new and significant information has been identified.

4.4.4 REFERENCES

None.

4.5 RADIATION EXPOSURE TO CONSTRUCTION WORKERS

The information for this section is provided in the ESP Application Part 3 – Environmental Report, Section 4.5, and associated impacts are resolved in NUREG-1817, Section 4.9. NUREG-1817, Subsection 4.9.5 concluded that the doses to construction workers would be well within NRC exposure limits designed to protect the public health, even if workers exceed the 2080-hour per year occupancy factor, and that the impact of radiological exposures to site preparation and construction workers would be SMALL. No new and significant information has been identified.

4.5.1 REFERENCES

None.

4.6 MEASURES AND CONTROLS TO LIMIT ADVERSE IMPACTS DURING CONSTRUCTION

Table 4.6-201 lists areas of potential impact, a description of the impact itself, and proposed mitigation measures that may be necessary due to construction activities at Unit 3. The mitigation measures and controls described in Table 4.6-201 are in addition to those provided in the ESP Application Part 3 – Environmental Report and evaluated in NUREG-1817.

The measures and controls described in Table 4.6-201 are considered reasonable from a practical, engineering, and economic view. They are based on statutes and regulatory requirements, or they are accepted practices within the construction industry. Therefore, these controls and measures are not expected to present an unreasonable or undue hardship on the licensee.

4.6.1 REFERENCES

None.

TABLE 4.6-201 (Sheet 1 of 6)
MEASURES AND CONTROLS TO LIMIT ADVERSE IMPACTS DURING CONSTRUCTION

	Impact Description or Activity[1]	Specific Mitigation Measures and Controls[2,3]
4.1 Land-Use Impacts		
4.1.1 The Site and Vicinity	(1) Generation of construction spoils/ borrows. (2) Ground disturbing activities including dredging, grading and excavation at GGNS. (3) Construction of new buildings and impervious surfaces.	(1) Grade elevations in the parking, laydown, and batch plant areas can be adjusted to balance the cut and fill volume as much as possible, resulting in a net excess cut volume. (1) Excess material is anticipated to be disposed of in an upland location south of the plant in accordance with appropriate soil management and stormwater control practices.
4.1.2 Transmission Corridors and Off-site Areas	(1) Construction of transmission ROW corridor in previously undisturbed land.	(1) Use best management and standard industry practices and follow applicable laws and regulations pertaining to ground-disturbing activities, such as forest and wetlands protection and storm water controls.
4.1.3 Historic Properties	(1) Potential for impacts to historical properties during construction.	(1) A cultural resource survey was performed for areas recommended by the MDAH prior to construction. (1) Follow procedures for inadvertent discovery that have been developed and are included in the site-wide Excavation and Backfill Work Procedures for on-site construction activities. (1) Consultation with MDAH and tribal representatives concerning the proposed transmission line ROW.

TABLE 4.6-201 (Sheet 2 of 6)
MEASURES AND CONTROLS TO LIMIT ADVERSE IMPACTS DURING CONSTRUCTION

	Impact Description or Activity[1]	Specific Mitigation Measures and Controls[2,3]
4.2 Water Related Impacts		
4.2.1 Hydrologic Alterations	(1) Some clearing and grading, development of construction related facilities and new cooling towers are located outside the boundary anticipated at ESP Application. (2) Increase in runoff intensity from increase in impervious surface area and decreased vegetative cover. (3) Construction of new off-site transmission line ROW and distribution facilities through wetlands and floodplain areas.	(1-3) Acquire a new stormwater permit for construction along the ROW for the new transmission lines. (1-3) Manage construction in accordance with the stormwater management program and engineering BMPs established for that portion of the project. (1-3) Manage and discharge effluents in accordance with the provisions of the COL, and applicable state and federal discharge limitations as set by MDEQ and EPA, and in accordance with the U.S. Army Corps of Engineers Section 404 permit program. (1-3) Acquire a Clean Water Act Section 404 permit from the U.S. Army Corps of Engineers prior to construction within any floodplain and wetland areas, supported by a MDEQ Section 401 Water Quality Certification.

TABLE 4.6-201 (Sheet 3 of 6)
MEASURES AND CONTROLS TO LIMIT ADVERSE IMPACTS DURING CONSTRUCTION

	Impact Description or Activity[1]	Specific Mitigation Measures and Controls[2,3]
4.2.2 Water-Use Impacts	(1) Construction is expected to require water amounts between approximately 129,600 gpd and 162,000 gpd. (2) Pumping rates and the ROI of at least two groundwater wells may impact existing Unit 1 wells and Unit 1 operations. (3) Potential to interfere with the available groundwater yield of the existing three potable water wells. (4) Impacts from erosion and sediment from runoff from construction of new transmission line rights-of-way. (5) Construction of new transmission line ROW and distribution facilities through wetlands and floodplain areas.	(1) Withdraw water for Unit 3 station construction or operations from the Mississippi River Alluvium aquifer, if necessary. (2-3) Groundwater withdrawal at the site is in accordance with applicable standards published in the MDEQ groundwater use and protection regulations. (4-5) Manage and discharge effluents in accordance with the provisions of the COL, and applicable state and federal discharge limitations as set by MDEQ and EPA, and in accordance with the U.S. Army Corps of Engineers Section 404 permit program, supported by a MDEQ Section 401 Water Quality Certification.
4.2.2.5 Potential Water-Use Impacts on Water Quality	(1) Potential impacts to the Mississippi River Alluvium aquifer and Upland Complex aquifer. (2) Increased discharge of effluents into surface waters.	(1-2) Groundwater withdrawal at the site is in accordance with applicable standards published in the MDEQ groundwater use and protection regulations. (3) Manage and discharge effluents in accordance with the provisions of the COL, and applicable state and federal discharge limitations as set by MDEQ and EPA, and in accordance with the U.S. Army Corps of Engineers Section 404 permit program, supported by a MDEQ Section 401 Water Quality Certification.

TABLE 4.6-201 (Sheet 4 of 6)
MEASURES AND CONTROLS TO LIMIT ADVERSE IMPACTS DURING CONSTRUCTION

	Impact Description or Activity[1]	Specific Mitigation Measures and Controls[2,3]
4.3 Ecological Impacts		
4.3.1 Terrestrial Ecosystems	(1) A relatively small loss of high quality upland habitat from clearing along the on-site and off-site transmission corridor ROW. (2) Loss of "candidate trees" for potential black bear dens. (3) Permanent or temporary loss of wetland function and value.	(3) Manage construction of new transmission lines and ROWs in accordance with a Clean Water Act Section 404 permit from the U.S. Army Corps of Engineers and BMPs as required by the MDEQ.

TABLE 4.6-201 (Sheet 5 of 6)
MEASURES AND CONTROLS TO LIMIT ADVERSE IMPACTS DURING CONSTRUCTION

	Impact Description or Activity[1]	Specific Mitigation Measures and Controls[2,3]
4.3.2 Aquatic Ecosystems	Associated impacts are resolved in NUREG-1817.	EMI is expected to work with the appropriate state and federal agencies to minimize impacts from construction of the new transmission line at river and stream crossings. It is expected that the final design of the proposed new transmission lines is to span any aquatic ecosystems and that construction of towers is expected to be limited to terrestrial rather than aquatic locations. ROW clearing can occur in the area adjacent to aquatic ecosystems. EMI is expected to be required to prepare a SWPPP to minimize transport of eroded materials to the aquatic environment. The SWPPP is to contain BMPs to ensure proper site conditions are maintained during the construction of the line. Should any activities take place within the boundaries of waters of the U.S., EMI is expected to obtain authorization from the USACE with water quality certification from the MDEQ prior to initiating any covered activities.
4.4 Socioeconomic Impacts		
4.4.1 Physical Impacts	Associated impacts are resolved in NUREG-1817.	
4.4.2 Social and Economic Impacts	Associated impacts are resolved in NUREG-1817.	

TABLE 4.6-201 (Sheet 6 of 6)
MEASURES AND CONTROLS TO LIMIT ADVERSE IMPACTS DURING CONSTRUCTION

	Impact Description or Activity[1]	Specific Mitigation Measures and Controls[2,3]
4.4.3 Environmental Justice Impacts	Associated impacts are resolved in NUREG-1817.	
4.5 Radiation Exposure to Construction Workers		
4.5.1 Site Layout	Associated impacts are resolved in NUREG-1817.	
4.5.2 Radiation Sources	Associated impacts are resolved in NUREG-1817.	
4.5.3 Measured Radiation Dose Rates and Airborne Concentrations	Associated impacts are resolved in NUREG-1817.	
4.5.4 Construction Worker Dose Estimates	Associated impacts are resolved in NUREG-1817.	

NOTES:

1. Mitigation measures and controls correlate to the similarly numbered impact.
2. The mitigation measures and controls described herein are supplemental to those provided in the ESP ER.
3. No specific mitigation measures and controls beyond those identified in the ESP ER were considered necessary, except as noted in the table.

CHAPTER 5 ENVIRONMENTAL IMPACTS OF STATION OPERATION

Chapter 5 presents the potential environmental impacts of operation of the Grand Gulf Nuclear Station (GGNS), Unit 3. In accordance with 10 CFR 51, impacts are analyzed, and a single significance level of potential impact to each resource (i.e., SMALL, MODERATE, or LARGE) is assigned consistent with the criteria that the NRC established in 10 CFR 51, Appendix B, Table B-1, Footnote 3. Unless the significance level is identified as beneficial, the impact is adverse, or in the case of "small," may be negligible. The definitions of significance 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. For the purposes of assessing radiological impacts, the Commission has concluded that those impacts that do not exceed permissible levels in the Commission's regulations are considered small.
- MODERATE Environmental effects are sufficient to alter noticeably, but not to destabilize any important attribute of the resource.
- LARGE Environmental effects are clearly noticeable and are sufficient to destabilize any important attributes of the resource.

This chapter is divided into 10 sections:

- Land Use Impacts (Section 5.1).
- Water-Related Impacts (Section 5.2).
- Cooling System Impacts (Section 5.3).
- Radiological Impacts of Normal Operation (Section 5.4).
- Environmental Impacts of Waste (Section 5.5).
- Transmission System Impacts (Section 5.6).
- Uranium Fuel Cycle Impacts (Section 5.7).
- Socioeconomic Impacts (Section 5.8).
- Decommissioning (Section 5.9).
- Measures and Controls to Limit Adverse Impacts During Operation (Section 5.10).

These sections present potential ways to avoid, minimize, or mitigate adverse impacts of operation to the maximum extent practical.

5.1 LAND USE IMPACTS

The information for this section is provided in the Early Site Permit (ESP) Application Part 3 – Environmental Report (ER), Section 5.1, and associated impacts are resolved in NUREG-1817; the following supplemental information is provided.

5.1.1 SITE AND VICINITY

NUREG-1817, Subsection 5.1.1 concluded that land-use impacts in the vicinity of the ESP facility due to operations are SMALL. No new and significant information has been identified.

5.1.2 TRANSMISSION CORRIDORS AND OFF-SITE AREAS

NUREG-1817, Subsection 5.1.2 concluded that the land-use impact from the operation of transmission lines within transmission corridors on off-site and on-site areas, including right-of-way (ROW) and line maintenance, would be SMALL. No new and significant information has been identified.

5.1.3 HISTORIC PROPERTIES

NUREG-1817, Section 5.6 concluded that the impacts of operation of a new unit at GGNS on historic and cultural resources are SMALL. ER Subsection 4.1.3 describes the cultural resource surveys and mitigation procedures conducted prior to plant construction to ensure that impacts to cultural resources and historical properties are minimal. Procedures have been implemented in site-wide operational manuals for activities such as trenching, excavation and ground penetration, environmental reviews and evaluations, and cultural resources protection. These procedures detail immediate stop work orders and notification of appropriate personnel should inadvertent discovery of cultural resources take place during operational activities. No new and significant information has been identified.

5.1.4 REFERENCES

None.

5.2 WATER-RELATED IMPACTS

The information for this section is provided in the ESP Application Part 3 – Environmental Report Section 5.2, and associated impacts are not fully resolved in NUREG-1817 Section 5.3. The following corrections and supplements are provided.

5.2.1 HYDROLOGIC ALTERATIONS AND PLANT WATER SUPPLY

Surface Water

NUREG-1817 Subsection 5.3.1 states that any increase in stormwater runoff as a result of increased impervious surfaces related to the new plant can be addressed using standard engineering stormwater practices under the GGNS site's National Pollutant Discharge Elimination System (NPDES) stormwater management program.

NUREG-1817 Subsection 5.3.1 also states that, "given the small amount of water withdrawn for a new nuclear facility relative to the large flow of the Mississippi River, the intake and discharge would have minimal impact on the river's flow pattern adjacent to the shoreline." Because of the location and design of the intake structure, surface water withdrawals from the Mississippi River are not expected to cause significant hydrologic alterations. Likewise, the design and location of the concrete discharge diffuser should cause no hydrologic alterations to the Mississippi River. Therefore, the impacts related to hydrologic alterations are the same as those evaluated in NUREG-1817, and are SMALL.

Groundwater

Hydrologic alterations related to dewatering systems active during operation are resolved in NUREG-1817, Subsection 5.3.1 as SMALL. Section 2.3 discusses maximum elevations of groundwater measured in GGNS site wells. Based upon this information, operational dewatering for Unit 3 is not necessary because the highest groundwater levels are within the design limit of 2 ft. below final plant grade.

As discussed in Sections 2.3, 4.2, and Subsection 5.2.2 below, all existing potable water wells area screened in the Upland Complex. Additional potable water wells, screened in the Upland Complex, are planned for construction and operation of Unit 3. Water levels in Upland Complex sediments experience some drawdown in the vicinity of the existing potable water wells during periods when those wells are pumped. Because of the heterogeneity of the Upland Complex, there is a potential that adequate well spacing cannot be achieved for all the required wells needed. Actual well installation and placement is dependent upon confirmation of adequate aquifer thickness and flow characteristics. If the Upland Complex cannot meet the demand, additional wells may be sited in the Mississippi River Alluvium.

Based upon the above information, potential impacts due to hydrological alterations as a result of plant operations are SMALL and no further mitigation measures are warranted.

5.2.2 WATER-USE IMPACTS

The information for this section is provided in Subsection 5.2.2 of the ESP ER. The staff concluded in Subsection 5.3.2 of NUREG-1817 that water-use impacts of operation on groundwater were unresolved at ESP. The following supplemental information is provided to resolve this issue.

Operational impacts from Unit 3 on water users for both surface water and groundwater are summarized in Table 5.2-201 and discussed below. Unit 3 design water use information is shown in Table 3.0-201. Plant water use is described in further detail in Section 3.3.

Surface Water

In Subsection 5.3.2 of NUREG-1817, the NRC staff found that certain details concerning operation of a new nuclear facility at the Grand Gulf ESP Site were not known at the ESP stage. Consequently, the staff's analysis was not to the depth warranted for actual operation. The following supplemental information is provided.

Normal makeup water flow rate information has changed since the ESP. The flow rate has decreased from an average of 50,320 gpm in the ESP to approximately 29,200 gpm (see Figure 3.3-201). The magnitude of the water use impact on the Mississippi River was evaluated in NUREG-1817 Subsection 5.3.1 to be SMALL. A lower flow rate would reduce the expected impact. Therefore, the NRC conclusion of SMALL impacts in NUREG-1817 would not be expected to change.

Unit 3 uses surface water from the Mississippi River to supply all plant water requirements except for the potable and sanitary systems. As presented in Figure 3.3-201, the Unit 3 design withdraws water from the Mississippi River at a rate of about 29,200 gpm. As concluded in NUREG-1817, Subsection 5.3.2, this represents a small portion of available water in the river.

The Southeast Wood Fiber facility is the nearest user of Mississippi River water downstream from the GGNS facility. It is located at the Claiborne County Port facility, which is about 0.8 mi. downstream of the GGNS site and about 2 mi. downstream of the existing barge slip. The Port Claiborne facility uses an estimated maximum of 0.9 Mgd for industrial (non-potable water) purposes (See ESP ER Subsection 5.2.2.1). No significant effects on the Southeast Wood Fiber facility are expected as a result of operation of the new facility.

The State of Mississippi has only three public water supply systems that use surface water as a potable water source. None of these facilities are located within 50 mi. of the GGNS site. There are no systems that use the Mississippi River as a potable water supply within 100 mi. downstream of the facility (see ESP ER Subsection 5.2.2.1). Water withdrawn from the Mississippi River by the plant has a negligible impact on water availability for downstream water users.

The embayment is designed to minimize the amount and rate of sediment deposition and littoral debris carried into the embayment. The embayment position, excavated out of the eastern bank of the Mississippi River, is sufficiently set off from the river channel to pose no navigational hazard to normal river traffic. By design, the intake suction pipes are to extend horizontally from the intake structure and are to be positioned below the predicted extreme low water river level. The base of the intake screens is designed to be placed at an elevation above the dredged base of the embayment to minimize the uptake of aquatic biota and river debris. Riprap, or other appropriate means, is planned to be used to stabilize the banks of the embayment and the river shoreline around the embayment. Dredging of the embayment for maintenance of the embayment depth and configuration is expected to be necessary on a periodic basis. Spoils dredged from the embayment are to be disposed in a manner satisfactory to the U.S. Army Corps of Engineers and the Mississippi Department of Environmental Quality (MDEQ), and according to applicable permits. Potential alterations to aquatic ecosystems as a result of plant water intake and discharge systems are discussed in Section 5.3.

Based upon the above information, potential impacts to surface water as a result of Unit 3 operations water use are judged to be SMALL.

Groundwater

Effects of groundwater withdrawal on the Catahoula Formation are considered unresolved in NUREG-1817 Subsection 5.3.2. The NRC staff states that because of the limited number of borings, hydraulic conductivity measurements, and long-term pump tests in this portion of the aquifer that are available in the vicinity of Unit 3, the staff was unable to assess reliably the impact of a significant increase in the groundwater withdrawal from the Catahoula Formation at the Grand Gulf ESP site. The following discussions provide information to address this unresolved issue.

Unit 1 currently uses three groundwater wells, completed in the Upland Complex (Subsection 2.3.2.2 indicates this as a correction to errors in the ESP ER concerning the Catahoula Formation), for general site needs, which include potable and sanitary water systems, air conditioning, and landscape maintenance. Unit 1 uses two of the wells on a routine basis and reserves the third as a backup water supply well. As discussed in Sections 2.3 and 3.3, Unit 3 also does not require groundwater withdrawal from the Catahoula Formation.

Additional aquifer characterization studies have been conducted to evaluate water use impacts resulting from to groundwater withdrawals from the Upland Complex, the Mississippi River Alluvium, or both. Groundwater hydrologic characteristics are discussed in Section 2.3. New Unit 3 water wells in the Upland Complex, overlying the Catahoula Formation, are planned to supply only potable and sanitary water systems. Other water requirements for Unit 3, such as makeup water for the cooling systems and water for the fire protection system, are to be obtained from Mississippi River. Based on estimates of pumping rates and radii of influence around Unit 3 wells, the only potential impact to identified groundwater users during operation of Unit 3 is to Unit 1 potable water wells. The radius of impact due to groundwater withdrawals does not extend beyond the GGNS property boundaries. Based upon recent hydrological studies, increased groundwater withdrawal from the Upland Complex and/or Mississippi River Alluvium have only SMALL and localized impact on these two aquifers. These withdrawals are expected to have a negligible effect on the underlying Catahoula Formation.

The NRC staff indicated in NUREG-1817, Subsection 5.3.2 that there would be no anticipated effects on the alluvial aquifer as no new wells were proposed in that aquifer system. One or two new wells are planned to supply the construction and operation needs of Unit 3. The new wells are anticipated to be installed in the Upland Complex in the vicinity of the existing three wells along the bluff area, but may be sited within the Mississippi River Alluvium west of the bluff if adequate aquifer thickness is not available in the Upland Complex. Plant operation plans do not require groundwater withdrawal from the Catahoula Formation. Unit 3 will require a monthly average flow of 35 gpm (see Figure 3.3-201) and a maximum flow of 200 gpm to supply potable and sanitary systems. Water use requirements for construction activities are discussed in Section 4.2. Some overlap in use requirements is possible during the transition period from construction to operation. However, maximum uses should remain within the bounds discussed here and in Section 4.2.

Unit 3 is designed to use surface water for all water requirements except the potable and sanitary systems. This usage reduces the need for groundwater withdrawals and minimizes potential impacts to groundwater sources.

Water use effects upon groundwater users of water from local aquifers as a result of withdrawals from the Upland Complex aquifer system are anticipated to be SMALL.

5.2.3 WATER QUALITY IMPACTS

The information for this section is provided in Section 5.2 of the ESP ER, and associated impacts are not fully resolved in NUREG-1817 Subsection 5.3.3. The following supplemental information is provided to resolve this issue.

Surface Water

Unit 1 currently discharges various waste streams to surface water under an existing NPDES permit. There are three primary outfall locations covered by permit (see ESP ER Figure 2.3-12). Each of these primary locations is, in turn, supplied by other minor outfalls. Outfall 001 includes flow from the Unit 1 cooling towers, standby service water, treated low volume wastewater, and treated liquid radwaste water. Outfall 007 includes miscellaneous waste waters discharged into Sediment Basin B. Outfall 010 includes total facility treated sanitary waste water discharged to Sediment Basin A. Outfall 013 includes treated effluent from Sediment Basin A, that enters Stream A, and then flows into Hamilton Lake. This includes flow from Outfall 010. Outfall 014 includes treated effluent from Sediment Basin B that enters Stream B, and then flows into Hamilton Lake. This includes flow from Outfall 007 and stormwater runoff.

Except for discharges from the sanitary sewer system, effluent from Unit 3 is to be combined with that from Unit 1, and the combined effluent will be discharged directly to the Mississippi River via the new outfall diffuser. This combined discharge from Units 1 and 3 would bypass Streams A and B, and Gin and Hamilton Lakes. Section 3.6 contains more detail concerning the concentrations of chemicals contained in these effluents. Sanitary waste water from Unit 3 would be discharged to Sediment Basin A along with that from Unit 1, using a common treatment system.

Biocides are to be used intermittently during operation of Unit 3. Table 3.6-201 contains information related to concentrations of chemical effluents discharged in the common plant outfall. Section 5.5 discusses impacts of nonradioactive-waste-system effluents. Based on process chemical requirements, water quality standards, and permit restrictions based on those criteria, the effects from these effluent streams would be SMALL (Subsection 5.5.1.2). Sanitary wastes are to undergo treatment by an expansion of the current treatment system prior to disposal under an NPDES permit protective of Mississippi River water quality. GGNS would also dispose of wastes from floor drains and other systems under applicable monitored permits. Section 3.6 contains more detailed information concerning these systems.

NUREG-1817 Subsection 5.3.3.1 concluded that the impact of the thermal discharge plume on the Mississippi River would be SMALL and localized. A bathymetric survey including temperature and velocity measurements was conducted in the Mississippi River in the vicinity of the proposed intake and discharge structures. Section 2.3 discusses thermal characteristics of the river. Section 5.3 discusses physical impacts related to the temperature of water discharged from the cooling system.

In Subsection 5.3.3.1 of NUREG-1817, the NRC staff found effects resulting from effluent discharge to the Mississippi River were unresolved because information was not provided in the plant parameter envelope (PPE) or ESP ER defining the bounds of concentrations of chemical effluents to be discharged to the Mississippi River for sources other than the cooling water blowdown. The following discussions provide information to address the unresolved issue.

Various liquid waste streams are to be combined for discharge to the Mississippi River. The Unit 3 portion of this discharge has an average flow rate of 7482 gpm (see Figure 3.3-201). Flow from these streams to the new common outfall diffuser includes:

- Cooling water systems blowdown
- Wastewater from makeup demineralizer system
- Water-treatment wastes
- Wastewater from granular filters
- Wastewater from clarifiers
- Wastewater from the liquid radwaste system

A bathymetric survey of the Mississippi River in the vicinity of the intake and discharge structures was conducted in October 2006. The survey included measurements of river depth, along with water temperature and flow velocity. This information was consistent with published data and supports the conclusion that waters from the location of the new outfall diffuser would not be expected to circulate back upstream to the location of the intake structure. For more details of this survey, refer to Subsection 2.3.3.1.2. Water quality impacts from the thermal discharge plume are described in Section 5.3. Discharges to the Mississippi River would occur under an NPDES permit, governed by the MDEQ. Details concerning concentrations of effluents discharged under this permit are discussed in more detail in Section 3.6. GGNS would continue to monitor discharges to ensure they comply with applicable permits. As discharges of various non-radioactive liquid waste streams to the Mississippi River would be held to within acceptable limits, defined by the NPDES permit, effects of those discharges upon the Mississippi River are anticipated to be SMALL.

In Subsection 5.3.3.2 of NUREG-1817, the NRC staff found effects resulting from effluent discharge to Streams A and B were unresolved because information was not provided in the ESP ER defining the bounds of concentrations of chemical effluents to be discharged to Streams A and B. The following discussions provide information to address this unresolved issue. Except for discharges from the sanitary sewer system, effluent from Unit 3 is to be combined with that from Unit 1, both of which are to be discharged directly to Mississippi River via the new outfall diffuser. This discharge would bypass Streams A and B, and Gin and Hamilton Lakes.

Sanitary discharges from Unit 3 are to be combined with existing sanitary discharges from Unit 1 that flow into Stream A through Sediment Basin A, into Hamilton Lake, and then into the Mississippi River. See ESP ER Figure 2.3-12, which illustrates current GGNS NPDES outfalls. Though this figure reflects the outfalls for the current NPDES permit, it is anticipated that those outfalls would not change under the NPDES permit as modified to include Unit 3. Unit 3 is designed to produce an average monthly flow of 35 gpm from the potable water/sanitary waste system (see Figure 3.3-201), with a maximum flow of 200 gpm. Details concerning concentrations and discharge limits related to the potable water/sanitary waste system as they relate to the existing NPDES permit are discussed in Section 3.6. Table 3.6-202 lists concentrations of constituents from the Sanitary Waste System. Sanitary system concentrations are less than the permitted concentrations under the current NPDES permit. Section 2.3 of the ESP ER discusses concentrations for the maximum average nutrient concentration of the sanitary waste treatment system and the maximum total suspended solids from the combined outflow from Sediment Basin A. Discharges associated with Unit 3 are to be maintained under similar conditions. GGNS would continue to monitor systems producing discharges to maintain those discharges within permitted levels. Monitoring trends would also continue to be observed to note any changes that might warrant additional mitigating actions. Surface water quality changes related to plant operations are expected to be minimal and are not expected to affect surface water use.

Discharges from the demineralized water system for the new unit will be at a monthly average of 36 gpm (see Table 3.0-201), with a maximum flow of 146 gpm. Table 3.0-201 contains further details concerning Unit 3 water use and discharges. Discharge to the Mississippi River would continue to be controlled in accordance with applicable NPDES permit requirements. Section 3.6 contains information related to the effluent quantities and characteristics of the sanitary systems.

Unit 3 would use clarifiers to remove suspended solids from water withdrawn from the Mississippi River. The plant then plans to dilute the solids with cooling system blowdown flow and return them to the river. Initial consultations with MDEQ have confirmed that this conceptual design approach would be acceptable provided the reintroduction of these solids to the Mississippi River in cooling system blowdown would result in no net increase in solids in river water, and no violation of the state's water quality standard for turbidity outside of an appropriate mixing zone. MDEQ's final approval would be contingent of the agency’s review of additional design details that would be provided as part of the NPDES permitting process. Surface water discharges related to the cooling system and solids from the clarifiers are discussed in Section 3.6.

Surface water discharges would be governed and monitored under an NPDES permit. Engineering controls are to be put in place to help maintain discharges at permitted conditions. Water use effects upon surface water users as a result of surface water discharges to local streams and the Mississippi River are SMALL.

Limited and temporary surface water quality impacts may occur due to erosion and sediment from runoff during maintenance activities associated with on-site and off-site transmission line rights-of-way. Established environmental protection engineering and environmental protection practices, as well as policy procedures that manage vegetative management practices and land disturbance, are used to mitigate any potential adverse impacts due to transmission line maintenance programs. These programs include requirements for written planning documents and work permits whenever earthwork or land disturbance is anticipated, or spanning of "navigable" waters of the U.S. or any work that is involved within the 100-year floodplain or near wetlands.

Groundwater

In Subsection 5.3.3.3 of NUREG-1817, the NRC staff found that impacts of additional groundwater withdrawals from the Catahoula Formation were unresolved because further aquifer characterization was needed to determine the extent of the impacts. Groundwater hydrology is discussed in Section 2.3, and groundwater use is discussed in Subsection 5.2.2 above. Two new water supply wells, located in the Upland Complex or Mississippi River Alluvium, with production rates similar to the existing wells should be adequate to meet peak usage requirements. Plant operation plans do not require groundwater withdrawal from the Catahoula Formation. As stated in Section 2.3, because of the impermeable nature of the Catahoula Formation underlying the Upland Complex, no impacts to the Catahoula Formation are expected as a result of additional withdrawals from the Upland Complex.

5.2.4 REFERENCES

None.

TABLE 5.2-201 (Sheet 1 of 2)
OPERATIONAL IMPACTS OF UNIT 3 ON WATER USERS

Water body affected by operation	Operational Activity	Water Use / User	Potential Effects on Water Users	Impact Level / Mitigation
Surface Water				
1. Mississippi River	Effluent Discharges	Downstream Water Users	Decrease in water quality	**SMALL**. Effluent discharges are to be combined with Unit 1 effluent prior to being discharged at the new outfall diffuser. **Mitigation –** discharges are maintained at concentrations mandated by NPDES permit.
2. Local Streams A and B	Discharges from Sediment Basins A and B	Unit 1	Decrease in water quality	**SMALL**. Except for sanitary wastes, Unit 3 does not discharge effluents to Sediment Basins A and B, nor to Streams A and B. Combined treated sanitary wastes from Unit 1 and Unit 3 are to be discharged to Sediment Basin A. Other combined effluents from Unit 1 and Unit 3 are to be discharged to Mississippi River via a new outfall diffuser. **Mitigation** – discharges are maintained at concentrations mandated by NPDES permit.

TABLE 5.2-201 (Sheet 2 of 2)
OPERATIONAL IMPACTS OF UNIT 3 ON WATER USERS

Water body affected by operation	Operational Activity	Water Use / User	Potential Effects on Water Users	Impact Level / Mitigation
Groundwater				
1. Upland Complex	Pumping to Meet Operational Needs	A. Unit 1	Loss of water availability for Unit 1 potable water wells	**SMALL.** **Mitigation –** GGNS plans to install up to two new wells to help supply operational needs of the new unit. This, plus the site's existing well capacity should minimize water availability effects.
		B. Off-site Users	Loss of water availability	**SMALL**. **Mitigation –** None. Based upon aquifer characterization studies, effects of operational water use are expected to be localized. Off-site water users would be unaffected.
2. Catahoula Formation	Pumping to Meet Operational Needs	A. Unit 1	Loss of water availability for existing water wells	**Minimal.** Currently not pumping from Catahoula Formation. **Mitigation –** GGNS plans to install up to two new wells in the Upland Complex or the Mississippi River Alluvium to help supply operational needs of the new unit.
		B. Off-site Users	Loss of water quality as a result of upwelling from deeper, lower quality zones.	**SMALL.** Aquifer characterization studies have shown the likelihood of water quality deteriorization in the Catahoula Formation as a result of operational pumping from the Upland Complex is small. **Mitigation –** GGNS is not withdrawing water from the Catahoula, nor does it have plans to do so in the future.
			Loss of water availability	**Minimal.** Based upon aquifer characterization studies, effects of operational pumping from the Upland Complex are expected to be localized. Off-site water users of Catahoula Formation waters should remain unaffected.

5.3 COOLING SYSTEM IMPACTS

The information for this section was provided in the ESP Application Part 3 – Environmental Report, Section 5.3, and associated impacts are not fully resolved in NUREG-1817; the following supplemental information is provided.

5.3.1 INTAKE SYSTEM

The information for this section is provided in the ESP ER, Subsection 5.3.1, and associated impacts are resolved as SMALL in NUREG-1817, Subsections 5.3.1 (Hydrological Alterations), 5.3.2 (Water-Use Impacts), 5.4.1.4 (Shoreline Habitat), 5.4.2.1 (Intake Structure), and 5.4.3 (Threatened and Endangered Species). The proposed Unit 3 intake system is described in Subsection 3.4.2. No new and significant information has been identified for this issue.

5.3.2 DISCHARGE SYSTEM

The information for this section was provided in the ESP ER, Subsection 5.3.2, and associated impacts are not fully resolved in NUREG-1817; the following supplemental information is provided.

5.3.2.1 Thermal Description and Physical Impacts

In Subsection 5.3.3.1 of NUREG-1817, the NRC staff found effects resulting from effluent discharge to the Mississippi River were unresolved because information was not provided in the PPE or ESP ER defining the bounds of concentrations of chemical effluents to be discharged to the Mississippi River for sources other than the cooling water blowdown. Subsection 5.2.3 provides information to address the unresolved issue.

NUREG-1817 Subsection 5.3.3.1 concluded that the impact of the thermal discharge plume on Mississippi River would be small and localized. No new and significant information has been identified for this issue.

NUREG-1817, Subsection 2.6.3.3, states that the NRC staff found the thermal plume data for the existing GGNS discharge are currently inadequate to calibrate the Cornell Mixing Zone Expert System (CORMIX) model. The following supplemental information is provided to address this issue.

A bathymetric survey including temperature and velocity measurements was conducted in October 2006 in the Mississippi River in the vicinity of the proposed intake and discharge structures. Subsection 2.3.3 discusses this survey and the data collected. Discharge flow from Unit 1 at the time of data collection was approximately 5700 gpm, and river channel flow was assumed to be the average value of 560,000 cfs reported in the ESP ER. These data were input into CORMIX and the output indicated the plume would be dissipated in the near field; essentially no plume would develop in the river. These October 2006 data indicate that the thermal plume from Unit 1 discharge is essentially imperceptible and confirm that the thermal plume projected by the CORMIX model is representative of actual conditions in the river during discharge.

5.3.2.2 Aquatic Ecosystems

The information for this section is provided in the ESP ER, Subsection 5.3.2.2, and associated impacts are resolved as SMALL in NUREG-1817, Subsections 5.4.2 (Aquatic Ecosystems) and 5.4.3 (Threatened and Endangered Species). No new and significant information has been identified for this issue.

5.3.3 HEAT-DISCHARGE SYSTEM

The information for this section is provided in the ESP ER, Subsection 5.3.3, and associated impacts are resolved as SMALL in NUREG-1817, Subsections 5.1.1 (Site and Vicinity), 5.2.1 (Cooling System), 5.4.1 (Terrestrial Ecosystem), 5.4.3 (Threatened and Endangered Species), and 5.5.1 (Physical Impacts). No new and significant information has been identified for this issue.

5.3.4 IMPACTS TO MEMBERS OF THE PUBLIC

The information for this section is provided in the ESP ER, Subsection 5.3.4, and associated impacts are resolved as SMALL in NUREG-1817, Subsections 5.1.1 (Site and Vicinity) and 5.5.1 (Physical Impacts). No new and significant information has been identified for this issue.

5.3.5 REFERENCES

None.

5.4 RADIOLOGICAL IMPACTS OF NORMAL OPERATION

The information for this section is provided in the ESP Application Part 3 – Environmental Report Section 5.4, and was evaluated in NUREG-1817 Section 5.9. Source terms used in the determination of dose to members of the public are provided in ESP ER Table 3.0-7 (airborne release) and Table 3.0-8 (liquid release), and are reproduced in the ESP, ESP-002, in Appendix D, Tables D7 and D8, respectively. These source terms are “conditions” of the permit, as indicated in Section 3.D of the permit. Supplemental information is presented below to demonstrate that doses from liquid and gaseous releases during normal operation meet the regulatory requirements.

5.4.1 EXPOSURE PATHWAYS

Exposure pathways are discussed in the ESP Application Part 3 – Environmental Report Section 5.4 and evaluated in NUREG-1817, Subsection 5.9.1. No additional information is provided.

5.4.2 RADIATION DOSES TO MEMBERS OF THE PUBLIC

5.4.2.1 Impacts from Liquid Pathway

NUREG-1817 Subsection 5.9.2.1 addresses dose to the public from the liquid release pathway. The NRC performed an independent evaluation of dose from this pathway, and found results to be similar to those documented in the ESP ER. Subsection 5.9.3.3 of NUREG-1817 concluded there would be no observable health impacts on the public from normal operation of new nuclear units, and the health impacts would be SMALL.

However, as indicated in Table 3.0-201 and Table 3.0-208, the ESBWR liquid effluent isotopic releases are not bounded on an isotope-by-isotope basis by the releases given in Appendix D of the GGNS ESP. Because the ESBWR liquid releases are not bounded by the releases assumed for the ESP, the individual, population, and biota doses were recalculated with the ESBWR source term. Figure 3.3-201 indicates that the blowdown flow rate for the normal heat sink cooling towers is approximately 7000 gpm. As in the ESP ER (see Table 3.0-201, PPE Subsection 10.2.1) the assumed discharge flow rate is 35 gpm with a dilution factor of 2 taken for the Mississippi River. Therefore, the minimum dilution factor during liquid effluent discharge for Unit 3 is 400 (i.e., 2 x [7000/35]). The remaining input data and parameters used in the ESP application evaluation are bounding for the ESBWR, and are unchanged for the updated impact evaluations for Unit 3. Revised liquid effluent doses are given in Tables 5.4-201, 5.4-202, and 5.4-203.

5.4.2.2 Impacts from Gaseous Pathway

NUREG-1817 Subsection 5.9.2.2 addresses dose to the public from the airborne release pathway. The NRC performed an independent evaluation of dose from this pathway, and found results to be similar to those documented in the ESP ER. As indicated in Table 3.0-201 and Table 3.0-207, the ESBWR gaseous effluent isotopic releases are bounded on an isotope-by-isotope basis by the releases given in Appendix D of the GGNS ESP. No additional information is provided.

5.4.3 IMPACTS TO MEMBERS OF THE PUBLIC

In NUREG-1817 Subsection 5.9.3.3 the NRC concluded there would be no observable health impacts on the public from normal operation of new nuclear units, and the health impacts would be SMALL.

The liquid effluent doses given in Tables 5.4-201, 5.4-202, and 5.4-203 are within the applicable regulatory limits of 10 CFR 50 Appendix I, and the criteria of 40 CFR 190 for Unit 3 normal operation. The results of the normal liquid release doses presented in this subsection support the conclusion that there would be no observable health impacts on the public from normal operation of new nuclear units, and the health impacts would be SMALL.

NUREG-1817 Subsection 5.9.3.1 concluded that the combined dose to the maximally exposed individual from Unit 1 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. Table 5.4-205 presents the combined dose from all effluent pathways for Unit 1 and Unit 3, and a comparison to 40 CFR 190 criteria. Combined doses are within 40 CFR 190 criteria, also supporting the continued validity of the conclusion that there would be no observable health impacts on the public from normal operation of new nuclear units.

5.4.4 IMPACTS TO BIOTA OTHER THAN MEMBERS OF THE PUBLIC

The NRC evaluated impacts to biota other than members of the public in NUREG-1817, Subsection 5.9.5. In Subsection 5.9.5.3, the NRC indicated that the cumulative effects of current operating units and the proposed unit or units would result in dose rates significantly less than the NCRP and IAEA studies. Based on the available information related to the radiological impact on biota from the routine operation of the proposed Grand Gulf ESP unit(s) the NRC concluded that the impact would be SMALL, and mitigation would not be warranted.

Because the liquid release source term for the ESBWR is not bounded by the ESP source term as discussed above, the doses to biota due to liquid effluent releases were reevaluated. The results are given in Table 5.4-204. The impact to biota due to gaseous effluent releases was not reevaluated because the ESBWR gaseous effluent releases are fully bounded on an isotope-by-isotope basis by the ESP gaseous effluent releases.

Table 5.4-204 compares the biota doses due to liquid releases, on a per unit basis, as reported in Table 5-9 of NUREG-1817, to the dose for Unit 3 from the liquid effluent pathway. Calculated total dose from the liquid effluent pathway for Unit 3, using the ESBWR source term, is less for all forms of biota considered, supporting the conclusion that the radiological impact on biota from the routine operation of the proposed Unit 3 would be SMALL, and mitigation would not be warranted.

5.4.5 REFERENCES

None.

TABLE 5.4-201
LIQUID PATHWAY
COMPARISON OF MAXIMUM INDIVIDUAL DOSE TO 10 CFR 50, APPENDIX I CRITERIA

Estimated Maximum Individual Dose from Liquid Effluents mrem/yr (mSv/yr), Per Unit				
	ESP		ESBWR	
Dose Limit [1] (mrem/yr)	**3**	**10**	**3**	**10**
Pathway	Annual Dose Total Body 2	Maximum Organ (bone) 3	Annual Dose Total Body 2	Maximum Organ (bone) 3
Aquatic Foods	2.17 (2.17E-02)	4.09 (4.09E-02)	6.2E-01 (6.2E-03)	9.0 (9.0E-02)
Shoreline Use	3.06E-03 (3.06E-05)	3.56E-03 (3.56E-05)	5.6E-04 (5.6E-06)	6.6E-04 (6.6E-06)
Total	2.17 (2.17E-02)	4.10 (4.10E-02)	6.2E-01 (6.2E-03)	9.0 (9.0E-02)

1 mrem = 0.01 mSv

NOTES:

1. 10 CFR 50 Appendix I limits.
2. An adult was found to receive the maximum individual total body dose.
3. A child was found to receive the maximum individual organ dose.

TABLE 5.4-202
ESTIMATED POPULATION DOSE FROM LIQUID EFFLUENTS VIA THE AQUATIC FOOD PATHWAY

	Annual Dose ESP person-rem/yr (person-Sv/yr), per unit	Annual Dose ESBWR COL person-rem/yr (person-Sv/yr), per unit
Whole Body	2.06 (2.06E-02)	5.65E-01 (5.65E-03)
Maximum Organ	3.32 (3.32E-02) (Liver)	5.75 (5.75E-02) (Bone)

Dose limits for individual members of the public – 0.1 rem (1 mSv) total effective dose equivalent in a year, § 20.1301.

TABLE 5.4-203
LIQUID PATHWAY
COMPARISON OF MAXIMUM INDIVIDUAL DOSE TO 40 CFR 190 CRITERIA

Type of Dose (Annual)	Design Objective mrem/yr (mSv/yr)	Calculated Dose mrem/yr (mSv/yr)
Whole body dose equivalent[1]	25 (0.25)	6.2E-01 (6.2E-03)
Thyroid dose[2]	75 (0.75)	1.43E-01 (1.43E-03)
Dose to another organ[2]	25 (0.25)	9.0 (9.0E-02) (Bone)

NOTES:

1. An adult was found to receive the maximum whole body dose equivalent.
2. A child was found to receive the maximum thyroid and organ (bone) dose.

TABLE 5.4-204
DOSE TO BIOTA FROM LIQUID EFFLUENTS

	Liquid Effluents ESP (Per Unit)	Liquid Effluents Unit 3 – ESBWR
Organism	Total Dose[(a)] mrad/yr (mGy/yr)	Total Dose mrad/yr (mGy/yr)
Fish	25 (0.25)	12.0 (0.120)
Invertebrate	165 (1.65)	42.5 (0.425)
Algae	148 (1.48)	61.7 (0.617)
Muskrat	81 (0.81)	76.4 (0.764)
Raccoon	19 (0.19)	2.2 (0.022)
Heron	193 (1.93)	35.5 (0.355)
Duck	81(0.81)	76.1 (0.761)

NOTES:

a. Taken from NUREG-1817, Table 5-9.

b. mGy = milligray.

TABLE 5.4-205
TOTAL SITE DOSE
COMPARISON OF MAXIMUM SITE INDIVIDUAL DOSE TO 40 CFR 190 CRITERIA

Type of Dose (Annual)	Unit 3 Dose [(2)] (mrem)	Unit 1 Dose [(2)] (mrem)	Total Site Dose[(1)] (mrem)	Design Objective [(3)] (mrem)
Whole Body Dose Equivalent	2.24	1.33	3.57	25
Thyroid Dose	3.35	<9.65	<13.00	75
Dose to Another Organ	10.39 (bone)	9.65[(4)] (thyroid)	20.04 (bone)	25
	4.42 (skin)	2.16 (skin)	6.58 (skin)	

NOTES:

1. Includes all pathways for all effluents and direct radiation sources for all units at the site. Direct radiation has been shown to be negligible per ESP ER Subsection 5.4.1.3.

2. Includes all pathways for all effluents and direct radiation sources. Direct radiation has been shown to be negligible. Source for Unit 1 data is Unit 1 UFSAR Tables 11.2-11 and 11.3-12.

3. Source: 40 CFR 190.

4. Doses to other organs are less than the dose to the thyroid.

5.5 ENVIRONMENTAL IMPACTS OF WASTE

The information for this section is provided in the ESP Application Part 3 – Environmental Report Section 5.5, and associated impacts are not fully resolved in NUREG-1817; the following supplemental information is provided.

5.5.1 NON-RADIOACTIVE WASTE-SYSTEM IMPACTS

5.5.1.1 Solid Wastes

Solid non-hazardous and hazardous wastes are managed and disposed of in accordance with applicable regulations. The ESP ER provided discussion on the management and disposition of these wastes in Section 3.6 (Subsections 3.6.3.2, 3.6.3.3, and 3.6.3.4) and Section 5.5 (Subsections 5.5.1.1, 5.5.1.5.1 and 5.5.1.5.2) for Unit 3 based on Unit 1 experience. Those projections and waste types are anticipated to be the same for Unit 3. Solid wastes are not burned, buried, or deposited on site. There are no on-site effects from management of solid wastes. The wastes are transported off-site and disposal would comply with the requirements of any Federal, State, or local regulations at the time of facility construction and operation. Based on the controls imposed by solid waste disposal regulations, the effects of non-radioactive wastes associated with the construction and operation of Unit 3 are SMALL.

5.5.1.2 Liquid Wastes

Unresolved issues in NUREG-1817 concerning plant wastewater discharges consisted of questions regarding chemicals in stormwater and sanitary discharges to Streams A and B (NUREG-1817 Subsection 5.3.3.2), and plant wastewater discharges to the Mississippi River (NUREG-1817 Subsections 5.3.3.1, 5.3.3.4, and 7.3.3).

Industrial wastewater discharges to the environment are governed by the Clean Water Act (CWA) and by federal regulations in 40 CFR 122. The State of Mississippi is authorized to establish water quality rules for the protection of its waters and to enforce them through the NPDES program for industries in Mississippi. The Mississippi regulations establish discharge chemical concentrations and enforcement mechanisms for wastewater and stormwater discharges to assure maintenance of the water quality standards. (References 201 and 202)

The effluent streams and chemical concentrations anticipated from the operation of Unit 3 are provided in Sections 3.3 and 3.6. Projections of chemical concentrations for the two effluent streams are provided in Tables 3.6-201 and 3.6-202. Operation of Unit 3 uses chemicals and concentrations in ranges similar to Unit 1 for de-scaling, oxygen scavenging, biocides and water treatment. Other than the use of flocculants and coagulants, added in 1-4 ppm concentrations for removal of suspended solids from the raw Mississippi River water for cooling water makeup, the chemical discharge concentration and character of these streams is not considered different from those at the regulated Unit 1 outfalls.

There are two waste streams associated with Unit 3 that discharge through NPDES permitted outfalls: the sanitary stream and the process stream. The discharge monitoring requirements are based on State of Mississippi Water Quality Protection Standards and effluent limits are established for each discharge stream. Based on the process chemical requirements, water quality standards, and permit restrictions based on those criteria, the effects from these effluent streams are SMALL.

The processing of raw Mississippi River water to remove the suspended solids for Unit 3 cooling water requirements creates an additional input to the liquid process waste stream. The clarified water is used for cooling water applications, and the suspended solids slurry is mixed with the process effluent stream and returned to the river, as described in Sections 3.3 and 3.6. The suspended solids are not chemically altered by the settling process and no additional solids are added as a result of the power generation process.

Based on process flow rates provided in Figure 3.3-201 for Unit 3, the flow to the clarifier/settler is about 29,200 gpm, and discharge flow to the river is 7480 gpm. With a river suspended solids content of 446 ppm (avg. monthly maximum) and complete sedimentation, the solids in the discharge are 1740 ppm. When Unit 1 and Unit 3 are both in operation, the Unit 3 discharge is combined with the Unit 1 discharge of 11,200 gpm for a rate of 18,680 gpm, resulting in a solids concentration of approximately 700 ppm. In either scenario the mass loading (net mass of solids in the effluent) effectively is unchanged, and the amount (mass) of solids returned to the river is the same as the amount of solids removed from the river. The effect of the suspended solids return to the river is SMALL.

5.5.1.3 Gaseous Effluents

The effect of non-radioactive gaseous effluents was resolved in NUREG-1817 Subsection 5.2.2 as SMALL. No new and significant information has been identified.

5.5.2 MIXED WASTE IMPACTS

Mixed waste impacts are discussed in ESP ER Subsection 5.5.2. No new and significant information has been identified.

5.5.3 REFERENCES

201 Mississippi Commission on Environmental Quality, “Regulation WPC-1: Wastewater Regulations for National Pollutant Discharge Elimination System (NPDES) Permits, Underground Injection Control (UIC), Water Quality Based Effluent Limitations and Water Quality Certification,” Chapter Two: Water Quality Based Effluent Limitations, Section VI. Toxicity, October 25, 2001.

202 Mississippi Commission on Environmental Quality, Regulation WPC-2, “Water Quality Criteria for Intrastate, Interstate, and Coastal Waters, State of Mississippi,” June 27, 2003.

5.6 TRANSMISSION SYSTEM IMPACTS

The information for this section is provided in the ESP Application Part 3 – Environmental Report, Section 5.6, and associated impacts are not fully resolved in NUREG-1817; the following supplements are provided.

The proposed transmission system is described in Section 3.7 and illustrated in Figure 2.2-201.

5.6.1 TERRESTRIAL ECOSYSTEMS

The impacts of transmission line maintenance and operation, including potential increases in ROW widths, on terrestrial ecosystems were evaluated in NUREG-1817, Subsection 5.4.1 and determined to be SMALL. No new and significant information has been identified.

5.6.2 AQUATIC ECOSYSTEMS

The impacts of transmission line maintenance and operation, including potential increases in ROW widths, on aquatic ecosystems were evaluated in NUREG-1817, Subsection 5.4.2 and determined to be SMALL. No new and significant information has been identified.

5.6.3 IMPACTS TO MEMBERS OF THE PUBLIC

The impacts of transmission line maintenance and operation on members of the public were evaluated in NUREG-1817. Aesthetic impacts are considered to be minor in NUREG-1817 Subsection 5.5.1.4, and in NUREG-1817 Subsection 5.5.1.5 these impacts are resolved as SMALL. No new and significant information related to aesthetic impacts of transmission line maintenance and operation has been identified.

NUREG-1817 Subsections 5.8.3 (Acute Effects of Electromagnetic Fields) and 5.8.4 (Chronic Effects of Electromagnetic Fields) contain evaluations of impacts to the public from electromagnetic fields. No conclusions were drawn with regard to these issues, and they were considered to be unresolved at ESP.

It is stated in NUREG-1817 Subsection 5.8.3 that, because SERI did not assert that the existing transmission and distribution system meets National Electric Safety Code (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, the staff could not come to a conclusion on potential acute impacts of EMFs, and this issue was not considered to be resolved. Engineering and construction design control documents have been developed that pertain to transmission systems. These design control documents establish company requirements to comply with current, applicable NESC criteria. Entergy Mississippi Inc. (EMI) transmission lines meet these standards, which provides appropriate assurance that impacts to the public attributable to the acute effects of EMFs are minimal.

It is stated in NUREG-1817 Subsection 5.8.4 that the scientific evidence cited in a 1999 National Institute of Environmental Health Sciences (NIEHS) report (Reference 201) is not sufficient to cause the NRC staff to consider the potential impact of chronic EMF exposure to be significant to the public. The staff went on to say, however, that available information was found to be inconclusive, and the issue was not considered to be resolved in NUREG-1817. In a later bulletin, the NIEHS provides an overview of recent scientific studies and summarizes various expert review panel evaluations of the current body of evidence regarding EMFs (Reference 202). That bulletin restates and accepts the conclusions provided in the 1999 study report.

Acute and chronic effects of transmission line operation to members of the public are found to be minimal and unproven, respectively. Accordingly, impacts to members of the public from transmission line operations associated with Unit 3 are considered to be SMALL. Entergy, through its membership in industry research associations including the Edison Electric Institute (EEI) and the Electric Power Research Institute (EPRI), supports the ongoing research on the effects of EMFs.

5.6.4 REFERENCES

201 National Institute of Environmental Health Sciences (NIEHS), “Report on Health Effects from Exposure to Power-Line Frequency and Electric and Magnetic Fields,” Publication No. 99-4493, National Institutes of Health, Research Triangle Park, NC 27709, May 1999.

202 National Institute of Environmental Health Sciences (NIEHS), “EMF Questions & Answers, Electric and Magnetic Fields Associated with the Use of Electric Power,” Publication No. 02-4493 National Institutes of Health, Research Triangle Park, NC 27709, June 2002.

5.7 URANIUM FUEL CYCLE IMPACTS

The information for this section is provided in the ESP Application Part 3 – Environmental Report, Section 5.7, and associated impacts are resolved in NUREG-1817. The following supplements are provided.

NUREG-1817, Subsection 6.1.1, resolved that uranium fuel cycle impacts associated with the ESP facility due to operations would be small, and mitigation would not be warranted. The staff's evaluation used the fuel cycle impacts in 10 CFR 51.51(b) Table S–3, which are based on a reference 1000-MWe light-water-cooled reactor (LWR) that uses uranium dioxide fuel operating at an annual capacity factor of 80 percent for a net electric output of 800 MWe, and scaled the results to account for the higher net electrical output for the GGNS site. Specifically, the staff scaled the impacts to the PPE total net electric output of 3000 MWe (8600 MWt) for the ESP site using a capacity factor of 95 percent. This resulted in an impact approximately four times the values given in Table S–3. The staff resolved that these impacts would be SMALL and mitigation would not be warranted.

Throughout NUREG-1817 Chapter 6, the 3000 MWe PPE surrogate plant (corresponding to 8600 MWt) was referred to as the 1000-MWe LWR scaled model. The Unit 3 ESBWR design is an LWR single unit rated at 4500 MWt with a net electrical output of 1520 MWe, that uses uranium dioxide fuel. This net electrical rating of 1520 MWe would result in a multiplier of approximately two times for evaluation of impacts from the uranium fuel cycle given in Table S-3. Consequently, the Unit 3 impacts would be approximately one-half the impacts for the LWR scaled model (based on 3000 MWe and 8600 MWt) evaluated in NUREG-1817 Subsection 6.1.1. Therefore, the overall conclusions of the NUREG-1817 evaluation of uranium fuel cycle impacts (SMALL) remain valid for the ESBWR at the 4500 MWt thermal power and 1520 MWe net electrical rating.

5.7.1 REFERENCES

None.

5.8 SOCIOECONOMIC IMPACTS

The information for this section is provided in the ESP Application Part 3 – Environmental Report Section 5.8, and associated impacts are resolved in NUREG-1817; no supplements are provided.

5.8.1 PHYSICAL IMPACTS OF STATION OPERATION

The physical impacts of station operation in the vicinity of the ESP facility are evaluated in NUREG-1817, Subsections 5.5.1, 5.2.1, 5.2.2, and 5.2.3, and determined to be SMALL. No new and significant information has been identified.

5.8.2 SOCIAL AND ECONOMIC IMPACTS OF STATION OPERATION

The social and economic impacts of station operation are evaluated in NUREG-1817, Subsection 5.5.5 and are determined to be SMALL for most of the region, with a possible MODERATE beneficial impact in Warren County. In Claiborne County, socioeconomic impacts are determined in NUREG-1817 to vary from LARGE beneficial to MODERATE adverse. No new and significant information has been identified.

5.8.3 ENVIRONMENTAL JUSTICE IMPACTS

The impacts of station operation on environmental justice were evaluated in NUREG-1817, Section 5.7 and determined to be SMALL for environmental and human health, and LARGE beneficial for socioeconomics. No new and significant information has been identified.

5.8.4 REFERENCES

None.

5.9 DECOMMISSIONING

The information for this section is provided in the ESP Application Part 3 – Environmental Report, Section 5.9, and associated impacts are not fully resolved in NUREG-1817; the following correction and supplemental information are provided.

As required by 10 CFR 50.33(k), a COL application must include the information in the form of a report, as described in 10 CFR 50.75 that certifies how reasonable assurance is to be provided that funds are to be available to decommission the facility. The GGNS Unit 3 Decommissioning Funding Assurance Report containing the information required by 10 CFR 50.75 is provided in Part 1 of this application.

As discussed in NUREG-1817, Section 6.3 the impacts 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. That report determined that the impacts associated with decommissioning under the stated decommissioning options were either SMALL, or may require site-specific assessment (e.g., environmental justice, threatened and endangered species). In accordance with 10 CFR 50.82(a)(4)(i), a licensee is required to submit a post-shutdown decommissioning activities report (PSDAR), which must include a discussion that provides the reasons for concluding that the environmental impacts associated with site-specific decommissioning activities are bounded by appropriate previously issued environmental impact statements. If identified environmental impacts have not been considered in existing environmental assessments, the licensee is required to request a license amendment regarding the activities and submit a supplement to the ER relating to the additional impacts. Therefore, the impacts associated with decommissioning Unit 3 are addressed in NUREG-0586, with the exception of site-specific impacts that are required by regulation to be assessed prior to commencement of decommissioning activities having an impact in these areas. The environmental impacts from the activities associated with decommissioning were unresolved at the GGNS ESP stage.

The U.S. Department of Energy (DOE) funded a study that compares activities and costs required to decommission existing reactors to those required for advanced reactor designs, including the ESBWR. This study, "*Study of Construction Technologies and Schedules, O&M Staffing and Cost, and Decommissioning Costs and Funding Requirements for Advanced Reactor Designs"* (Reference 201), was prepared to assess the impact of these new designs construction, operation, and decommissioning, including an assessment of the impact of these designs on decommissioning funding estimates. Four reactor types were evaluated in this report: the Toshiba and General Electric (GE) Advanced Boiling Water Reactor (ABWR), the GEH ESBWR, the Westinghouse Advanced Passive Pressurized Water Reactor (AP1000), and the Atomic Energy of Canada, Limited's (AECL) Advanced CANDU Reactor (ACR-700). The cost analysis described in the study is based upon the prompt decommissioning alternative, or DECON, as defined by the NRC. The DECON alternative is also the basis for the NRC funding regulations (10 CFR 50.75), and the use of the DECON alternative for the advanced reactor designs facilitates the comparison with the NRC's own estimates and financial provisions.

Based on this study, projected physical plant inventories associated with the advanced LWR reactor designs are generally expected to be less than those for currently operating power reactors. This is due to advances in technology and the use of passive support systems that have significantly simplified and reduced inventories of electrical cabling, piping, pumps, motors, instrumentation and controls wiring, building size and concrete volume typically used in contemporary power plants. This ultimately reduces the overall quantity of contaminated and non-contaminated waste required for disposal, along with transportation to and from disposal sites. The reduction is expected to have a noticeable impact on the decommissioning cost, including reduced labor costs associated with removal and radiation protection, reduced decommissioning equipment and material costs, and reduced waste processing and disposal costs. Additionally, the new facility is situated on the existing GGNS site and is contained within the original site boundaries, not requiring encroachment onto additional property that is not already designated for use in power production.

Based on the above it can be reasonably concluded that the environmental decommissioning impacts resulting from Unit 3 are considered to be equal to, or less than, those evaluated in and bounded by NUREG-0586. Therefore, with respect to those impacts that can be assessed at this time, the environmental impacts of decommissioning are anticipated to be SMALL.

The ESP ER, Section 5.9, Page 5.9-1, incorrectly indicated that site-specific considerations of impacts related to decommissioning were discussed in Section 5.9 of the “Mississippi Power and Light Company, Grand Gulf Nuclear Station, Units 1 and 2 Final Environmental Report (FER)” (Reference 202). This section should have referred to Section 5.8 of the GGNS FER.

5.9.1 REFERENCES

201 U.S. Department of Energy, “Study of Construction Technologies and Schedules, O&M Staffing and Cost, and Decommissioning Costs and Funding Requirements for Advanced Reactor Designs,” Contract DE-AT01-020NE23476, May 27, 2004.

202 “Mississippi Power and Light Company, Grand Gulf Nuclear Station, Units 1 and 2 Final Environmental Report (FER), as amended through Amendment 8.”

5.10 MEASURES AND CONTROLS TO LIMIT ADVERSE IMPACTS DURING OPERATION

Table 5.10-201 lists areas of potential impact, a description of the impact itself, and proposed mitigation measures that may be necessary due to operation activities at Unit 3.The mitigation measures and controls described in Table 5.10-201 are in addition to those provided in the ESP Application Part 3 – Environmental Report and evaluated in NUREG-1817.

The measures and controls described in Table 5.10-201 are considered reasonable from a practical, engineering, and economic view. They are based on statutes and regulatory requirements, or they are accepted practices within the industry. Therefore, these controls and measures are not expected to present an unreasonable or undue hardship on the licensee.

5.10.1 REFERENCES

None.

TABLE 5.10-201 (Sheet 1 of 5)
SUMMARY OF MEASURES AND CONTROLS TO LIMIT ADVERSE IMPACTS DURING OPERATION

	Impact Description or Activity[1]	Specific Mitigation Measures and Controls[2,3]
5.1 Land Use Impacts		
5.1.1 The Site and Vicinity	Associated impacts are resolved in NUREG-1817.	
5.1.2 Transmission Corridors and Off-site Areas	Associated impacts are resolved in NUREG-1817.	
5.1.3 Historic Properties	Associated impacts are resolved in NUREG-1817.	Procedures have been implemented in site-wide operational manuals, including Trenching, Excavating and Ground Penetrating Activities, Environmental Reviews and Evaluations, and the Cultural Resources Protection Plan. These procedures detail immediate stop work orders and notification of appropriate personnel should inadvertent discovery of cultural resources take place during operational activities.
5.2 Water-Related Impacts		
5.2.1 Hydrologic Alterations and Plant Water Supply	(1) Increased stormwater runoff. (2) Increased groundwater withdrawal from the Upland Complex. (3) Increased uptake of water from the Mississippi River.	(1) Use standard engineering stormwater practices under the site's NPDES stormwater management program. (2) Unit 3 uses surface water for all water requirements except the potable and sanitary systems reducing groundwater withdrawal.

TABLE 5.10-201 (Sheet 2 of 5)
SUMMARY OF MEASURES AND CONTROLS TO LIMIT ADVERSE IMPACTS DURING OPERATION

	Impact Description or Activity[1]	Specific Mitigation Measures and Controls[2,3]
5.2.2 Water-Use Impacts	(1) Increased uptake of water from the Mississippi River. (2) Sediment deposit and littoral debris in the embayment. (3) Uptake of aquatic biota and river debris through the intake structure. (4) Generation of spoils from dredging of the embayment. (5) Increased groundwater withdrawal from the Upland Complex and/or Mississippi River Alluvium. (6) Impacts to groundwater users of water from local aquifers as a result of withdrawals.	(2) The embayment is designed to minimize sediment deposit and littoral debris and riprap or other means is used to stabilize both the banks of the embayment and the nearby shoreline. (3) Intake screens are designed to be placed at an elevation above the dredge base of the embayment to minimize uptake, entrainment, and impingement. (4) Spoils are disposed according to U.S. Army Corps of Engineers, MDEQ, and applicable permit requirements.
5.2.3 Water Quality Impacts	(1) Increased generation of sanitary waste. (2) Increased effluent discharge that contain biocides and demineralized water treatment wastes. (3) Effluent discharge originating from floor drains and other systems. (4) Water use effects upon surface water users as a result of surface water discharges to local streams and the Mississippi River. (5) Discharge of non-radioactive liquid waste streams, including suspended solids removed from the Mississippi River water at the clarifier.	(1) Sanitary waste is treated by a state-of-the art system prior to disposal under a NPDES permit. (2) Planned discharges monitored by a NPDES permit. (3) Discharge is disposed under applicable monitored permits. (4-5) Planned discharges monitored by a NPDES permit. (5) The solids will be mixed with cooling system blowdown flow and returned to the river.
5.3 Cooling System Impacts		
5.3.1 Intake System		
5.3.1.1 Hydrodynamic Descriptions and Physical Impacts	Associated impacts are resolved in NUREG-1817.	

TABLE 5.10-201 (Sheet 3 of 5)
SUMMARY OF MEASURES AND CONTROLS TO LIMIT ADVERSE IMPACTS DURING OPERATION

	Impact Description or Activity[1]	Specific Mitigation Measures and Controls[2,3]
5.3.2 Discharge System		
5.3.2.1 Thermal Description and Physical Impacts	Chemical effluent concentrations discharged to the Mississippi River for sources other than the cooling water blowdown.	Discharge to the Mississippi River would continue to be controlled in accordance with applicable NPDES permit requirements.
5.3.2.2 Aquatic Ecosystems	Associated impacts are resolved in NUREG-1817.	
5.3.3 Heat-Discharge System		
	Associated impacts are resolved in NUREG-1817.	
5.3.4 Impacts to Members of the Public	Associated impacts are resolved in NUREG-1817.	
5.4 Radiological Impacts of Normal Operation		
5.4.1 Exposure Pathways	Associated impacts are resolved in NUREG-1817.	
5.4.2 Radiation Doses to Members of the Public	Increase in health impacts to individual, population and biota receptors due to effluent releases.	Comply with individual dose limits set in 10 CFR Part 50, Appendix 1. Comply with population dose limits set in 10 CFR 20.1301.
5.4.3 Impacts to Members of the Public	Associated impacts are resolved in NUREG-1817. Based on re-analysis of ESBWR-specific dose, impacts remain SMALL.	Comply with individual dose limits set in 10 CFR Part 50, Appendix 1. Comply with population dose limits set in 10 CFR 20.1301.
5.4.4 Impacts to Biota Other Than Members of the Public	Associated impacts are resolved in NUREG-1817. Based on re-analysis of ESBWR-specific dose, impacts remain SMALL.	

TABLE 5.10-201 (Sheet 4 of 5)
SUMMARY OF MEASURES AND CONTROLS TO LIMIT ADVERSE IMPACTS DURING OPERATION

	Impact Description or Activity[1]	Specific Mitigation Measures and Controls[2,3]
5.5 Environmental Impacts of Waste		
5.5.1 Non-Radioactive Waste-System Impacts	(1) Increased stormwater discharge into Streams A and B and industrial wastewater discharges to the Mississippi River. (2) Industrial solid waste generation.	(1) Planned effluent discharges will be limited and in compliance with CWA and federal regulations (40 CFR 122) and NPDES permit specifications. (2) Solid non-hazardous and hazardous wastes are managed and disposed in accordance with applicable regulations.
5.5.2 Mixed Waste Impacts	Associated impacts are addressed in ESP ER Subsection 5.5.2.	
5.6 Transmission System Impacts		
5.6.1 Terrestrial Ecosystems	Associated impacts are resolved in NUREG-1817.	
5.6.2 Aquatic Ecosystems	Associated impacts are resolved in NUREG-1817.	
5.6.3 Impacts to Members of the Public	Chronic and acute exposure to electromagnetic fields (EMFs).	Construct transmission systems in accordance with design control documents that comply with industry standards relevant to transmission systems including those established by the NESC criteria to minimize acute effects of electromagnetic fields. Entergy is supporting ongoing research on the effects of EMFs.
5.7 Uranium Fuel Cycle Impact		
5.7 Uranium Fuel Cycle Impacts	Associated impacts are resolved in NUREG-1817. The Unit 3 ESBWR uranium fuel cycle impacts are bounded by the environmental analysis of uranium fuel cycle impacts in NUREG-1817.	
5.8 Socioeconomic Impacts		

TABLE 5.10-201 (Sheet 5 of 5)
SUMMARY OF MEASURES AND CONTROLS TO LIMIT ADVERSE IMPACTS DURING OPERATION

	Impact Description or Activity[1]	Specific Mitigation Measures and Controls[2,3]
5.8.1 Physical Impacts of Station Operation	Associated impacts are resolved in NUREG-1817.	
5.8.2 Social and Economic Impacts of Station Operation	Associated impacts are resolved in NUREG-1817.	
5.8.3 Environmental Justice Impacts	Associated impacts are resolved in NUREG-1817.	
5.9 Decommissioning		
5.9 Decommissioning	Generic environmental impacts are discussed in NUREG-0586.Decommissioning impacts are considered to be equal to or less than those evaluated in and bounded by NUREG-0586.	

NOTES:

1. Mitigation measures and controls correlate to the similarly labeled impact.
2. The mitigation measures and controls described here are supplemental to those provided in the ESP ER.
3. No specific mitigation measures and controls beyond those identified in the ESP ER were considered necessary, except as noted in the table.

CHAPTER 6 ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

6.0 ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

Chapter 6 presents the details of the environmental monitoring programs that are instituted for the periods prior to application submission (preapplication), during construction, prior to operation (preoperational), and during the operation of Grand Gulf Nuclear Station (GGNS), Unit 3. These programs establish a baseline of information that allows for the evaluation of future information and provide a method of quantifying the environmental effects of Unit 3 operations.

The environmental measurements and monitoring programs are described in the following seven sections:

- Thermal Monitoring (Section 6.1).
- Radiological Monitoring (Section 6.2).
- Hydrological Monitoring (Section 6.3).
- Meteorological Monitoring (Section 6.4).
- Ecological Monitoring (Section 6.5).
- Chemical Monitoring (Section 6.6).
- Summary of Monitoring Programs (Section 6.7).

Monitoring details (e.g., sampling equipment, constituents, parameters, frequency, and locations) for each specific phase of the overall program are described in these sections.

The following provides brief details related to the applicable monitoring periods.

- Preapplication Monitoring. These field monitoring and data collection activities are used to support the baseline discipline-specific descriptions presented in the environmental report.
- Construction Monitoring. These monitoring activities evaluate the impacts from site preparation and construction. These activities also detect any environmental impacts and allow comparison to preconstruction baseline data for assessing the subsequent impacts of site preparation and construction.
- Preoperational Monitoring. These monitoring activities establish a baseline for identifying and assessing environmental impacts resulting from operation.
- Operational Monitoring. These monitoring activities establish the impacts of plant operations and detect any environmental impacts.

6.1 THERMAL MONITORING

The information for this section is provided in the Early Site Permit (ESP) Application Part 3 – Environmental Report (ER), Section 6.1 and in NUREG-1817 Subsection 2.6.3.3. The staff indicated in NUREG-1817 that continuation of the existing operational monitoring program would provide an adequate thermal monitoring program for a new power generation facility at the Grand Gulf ESP Site. No new and significant information is identified for this section. However, the following supplemental information is provided.

6.1.1 PRE-APPLICATION MONITORING

NUREG-1817, Subsection 2.6.3.3, states that the NRC staff found the thermal plume data for the existing GGNS discharge are currently inadequate to calibrate the Cornell Mixing Zone Expert System (CORMIX) model. The NRC also noted in Subsection 2.6.3.3 that adequate temperature baseline data can be developed from the existing plant's discharge to calibrate and validate CORMIX. Mississippi River flow velocity, temperature, and bathymetric data were measured in October of 2006 at the Unit 1 discharge location (including points upstream and downstream), as described in Subsection 2.3.3. As described in Subsection 5.3.2 the CORMIX model adequately represents the thermal plume from GGNS discharges. Therefore, no further pre-application thermal monitoring is warranted.

6.1.2 CONSTRUCTION/PRE-OPERATIONAL MONITORING

The existing base of monitoring data described in the ESP ER Subsection 6.1.2, combined with additional thermal measurements performed in support of this report, as described in Sections 2.3 and 5.3, is considered sufficient to develop a National Pollutant Discharge Elimination System (NPDES) permit application. Therefore, no additional construction or pre-operational thermal monitoring is planned or warranted.

6.1.3 OPERATIONAL MONITORING

The existing Unit 1 NPDES permit includes thermal monitoring on a continuous basis, as described in the ESP ER Subsection 6.1.1. The operational monitoring program for Unit 3 is an extension of that program previously established by the Unit 1 NPDES permit, as revised to include the Unit 3 discharge. This extension provides an adequate operational thermal monitoring program for Unit 3.

6.1.4 REFERENCES

None.

6.2 RADIOLOGICAL MONITORING

The information for this section was provided in the ESP Application Part 3 – Environmental Report, Section 6.2 in NUREG-1817 Subsection 5.9.6. The staff determined that the current operational monitoring program is adequate to establish the radiological baseline for comparison with the expected impacts on the environment related to the construction and operation of proposed new unit(s) at the Grand Gulf ESP site. No new and significant information is identified for this section.

6.2.1 REFERENCES

None.

6.3 HYDROLOGICAL MONITORING

Hydrological monitoring information is provided in Section 6.3 of the ESP Application Part 3 – Environmental Report. The NRC staff found in NUREG-1817 Subsection 2.6.1.3 that the hydraulic conductivity information from various permeability tests reported by SERI in the ESP ER for the Catahoula Formation is inadequate to provide a reliable basis to estimate the groundwater drawdowns associated with withdrawals from this formation. With this exception, the NRC staff found that continuation of the existing monitoring program provides an adequate hydrological monitoring program. The following corrections to information provided in the ESP ER and supplemental information are provided.

6.3.1 PRE-APPLICATION MONITORING

The NRC staff found the hydraulic conductivity information provided at the ESP stage was inadequate to provide a basis to estimate the groundwater drawdowns associated with the Catahoula Formation. Additional site hydrological characterization has been completed for the COL application for Unit 3 as described in Section 2.3. Evaluation of the potential adverse hydrological impacts is completed, as described in Sections 4.2 and 5.2.

The ESP Application states the Unit 1 potable water wells, and any new wells installed for Unit 3 construction and operations, withdraw groundwater from the Catahoula Formation. This statement has been changed as discussed in Sections 2.3, 4.2, and 5.2. Unit 1 is not currently withdrawing groundwater from the Catahoula Formation, but is pumping from the overlying Upland Complex aquifer. Groundwater withdrawal from the Catahoula Formation is not anticipated for Unit 3 construction or operations. Because no groundwater withdrawal from the Catahoula Formation is planned, no pre-application, construction, pre-operational, or operational monitoring of the Catahoula Formation is warranted.

Additional characteristics of the Upland Complex and the upper strata of the Catahoula Formation were evaluated to confirm estimates of aquifer parameters such as hydraulic conductivity, transmissivity, groundwater gradient, and flow velocity. These characteristics are presented in Section 2.3. As discussed in Section 2.3, although the water levels in the Upland Complex and the Catahoula Formation respond similarly to seasonal changes, there is evidence of localized hydraulic separation. Withdrawal from the Upland Complex or the Mississippi River Alluvium is not expected to impact the underlying Catahoula Formation.

As discussed in Sections 2.3, 4.2, and 5.2, an increase in groundwater withdrawal is anticipated during Unit 3 construction and station operations, but all withdrawal is either from the Upland Complex, or from the Mississippi River Alluvium aquifer, or both. Groundwater withdrawals are regulated by permit from the Mississippi Department of Environmental Quality (MDEQ).

Based on review of site characteristics, and review of potential impacts, no further pre-application monitoring is warranted.

6.3.2 CONSTRUCTION MONITORING

As noted above, a correction is made to the ESP ER statement that groundwater is withdrawn from the Catahoula Formation. The withdrawal of groundwater from the Catahoula Formation is not anticipated. Potential hydrological impacts from construction are limited to groundwater in the Upland Complex and Mississippi River Alluvium, and to surface waters.

The potential hydrological impacts during construction of Unit 3 are evaluated in Section 4.2. As discussed in Subsection 4.2.1, potential impacts due to hydraulic alterations during construction are SMALL. As discussed in Subsection 4.2.1, there are no hydrological alterations on-site that are not bounded by the conclusions in NUREG-1817. Clearing and grading, establishment of construction related facilities, construction of new on-site and off-site transmission line right-of-way (ROW), construction of Unit 3 facilities, and construction of new cooling towers are anticipated.

Standard engineering stormwater management practices and monitoring pursuant to the site's NPDES stormwater management program provide adequate monitoring of hydrological impacts to surface water. Construction of off-site transmission line ROW utilizes engineering design incorporating standard practice for avoidance of construction in streams and wetland areas to minimize impacts due to hydrological alterations or to water quality. Construction of ROW is expected to be completed using stormwater best management practices (BMPs) and monitoring in conjunction with required MDEQ stormwater permits to provide adequate monitoring of off-site hydrological impact to surface water. Such BMPs typically include engineering controls to minimize discharge impacts from erosion, sediments, equipment, and concrete batch plant operations. Also, Clean Water Act (CWA) Section 404 permits will also be acquired as required by the CWA for ROW construction, incorporating appropriate monitoring and mitigation to minimize construction impacts where avoidance is not possible.

The monitoring programs described in the following sections assume the ongoing Unit 1 monitoring programs are to continue through the Unit 1 operational period.

<u>Groundwater</u>

Water Use Impacts are discussed in Section 4.2.2. Groundwater utilization during construction is limited to:

- Construction dewatering for the Unit 3 powerblock excavation in the Upland Complex.
- Withdrawal of groundwater from the Upland Complex for Unit 3 concrete batch plant operations and supply of potable and sanitary water for workers associated with construction of Unit 3 facilities.
- Continued withdrawal of groundwater from the Upland Complex for Unit 1 potable water, fire protection, sanitary water, and maintenance needs.
- Continued radial well (Ranney well) withdrawal of groundwater from the Mississippi River/Alluvium for Unit 1 cooling water makeup and service water.

As discussed in Section 4.2, potential impacts to groundwater use and water quality during construction are limited to on-site utilization. The potential impact to water quality from groundwater use during construction is SMALL, and does not warrant monitoring of water quality. The greatest potential hydrological impact that may occur is during excavation dewatering for the Unit 3 reactor construction and associated powerblock facilities. Safety related details of construction dewatering are provided in FSAR Subsection 2.5.4. The anticipated embedment depth is approximately 70 ft. below surface. Excavation for Unit 3 construction requires dewatering to lower the water table in the Upland Complex by approximately 15 to 20 ft. at the excavation. This drawdown is anticipated to extend under the nearest Unit 1 facilities (the Administration Building), and overlaps the location and drawdown of the existing Unit 1 potable water supply wells that pump from the Upland Complex. Construction dewatering is expected to have a duration of approximately 2 years.

A pre-construction groundwater monitoring program in the Upland Complex is to be initiated prior to initial construction in order to reaffirm baseline groundwater level data, confirm maximum drawdown and radius of drawdown of the existing Unit 1 potable water wells, and confirm the applicability of continued use of the Unit 1 potable water wells during excavation dewatering.

The pre-construction groundwater monitoring program includes monthly water level gauging of the Upland Complex and Loess wells installed as part of the COLA investigation. The identification and location of those wells are discussed in Section 2.3.

The pre-construction groundwater monitoring program includes completion of test wells at selected locations along the bluff region west of Unit 3 to confirm the sites for new potable water wells. This information is also used to confirm groundwater yields and pumping drawdown estimates for Unit 3 construction activity groundwater requirements (i.e. water supplies for the activities). This phase of pre-construction evaluation is scheduled to be initiated at least 3 months prior to initiation of site construction so that alternative locations for water well placement can be identified, including moving withdrawal of groundwater for Unit 3 potable water supplies to the Mississippi River Alluvium, if necessary.

The Unit 3 construction excavation dewatering monitoring program includes the potential installation of temporary piezometers surrounding the exterior of the excavation to monitor the drawdown impacts upon initiation of dewatering. Some of the existing monitoring wells would be destroyed during the construction process as excavation for the powerblock and other structures proceeds. Where existing monitoring wells, not abandoned during construction, can be used to monitor these drawdown impacts, plans are to utilize them also. It is anticipated that the wells at clusters MW1023, MW1025, MW1026, MW1027, MW1134, MW1033, MW1043, MW1045, MW1042, MW1082, and MW1134 should remain intact throughout construction.

Where necessary, and considering the use of the existing monitoring wells, additional piezometers are planned surrounding the excavation to provide adequate spacing to monitor drawdown against calculated estimates of drawdown in the Upland Complex. Groundwater measurements include twice-daily water level measurements immediately upon initiation of dewatering in the Upland Complex for at least the first 30 days of dewatering, and then decreasing the frequency to weekly or monthly when the data reveals a predictable trend of drawdown. After stabilization of drawdown becomes apparent, monthly water level gauging of select piezometers and existing groundwater monitoring wells is considered adequate until cessation of dewatering. Water quality sampling from the wells and piezometers is not necessary. Monitoring of the COL monitoring wells in the top of the Catahoula Formation can be included, but is not considered necessary.

Construction dewatering in the Upland Complex is not expected to have any influence on water levels in the Mississippi River Alluvium. For this reason, monitoring of groundwater in the Mississippi River Alluvium is not considered to be necessary, even if groundwater withdrawal from the Mississippi River Alluvium aquifer is necessary to support Unit 3 construction or to provide alternate supplies of potable water for Unit 1 operations. Water quality is monitored in accordance with U.S. Environmental Protection Agency (EPA) and MDEQ public water system requirements, and in accordance with applicable well permits.

As noted above, all existing Unit 1 monitoring programs applicable at the time of Unit 3 construction are assumed to continue during construction, modified as necessary considering pre-operational monitoring for Unit 3, and for initiation of Unit 3 operations.

Surface Water

The NRC staff found that continuation of the existing monitoring program provides an adequate hydrological monitoring program (NUREG-1817, Subsection 2.6.1.3).

Standard engineering stormwater management practices and monitoring pursuant to the site's NPDES stormwater management program provide adequate monitoring of hydrological impacts to surface water.

Construction of off-site transmission line ROW utilizes engineering design incorporating standard practice for avoidance of construction in streams and wetland areas to minimize impacts due to hydrological alterations or to water quality. Construction of ROW is completed using stormwater best management practices and monitoring in conjunction with required MDEQ stormwater permits to provide adequate monitoring of off-site hydrological impact to surface water. CWA Section 404 permits are also acquired as necessary for ROW construction incorporating appropriate monitoring and mitigation to minimize construction impacts where avoidance is not possible.

NUREG-1817, Subsection 4.3.3 states that potential impacts to the Mississippi River from dredging for construction of intake and discharge structures would be negligible. Minimization of sediment dislocation and transport is controlled by implementation of engineering controls and construction sequencing. The nearest surface water intake is the Southeast Wood Fiber located 0.8 mi. downstream. That withdrawal is not used for potable water. No potable water intakes are located within 100 mi. downstream of GGNS. Therefore, monitoring of surface water is not necessary during dredging other than as required in accordance with Section 404 of the CWA permits for the project.

6.3.3 PRE-OPERATIONAL MONITORING

Existing monitoring programs and a summary of select monitoring program results were described in Section 2.3 of the ESP ER. The investigations described in ESP ER Section 2.3 provide additional pre-application monitoring data and baseline data for Unit 3 pre-operational monitoring. The pre-construction and construction monitoring programs are described above.

As described in Section 5.2, dewatering is not necessary for Unit 3 operations. Potential groundwater hydrological impacts during Unit 3 operations are limited to withdrawals of groundwater from the Upland Complex and the Mississippi River Alluvium aquifers. As discussed in Subsection 6.3.2, surface water discharge construction monitoring requirements are met by continuing the existing Unit 1 monitoring programs. The construction monitoring programs and existing ongoing GGNS monitoring programs provide a preoperational baseline of hydrological characteristics, and adequate pre-operational monitoring.

With the exception of the monitoring of withdrawals and associated impacts to uses of the Catahoula Formation, the NRC staff found that continuation of the existing monitoring program provides an adequate hydrological monitoring program (NUREG-1817, Subsection 2.6.1.3). As mentioned above, this section includes corrections to the ESP regarding withdrawal of groundwater from the Catahoula. No groundwater withdrawal from the Catahoula is planned, thus no impacts to the Catahoula as a result of groundwater withdrawal are anticipated, as discussed in Sections 2.3, 4.2, and 5.2. All applicable existing Unit 1 monitoring programs in place at the time of Unit 3 construction are assumed to continue during construction. No additional pre-operational monitoring is planned or warranted.

6.3.4 OPERATIONAL MONITORING

Operational hydrological monitoring information is discussed in Subsection 6.3.3 of the ESP ER. The unresolved information relating to hydrological monitoring of station operations was due to concern of the impacts of withdrawals from the Catahoula Formation aquifer. As discussed in Sections 2.3, 4.2, and 5.2, groundwater withdrawal from the Catahoula Formation is not anticipated for the continued operation of Unit 1, or for Unit 3 construction or operations.

NUREG-1817 Subsection 5.3.2 states that no new consumptive wells in the Holocene alluvial aquifer (Mississippi River Alluvium) are proposed for operation of the new facility; therefore, the staff concluded no impacts are anticipated on the alluvial aquifer. However, it may be necessary to withdraw groundwater for either Unit 3 construction or station operations, or both, from the Mississippi River Alluvium aquifer.

All groundwater withdrawals for continued operation of Unit 1 and for operations of GGNS Unit 3 are anticipated to be from the Upland Complex, the Mississippi River Alluvium, or both. The impacts on the Upland Complex and the Mississippi River Alluvium aquifers are discussed in Section 5.2, and are SMALL. As discussed in Section 5.2, no impacts on the Catahoula Formation are expected from these withdrawals. Therefore, operational monitoring of the impacts on the Catahoula Formation, Upland Complex, or the Mississippi River Alluvium is not warranted.

Continued use of the potable water wells installed to support Unit 3 construction activities is expected for support of Unit 3 station operations. Thus, pre-operational baseline hydrological conditions are developed during the pre-construction and construction monitoring programs discussed above. Wells installed in the Upland Complex or the Mississippi River Alluvium are required to be permitted in accordance with the applicable MDEQ groundwater use and protection standards.

As discussed in Section 5.2, dewatering during Unit 3 station operations is not necessary, and monitoring of hydrological conditions related to safety related structures is not warranted.

6.3.5 REFERENCES

None.

6.4 METEOROLOGICAL MONITORING

The information for this section is provided in the ESP Application Part 3 – Environmental Report, Section 6.4 and in NUREG-1817 Subsection 2.3.3. The staff indicated that the current meteorological monitoring program for the GGNS is suitable for preoperational and operational monitoring. No new and significant information is identified for this section.

6.4.1 REFERENCES

None.

6.5 ECOLOGICAL MONITORING

The information for this section is provided in the ESP Application Part 3 – Environmental Report, Section 6.5, and in NUREG-1817 Subsections 2.7.1.3 and 2.7.2.3. following supplemental information is provided.

6.5.1 TERRESTRIAL ECOLOGY AND LAND USE

In NUREG-1817, Subsection 2.7.1.3, the NRC staff concluded that a plan for pre-construction monitoring of use of the Grand Gulf ESP site and vicinity by the Louisiana black bear should be established in consultation with the Fish and Wildlife Service (FWS) Jackson, Mississippi, Field Office. Regarding bald eagles, in NUREG-1817, Subsection 2.7.1.2, the NRC staff determined that bald eagle presence on the Grand Gulf ESP site during nesting season should be considered possible in the absence of an aerial or ground survey to confirm or deny the presence of nest trees. NUREG-1817, Subsection 4.4.1.4, states that upland and bottomland areas on the Grand Gulf ESP site that would be disturbed by construction should undergo a botanical survey for five state-listed plant species. As discussed in Subsection 2.4.1.2, terrestrial ecology surveys for the Louisiana black bear, the bald eagle, and the five state-listed plant species were conducted to address these concerns and to better characterize the ecological setting of the Grand Gulf ESP site.

As discussed in Subsection 2.4.1.2.2, field surveys for suitable Louisiana black bear habitat were conducted on December 13 to December 14, 2006, and April 22 to April 27, 2007. These surveys were performed by walking transects in suitable habitat and tallying all potential tree den sites (i.e., trees with a diameter at breast height (DBH) of ≥36 in.) and inspecting the area for ground dens. Although suitably large trees occur on-site, no trees were found with enclosed cavities, claw marks, or other evidence suggesting actual use as a den tree. However, a probable ground den was observed north of the haul road and well outside of the area of proposed disturbance, as reported in Subsection 2.4.1.2.2. The potential presence of a single ground den does not change the conclusion in NUREG-1817, Subsections 4.4.3.1 and 5.4.3.1, that the impacts on the Louisiana black bear from the construction and operation of Unit 3 would be negligible. In NUREG-1817, Subsection 2.7.1.3, the NRC staff recommends a pre-construction monitoring program be developed in consultation with the USFWS Jackson, MS field office. Appropriate consultations will be initiated and associated monitoring programs undertaken prior to beginning any construction activity in or adjacent to potential black bear habitat.

As discussed in Subsection 2.4.1.2.3, a field survey for the presence of over-wintering and/or nesting bald eagles was conducted on December 11, 2006. This survey was performed by observing the shoreline habitat from a boat cruising at slow speed in the river and later re-inspecting potential nesting trees from the land side. No eagles were observed foraging in the river. No eagle nests were observed either from the river or on-land. Therefore, the use of the site by bald eagles is not likely.

As discussed in Subsection 2.4.1.2.1, field reconnaissance targeting the state listed plants was conducted on September 10 to September 13, 2006, and April 22 to April 27, 2007. This reconnaissance was conducted by inspecting several on-site areas with suitable habitat. Inspection revealed none of the plants of special interest. Therefore, the occurrence of these plants on-site is not likely.

Based on the results of the field surveys described above and in Section 2.4, additional terrestrial ecological monitoring is not warranted with the exception of that planned for the Louisiana black bear. No additional on-site terrestrial ecological monitoring is planned during the construction, pre-operational, or operational phases of the project.

6.5.2 AQUATIC ECOLOGY

In NUREG-1817, Subsection 2.7.2.3, aquatic ecological monitoring is discussed, focusing on water quality as regulated by the NPDES permit program mandated by the Federal Water Pollution Control Act of 1972. This permit program is administered by the EPA. The EPA delegated the NPDES permit program to the MDEQ. Any new water quality monitoring that may be necessitated by the addition of a new nuclear power generating facility at this site will be developed and implemented in cooperation with MDEQ.

Construction of new intake and discharge structures within the Mississippi River has the potential to disturb limited portions of near-shore habitat that might be occupied by the fat pocketbook mussel. The NRC stated in NUREG-1817, Subsection 4.4.3.1, that impacts on the mussel from construction activities cannot be evaluated without conducting surveys along the shoreline at the proposed intake and discharge structures. To address this concern, a targeted field survey to identify mussels in the area of the proposed intake and discharge structures was conducted on November 20, 2006, as discussed in Section 2.4. No native mussels of any species, including the fat pocketbook mussel, were found in the area. Therefore, the colonization of the area by mussels of any species is not likely.

Although the applicable regulatory definitions are still under litigation and are the subject of remand to the Environmental Protection Agency, Unit 3 will be subject to the Phase I regulations for new facilities or the Phase II regulations for existing facilities under Section 316(b) of the CWA. Section 316(b) requires the installation of the best technology available (BTA) for cooling water intake structures. The determination of what constitutes BTA is a decision currently left to the professional judgment of the permit writer. The construction of Unit 3 as a closed-cycle cooling facility with cooling towers and a through-screen flow velocity of 0.5 ft/s or less will satisfy either the Phase II existing facilities rule or the more stringent Phase I new facility rule. Since the new unit would most likely meet BTA requirements, there are no plans for additional on-site aquatic ecological monitoring during the construction, pre-operational, or operational phases of the project.

6.5.3 REFERENCES

None.

6.6 CHEMICAL MONITORING

The information for this section is provided in Section 6.6 of the ESP Application Part 3 – Environmental Report. The NRC staff found in NUREG-1817 Subsection 2.6.3.4 that because no specific design had been selected for the ESP facility, water treatment and wastewater designs were not known, and thus there was no basis to evaluate the suitability of the current monitoring program to fit the needs of the liquid effluents from a new ESP facility. The following supplemental information concerning pre-application monitoring, construction/pre-operational monitoring, and operational monitoring is provided to address this unresolved issue.

6.6.1 PRE-APPLICATION MONITORING

The description of waste streams and waste management systems for Unit 3 is described in Section 3.6. Potential impacts during Unit 3 construction and station operations are described in Chapters 4 and 5, respectively. The potential effluents from Unit 3 are anticipated to be similar in type and magnitude to those of Unit 1. A description of ongoing regional and Unit 1 monitoring programs and the existing base of monitoring data are provided in the ESP ER Subsection 6.6.1 and in ESP ER Section 2.3. Ongoing Unit 1 monitoring programs include those related to the NPDES permits, the Unit 1 potable water system, MDEQ groundwater withdrawal permit program, and Unit 1 environmental management programs, as described in Subsection 6.6.1 and Section 2.3 of the ESP ER. These monitoring programs provide sufficient pre-application monitoring. No additional pre-application monitoring is warranted.

6.6.2 CONSTRUCTION/PRE-OPERATIONAL MONITORING

<u>Construction Monitoring</u>

Surface Water

The potential impacts to surface water during construction are those associated with discharges from construction activities as discussed in Section 4.2. Discharges to surface water during construction include 1) stormwater runoff, 2) construction excavation dewatering, and 3) sanitary waste discharges from the construction workforce.

1. Stormwater Runoff. Plans are for the MDEQ Large Construction Stormwater General Permit, which is acquired prior to construction, to regulate stormwater discharges associated with Unit 3 construction activities. Stormwater monitoring during Unit 3 construction is planned in accordance with both this construction stormwater permit and the existing Unit 1 stormwater permit/Stormwater Pollution Prevention Plan (SWPPP), as Unit 3 construction includes activities in areas covered by the existing stormwater permit. The Large Construction Stormwater General Permit is to also include a SWPPP specific to the Unit 3 construction activities. The SWPPP is to describe BMPs to be implemented during construction. Such BMPs typically include engineering controls to minimize discharge impacts from erosion, sediments, equipment, and concrete batch plant operations, and the SWPPP includes a stormwater drainage site map that identifies potential sources of construction stormwater contamination and associated outfalls. Such sources of contamination are monitored in accordance with the permit requirements, which typically include visual inspection of BMPs, sources, and outfalls on

a regular basis to ensure the efficacy of the implemented controls, thus minimizing impacts from runoff. Construction outfall monitoring is expected to be performed at the discharge points into Stream A and Stream B, and any other outfalls identified in the SWPPP developed for construction activities.

2. Construction Excavation Dewatering. Discharges from construction excavation dewatering are also regulated by the MDEQ Large Construction Stormwater General Permit, which allows discharges from uncontaminated excavation dewatering that do not cause or contribute to violations of the state water quality standards in the receiving surface water. The groundwater discharged from Unit 3 construction dewatering is mostly from the Upland Complex, and to a lesser degree from the Mississippi River Alluvium along the intake and discharge pipeline construction areas. Groundwater quality for the Mississippi River Alluvium and the Upland Complex at the site was discussed in ESP ER Subsection 2.3.3.2, with data summarized in ESP ER Tables 2.3-33 and 2.3-34. Because these units are of sufficient quality to be considered for water supply purposes for Unit 3, violations of state water quality standards for chemical constituents from either source in the receiving water body are unlikely. Monitoring of receiving surface water bodies is not a prerequisite for the Large Construction Stormwater General Permit. Therefore, pre-construction surface water monitoring is not warranted. After the discharge is initiated, monitoring of the discharge and receiving water body is to be performed in accordance with the construction stormwater discharge permit, as described in the preceding paragraph.

3. Sanitary Waste Discharges. Any increase in volume of sanitary wastewater generated by Unit 3 construction activities are to be handled by the existing sanitary system and/or temporary portable facilities serviced by an off-site vendor. Currently, sanitary effluent from Unit 1 operations is treated on-site and discharged to surface water under an existing NPDES permit, which does not specify a limit for flow at the outfall receiving treated sanitary wastewater. Therefore, use of the existing sanitary treatment system is limited only by design capacity. If the capacity of the existing system is approached, temporary, portable facilities are expected to be used to meet the additional demand. In either case, no additional monitoring for sanitary effluents during construction, beyond the existing permit requirements, is warranted.

Groundwater

As discussed in Sections 2.3 and 4.2, the underlying sole-source aquifer (Catahoula Formation) is locally confined with limited hydraulic communication with the overlying Upland Complex, and thus is not expected to be affected during construction. Discharges of effluents to the groundwater during construction are not expected. As discussed, water quality in the Upland Complex is adequately monitored under existing monitoring programs. Monitoring programs established under the stormwater monitoring program in effect during construction, and under environmental management programs established under the Clean Water Act (such as for the Oil Pollution Prevention regulations in 40 CFR 112), provide adequate protection from potential construction-related chemical releases that might affect groundwater quality. Therefore, no additional chemical monitoring for groundwater is warranted during construction.

Potable water required for Unit 3 construction is to be obtained from new supply wells installed in the Upland Complex, the Mississippi River Alluvium, or both. The installation and operation of the new supply wells is regulated under the EPA, MDEQ, and Mississippi State Department of Health (MSDH) permit and testing requirements, which include documentation of water quality. Monitoring data from the existing Unit 1 potable wells are expected to be used to support this requirement. Groundwater quality for the Mississippi River Alluvium and the Upland Complex at the site was discussed in ESP ER Subsection 2.3.3.2, with data summarized in ESP ER Tables 2.3-33 and 2.3-34. Data for the Upland Complex is to also be obtained from the existing Unit 1 potable water well monitoring program. In addition, a pre-construction hydrological monitoring program, as discussed in Subsection 6.3.2, is to include the collection of groundwater samples from existing monitoring wells. Plans are to use these data to confirm potable water quality suitable for drinking water supply, and define potential treatment requirements to meet the public water system criteria. This well sampling program is expected to be discontinued upon the completion of the new potable water well installation, when the new potable water supply wells are to be sampled pursuant to EPA, MDEQ, and MSDH permit and testing requirements. Sample parameters to be analyzed from the monitoring wells and new Unit 3 water wells include the EPA primary and secondary drinking water standards analyses, as implemented by the MSDH. Additional groundwater quality chemical monitoring during construction is not warranted.

Pre-Operational Monitoring

The existing baseline of monitoring data described in the ESP ER Section 2.3, along with the pre-construction monitoring and continued ongoing monitoring programs described above, combined with the additional monitoring to be required by the new/revised NPDES permit discussed above, are considered sufficient pre-operational monitoring. Therefore, no additional pre-operational monitoring is warranted.

6.6.3 OPERATIONAL MONITORING

As indicated in NUREG-1817 Subsection 2.6.3.4, 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, only proportionally greater. Chemical impacts of Unit 3 operation are discussed in Sections 5.2 and 5.5. The following supplemental information is provided to describe Unit 3 station operational water quality monitoring.

Surface Water

Effluents from Units 1 and 3 are combined as described in Section 3.6. The combined discharges from Units 1 and 3 discharges are anticipated to require a modification of the existing MDEQ NPDES permit, or a new NPDES permit.

Plans are to discharge the combined sanitary waste effluent from Units 1 and 3 to the existing Unit 1 sanitary discharge outfall. The existing NPDES permit for this outfall would be modified consistent with the increased loadings of the combined effluents. The NPDES permit monitoring requirements are expected to be similar in frequency and discharge limits to those that currently exist for Unit 1 sanitary discharge.

Unit 3 operational stormwater quality monitoring is anticipated to be in accordance with the MDEQ general permit for stormwater associated with an industrial activity. MDEQ is expected to review the existing permit and evaluate what revisions are needed, if any, based on the addition of Unit 3 facilities. Site outfall monitoring is expected to be performed consistent with existing outfall monitoring requirements at the discharge points into Stream A and Stream B, and any other outfalls identified in the Unit 3 or combined Units 1 and 3 SWPPP developed for operational activities. The SWPPP describes BMPs to be employed such as engineering controls to minimize discharge impacts from erosion, sediments, equipment, chemical storage, or tank storage. The SWPPP also includes a stormwater drainage site map that identifies potential sources of stormwater contamination and outfalls. Potential sources of contamination and associated outfalls are also monitored in accordance with permit requirements.

Unit 3 cooling water and service water make-up is expected to be withdrawn from surface water in the Mississippi River. This withdrawn water requires pretreatment prior to use in the cooling, service water, fire protection system, and demineralization systems to remove, at a minimum, sediments entrained in the Mississippi River water as described in Section 3.6. This pretreatment results in an effluent which is to be treated, as necessary, prior to discharge under the revised NPDES permit. Discharge monitoring parameters and frequency for the revised NPDES permit, which includes both Unit 1 and Unit 3, are expected to be similar to the existing Unit 1 permit. The actual monitoring frequency and discharge monitoring parameters are expected to be established in the new NPDES permit acquired prior to Unit 3 operations startup.

Environmental management programs similar to those implemented for Unit 1 operations will establish controls to ensure BMPs to minimize land disturbance, minimize and control on-site chemical use, handling, and disposal, minimize and control pesticide and herbicide use for pest and vegetative management programs, and manage solid or hazardous waste generation, handling, and disposal.

The monitoring programs discussed above are expected to provide adequate surface water chemical monitoring to address the potential operational impacts.

Groundwater

As indicated in Section 4.2, the underlying sole-source aquifer (Catahoula Formation) is locally confined with limited hydraulic communication with the overlying Upland Complex, and is not affected by Unit 3 operations. The programs described above are expected to provide adequate protection of groundwater from potential chemical releases during Unit 3 operation. Therefore, chemical monitoring of groundwater during station operations is not warranted.

Potable and sanitary water for Unit 3 station operations are anticipated to be obtained from the new groundwater wells installed during Unit 3 construction. The new potable water supply wells are to continue to be sampled pursuant to EPA, MDEQ and MSDH requirements for a public water system. No additional operational potable water chemical monitoring is warranted.

6.6.4 REFERENCES

None.

6.7 SUMMARY OF MONITORING PROGRAMS

The information for this section is provided in the ESP Application Part 3 – Environmental Report Section 6.7; the following supplemental information is provided.

There were no unresolved items associated with Radiological Monitoring (Section 6.2) and Meteorological Monitoring (Section 6.4) in NUREG-1817. No new and significant information is identified for these sections.

This section summarizes all of the environmental monitoring programs described in Chapter 6. It is divided into three subsections:

- Pre-Application Monitoring
- Construction and Pre-Operational Monitoring
- Operational Monitoring

6.7.1 PRE-APPLICATION MONITORING

Thermal Monitoring. Supplemental information regarding thermal monitoring is provided in Section 6.1.

Radiological Monitoring. The information for this section was provided in the ESP ER, Section 6.2, and NUREG-1817 contained no unresolved items regarding radiological monitoring. No new and significant information is identified for this section.

Hydrological Monitoring. Unresolved items regarding hydrological monitoring are addressed in Sections 2.3 and 6.3.

Meteorological Monitoring. The information for this section was provided in the ESP ER Section 6.4, and NUREG-1817 contained no unresolved items regarding meteorological monitoring. No new and significant information is identified for this section.

Ecological Monitoring. Unresolved items regarding ecological monitoring are addressed in Sections 2.4 and 6.5.

Chemical Monitoring. Unresolved items regarding chemical monitoring are addressed in Sections 3.6 and 6.6.

6.7.2 CONSTRUCTION AND PRE-OPERATIONAL MONITORING

Thermal Monitoring. As described in Subsection 6.1.2, the existing base of monitoring data is considered sufficient for NPDES permit application requirements. No further construction/pre-operational thermal monitoring is planned or warranted.

Radiological Monitoring. The information for this section was provided in the ESP ER, Section 6.2, and NUREG-1817 contained no unresolved items regarding radiological monitoring. No new and significant information is identified for this section.

Hydrological Monitoring – Construction. Subsection 6.3.2 describes hydrological monitoring to be performed prior to and during construction, summarized as follows:

> *Surface Water*. The NRC staff found that continuation of the existing monitoring program provides an adequate hydrological monitoring program (NUREG-1817, Subsection 2.6.1.3). Hydrological impacts to surface water would also be adequately monitored via NPDES stormwater permits obtained for construction. Finally, potential impacts from dredging for construction of intake and discharge structures would be monitored in accordance with the CWA Section 404 permit for the project.
>
> *Groundwater*. Pre-construction hydrological monitoring is to be performed to reaffirm baseline water level conditions related to the Unit 1 potable water supply wells, and to confirm the sites for the new potable water supply wells for Unit 3.
>
> Construction hydrological monitoring includes water level gauging to monitor drawdown impacts during construction dewatering. The installation of additional test wells and piezometers may be required in some instances, for example, where existing monitoring wells are removed during construction.

Hydrological Monitoring – Preoperational. Unresolved items regarding hydrological monitoring are addressed in Sections 2.3 and 6.3. The existing base of data from the Unit 1 monitoring programs, supplemented by additional investigations for this COLA, provides an adequate pre-operational baseline. Therefore, no additional construction/pre-operational monitoring is planned or warranted.

Meteorological Monitoring. The information for this section was provided in the ESP ER Section 6.4, and NUREG-1817 contained no unresolved items regarding meteorological monitoring. No new and significant information is identified for this section.

Ecological Monitoring. Unresolved items regarding ecological monitoring are addressed in Section 6.5. With the exception of any monitoring requirements identified during the MDEQ permitting process and pre-construction monitoring for the Louisiana black bear to be coordinated with the USFWS Jackson, MS field office, no other construction/pre-operational ecological monitoring is planned.

Chemical Monitoring.

Surface Water. Chemical monitoring at the construction and pre-operational stages relating to stormwater runoff and construction excavation dewatering would be performed in accordance with the required MDEQ Large Construction Stormwater General Permit.

Additional sanitary waste discharges associated with construction would be handled by the existing sanitary system and/or temporary, portable facilities serviced by an off-site vendor, resulting in no additional construction/pre-operational monitoring requirements.

Groundwater. Existing groundwater monitoring programs for Unit 1 potable water supply wells and environmental management programs established during construction through the MDEQ Large Construction Stormwater General Permit provide adequate protection from potential construction-related chemical releases that might affect groundwater quality. Therefore, no additional chemical monitoring of groundwater at the construction or pre-operational stages is planned or warranted.

As discussed above in Hydrological Monitoring, pre-construction hydrological monitoring is to be performed to reaffirm baseline water level conditions related to the Unit 1 potable water supply wells, and to confirm the sites for the new potable water supply wells for Unit 3. Such monitoring is to be performed in accordance with EPA, MDEQ and MSDH chemical monitoring requirements.

6.7.3 OPERATIONAL MONITORING

Thermal Monitoring. The thermal monitoring program at Unit 3 would be an extension of the existing NPDES wastewater permit for Unit 1, which includes ongoing thermal monitoring, as described in ESP ER Subsection 6.1.1.

Radiological Monitoring. The information for this section was provided in the ESP ER, Section 6.2, and NUREG-1817 contained no unresolved items regarding radiological monitoring. No new and significant information is identified for this section.

Hydrological Monitoring. The unresolved item related to hydrological monitoring regarded potential impacts of withdrawal from the Catahoula Formation aquifer, and is addressed in Sections 2.3, 4.2, 5.2 and Subsection 6.3.4. No operational hydrological monitoring is warranted.

Meteorological Monitoring. The information for this section was provided in the ESP ER Section 6.4, and NUREG-1817 contained no unresolved items regarding meteorological monitoring. No new and significant information is identified for this section.

Ecological Monitoring. Unresolved items regarding ecological monitoring are addressed in Section 6.5. With the exception of any monitoring requirements identified during the MDEQ permitting process, no further operational ecological monitoring is planned.

Chemical Monitoring.

Surface Water. Revisions to the existing Unit 1 NPDES Permits for stormwater and wastewater discharges, and Unit 1 environmental programs, as described in Subsection 6.6.3, would provide adequate chemical monitoring of surface water to address potential operational impacts.

Groundwater. Chemical monitoring of the potable water supply wells installed during Unit 3 construction would be performed pursuant to EPA, MDEQ and MSDH requirements for a public water system.

The programs established in the revised NPDES permits (stormwater pollution prevention plan) and Unit 1 environmental programs, as described in Subsection 6.6.3, would provide adequate protection of groundwater from potential chemical releases during Unit 3 operation. Therefore, aside from the public water supply requirements discussed above, no further chemical monitoring of groundwater during operation is warranted.

6.7.4 REFERENCES

None.

CHAPTER 7 ENVIRONMENTAL IMPACTS OF POSTULATED ACCIDENTS INVOLVING RADIOACTIVE MATERIALS

This Chapter 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 Section 3.8.

7.1 DESIGN BASIS ACCIDENTS

The information for this section is provided in the Early Site Permit (ESP) Application Part 3 – Environmental Report (ER), Section 7.1, and associated impacts for advanced light-water-cooled reactor (LWR) designs are resolved in NUREG-1817.

NUREG-1817 resolved, in Subsection 5.10.1, that the consequences of DBAs at the Grand Gulf Nuclear Station (GGNS) ESP site are of SMALL significance for advanced LWRs. The NRC indicated in NUREG-1817 that because the source terms for accident analyses are generally proportional to the power level, for the purposes of the environmental impact evaluation, the potential consequences of accidents for the other reactor designs are expected to be bounded by those for the Advanced Boiling Water Reactor (ABWR) and surrogate Advanced Passive PWR (AP1000) designs. Stated reactor power for the ESBWR in the ESP ER was 4000 MWt, less than the ABWR power level of 4300 MWt. Therefore, the ABWR source terms were expected to bound the source terms for the ESBWR design. However, the ESBWR power level has changed to 4500 MWt, which is not bounded by that for the ABWR. NUREG-1817 states that if an Applicant references a design other than the ABWR or surrogate AP1000, the Applicant 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 NUREG-1817.

The early site permit, ESP-002, is subject to terms and conditions specified therein (see Section 3 of the ESP). Condition 3.B specifies controlling values of parameters and design basis accident source term plant parameters, as listed in Appendix B of the ESP. The design basis accident source terms listed in Appendix B of the ESP are those used in the analyses presented in the ESP ER, Section 7.1, and are specific to the GE ABWR and the Westinghouse AP1000 (advanced passive PWR) designs. The design proposed for construction and operation at the GGNS ESP site is the GEH ESBWR design. As stated above, a number of the accident source terms are specific to the AP1000, and therefore, do not apply for the analysis presented in this section. The source terms for the listed ABWR design basis accidents do not bound the corresponding ESBWR source terms, in terms of isotopic content and activity level.

Condition 3.D of ESP-002 identifies values of plant parameters considered in the environmental review of the ESP application; these plant parameters used in the ESP are identified in Appendix D of the permit. Reactor core thermal power is included in Table D1 of Appendix D of the ESP, and is indicated as 4300 MWt (10 percent uprate from the ABWR rated thermal power of 3926 MWt). The analyses described in the ESP ER, Section 7.1, utilized 102 percent of the ABWR rated reactor thermal power (1.02*3926=4005 MWt) as an input for determination of dose consequences for the loss of coolant accident and the fuel handling accident. The ESBWR rated core thermal power is 4500 MWt (Table 3.0-201), and 102 percent of this value, or 4590 MWt, is used as an input to these same accidents analyzed for the ESBWR, as described herein.

Pursuant to 10 CFR 50.34(a)(1), doses from postulated design basis accidents are calculated for hypothetical individuals, located at the closest point on the exclusion area boundary (EAB) for a two-hour period, and at the outer radius of the low population zone for the course of the accident. Among the conservative assumptions used in the Chapter 15 analyses presented in the design control document (DCD) is the use of adverse meteorological dispersion conditions (i.e., 95th percentile χ/Q). Actual consequences will likely be far less severe than those given for the same events in safety analysis reports where more conservative evaluations are used. For this reason, DBAs are evaluated to determine radiological consequences using more realistic meteorological conditions.

This section presents analyses of the post-accident radiological consequences of DBAs for the ESBWR reactor proposed for the GGNS ESP site. The results of the analyses given in Table 7.1-213 demonstrate that the environmental impacts remain well within the NRC review criteria, and therefore, the impacts associated with these accidents remain SMALL.

7.1.1 SELECTION OF DESIGN BASIS ACCIDENTS

The postulated accidents analyzed to demonstrate that an ESBWR reactor can be operated on the GGNS site without undue risk to the health and safety of the public are those identified in the ESBWR DCD, Chapter 15, Section 15.4. The accidents evaluated cover those listed in Regulatory Guide 1.183, and in NUREG-1555 Section 7.1, Appendix A, for a boiling-water-reactor plant. The DBAs evaluated for the ESBWR are:

- Fuel Handling Accident – FHA
- Loss of Coolant Accident Inside Containment – LOCA
- Main Steam Line Break Outside Containment
- Control Rod Drop Accident
- Feedwater Line Break Outside Containment
- Failure of Small Line Carrying Primary Coolant Outside Containment
- Reactor water clean-up/shutdown cooling (RWCU/SDC) System Line
- Spent Fuel Cask Drop Accident

7.1.2 EVALUATION OF RADIOLOGICAL CONSEQUENCES

Dose consequences for these DBAs were evaluated at the EAB and low population zone (LPZ) boundary. Although the emergency safeguard features are expected to prevent core damage and mitigate releases of radioactivity, the LOCAs analyzed conservatively presume substantial fuel failure to maximize fission product release for radiological evaluations. The radiological criteria for the EAB and the outer boundary of the LPZ are provided in 10 CFR 50.34. These criteria are stated for evaluating reactor accidents of exceedingly low probability of occurrence and low risk of public exposure to radiation, e.g., a large-break LOCA. For events with a higher probability of occurrence, the more restrictive dose limits in NUREG-0800 are used to ensure that the accident doses are acceptable. The accident doses are expressed as a total effective dose equivalent (TEDE), consistent with 10 CFR 50.34. The TEDE consists of the sum of the committed effective dose equivalent (CEDE) from inhalation and the deep dose equivalent (DDE) from external exposure. The CEDE is determined using dose conversion factors in Federal Guidance Report 11 (Reference 201). The DDE is taken as the same as the effective dose equivalent from external exposure, and the dose conversions in Federal Guidance Report 12 (Reference 202) are applied.

The accident dose evaluations were performed using realistic 50th percentile direction independent atmospheric dispersion (χ/Q) values for the EAB and LPZ, developed based on the on-site meteorological data used in the analyses presented in the ESP ER Section 7.1. The site-specific 50th percentile χ/Q values are presented in Table 2.7-201. The accident dose estimates were performed using χ/Q and activity releases for the following intervals as appropriate:

Exclusion Area Boundary

- 0 to 2 hours

Low Population Zone

- 0 to 8 hours
- 8 to 24 hours
- 1 to 4 days
- 4 to 30 days

The site-specific doses are based on the accident doses provided in the ESBWR DCD and the ratio of the site-specific χ/Q's and the DCD χ/Q's. Because this χ/Q ratio is less than one for all χ/Q comparisons, the site-specific doses are bounded by the DCD values.

7.1.3 SOURCE TERMS

Time-dependent activities released to the environs were used in the dose calculations. These activities are based on the analyses used to support the design basis accident analyses in DCD Chapter 15. The released activities account for the reactor core source term and accident mitigation features in the ESBWR standard plant design. The ESBWR source term and accident analyses approaches are based on the alternate source term (AST) methodology in accordance with Regulatory Guide 1.183.

7.1.4 POSTULATED ACCIDENTS

This section identifies the DBAs, the resultant activity release paths, the important accident parameters and assumptions, and the credited mitigation measures used in the off-site dose calculations. The ESBWR DCD, Chapter 15, provides additional discussion of these postulated accidents.

7.1.4.1 Fuel Handling Accident

The fuel handling accident is postulated as failure of the fuel assembly lifting mechanism, resulting in the dropping of a fuel assembly onto the reactor core or into the spent fuel storage pool. Fuel rods in the dropped and struck assemblies are damaged, releasing radioactive gases to the pool water.

The activity released in the pool water bubbles to the surface and passes to the reactor building or fuel building atmosphere. The emergency protection guidelines require that under FHA conditions the Heating Ventilation and Cooling (HVAC) system be shut down and the fuel-handling area of the reactor building or fuel building be isolated. Following isolation, the operator determines the extent of contamination and time for resuming operation of the HVAC. Isolation of the reactor building ventilation refueling floor subsystem (REPAVS) is required to ensure the 2-hour release assumption is conservative. Pool water is credited with the removal of elemental iodine released from the failed rods. Guidance from Regulatory Guide 1.183 was used in performance of the design basis analysis. The calculated doses given in DCD Chapter 15 are based on activity releases that assume:

FHA Parameters	
Core thermal power	4590 MWt
Decay time after shutdown	24 hours
Activity release period from pool	2 hours
Number of fuel bundles damaged	2
Radial peaking factor of damaged rods	1.5
Average fuel exposure	35,000 MWd/MT
Fuel rod fission product gap fractions	
I-131	8 percent
Kr-85	10 percent
Other noble gases and halogens	5 percent
Iodine chemical form	
Organic Iodine	0.15 percent
Elemental Iodine	4.85 percent
Particulate Iodine	95 percent
Noble Gas	100 percent
Pool decontamination for iodine	
Iodine (effective)	200
Noble Gas	1
Reactor Building release rate, percent/hr	
0 – 1.95 hours	500
1.95 – 2.0 hours	1.0E+08
Dose conversion factors	Regulatory Guide 1.183, Regulatory Position 4.1

The radionuclide inventory released to the environment from the damaged fuel is listed in Table 7.1-201. The GGNS site-specific doses were calculated using the χ/Q values given in Table 2.7-201. The resulting doses are summarized in Table 7.1-202. The EAB and LPZ doses are well within (less than 25 percent of) the 25 rem TEDE guidelines in 10 CFR 50.34(a)(1) and NUREG-1555.

7.1.4.2 Loss of Coolant Accident Inside Containment

This event postulates piping breaks inside containment of varying sizes, types and locations. The break type includes steam and liquid process lines. The emergency core cooling analyses show that there is no core uncovery as a consequence of this event. The temperature and pressure transients resulting from this accident are insufficient to cause perforation of the fuel cladding. Therefore, no fuel damage results from this accident. Although no fuel damage occurs, a fission product release is assumed without regard to mechanistic causes to evaluate the ability of the design to mitigate potential fission product releases to the containment. The source terms given in Chapter 15 of the ESBWR for this accident are based on the AST dose methodology of RG 1.183.

RG 1.183, Appendix A, Section 3.1 states that the radioactivity released from the fuel should be assumed to mix instantaneously and homogeneously throughout the free air volume of the drywell. It also states that the release into the drywell should be terminated at the end of the early in-vessel (EIV) release phase. As such, the AST dose methodology assumes a 2-hour phased release. Three phases are assumed: coolant, gap, and EIV. The coolant release phase is assumed to last 20 minutes based on an ESBWR specific model using the MELCOR computer code. During the coolant release phase, no fuel damage occurs. The fission gases in the plenum of the fuel rods are assumed to be released during the gap release phase. This gap release phase is assumed to last for 30 minutes, from 20 to 50 minutes following the break. The final release phase for DBA considerations is the EIV phase. During this phase the core is assumed to melt, thus core geometry is compromised. This phase is assumed to last for 90 minutes, or from 50 minutes to 2 hours 20 minutes. Thus core damage is assumed to occur over a period of 2 hours, after the initial coolant release phase of 20 minutes.

Two specific pathways are analyzed in releasing radionuclides to the environment: leakage from the primary containment building and leakage through the main steam isolation valves. The primary containment leakage pathway is assumed to be no greater than an equivalent release of 0.5 percent volume per day from the containment per plant Technical Specifications. The bulk of the primary containment leakage (98 percent, or 0.49 percent volume per day) is released into the reactor building. The reactor building leaks to the environment at a rate specified below. The remaining 2 percent of primary containment leakage is assumed to leak through the passive containment cooling system (PCCS) into the airspace directly above the PCCS and isolation condenser (IC) pools. This leakage is quickly vented directly to the atmosphere.

The second potential release pathway is via the main steamline through leakage in the main steamline isolation valves that close automatically at the beginning of the accident. It is assumed that a pathway exists which permits the containment atmosphere, or in the non-break case, pressure vessel air space, direct access to the main steamlines. The main steamline isolation valves are assumed to leak at the Technical Specification limit. Furthermore, it is assumed that the most critical main steamline isolation valve fails in the open position. Therefore, the total leakage through the steamlines is equal to the Technical Specification limit for the plant.

The most probable pathway for radionuclide transport from the main steamlines is found to be from the outboard MSIVs into the drain lines coming off the outboard MSIV and then into the Turbine Building to the main condenser. A secondary path is found along the main steamlines into the turbine though flow through this pathway as described below is a minor fraction of the flow through the drain lines. Activity reaching the main condenser and the turbine is held up before leaking from the turbine building to the environment. Iodine plateout occurs in the turbine, main condenser, and the steamlines/drain lines. However, no plateout credit is taken.

The calculated off-site doses given in Chapter 15 of the DCD are based on activity releases that assume:

LOCA Parameters	
Duration of accident	30 days
Core power level	4590 MWt
Time to fuel damage	20 min
Fraction of core inventory released	Table 1 of RG 1.183
Iodine chemical form	(RG 1.183, Appendix A, Section 2)
cesium iodine (CsI)	95 percent
elemental iodine	4.85 percent
organic iodine	0.15 percent
Primary containment leakage	0.5 percent volume/day
Fraction to Reactor Building (Leak Rate, percent/day)	0.98 (0.49)
Fraction to PCCS Airspace (Leak Rate, percent/day)	0.02 (0.01)
Primary Containment volume	7.206E+03 m3
Reactor Building leak rate	50 percent/day
Reactor Building mixing efficiency	40 percent
Reactor Building volume	6.05E+04 m3
Primary containment elemental iodine removal rate constant (0-12 hrs)	0.92 hr-1
Aerosol removal rate constants, hr-1	time varying, see DCD Table 15.4-5
Main steam isolation valve total leakage	6.23E-02 m3/minute

LOCA Parameters (cont.)	
Main steam line plateout factor	0 (not credited)
Condenser free air volume	6.23E+03 m3
Fraction of condenser volume involved	20 percent
Condenser iodine removal:	
Elemental and particulate iodine	99.5 percent
Organic iodine	0.0 percent

The integrated activity released to the environment as a function of time post accident is listed in Table 7.1-203. The GGNS site-specific doses were calculated using the χ/Q values given in Table 2.7-201. The doses for the large break LOCA accident are shown in Table 7.1-204. The calculated doses meet the 10 CFR 50.34(a)(1) dose acceptance criterion.

7.1.4.3 Main Steam Line Break Outside Containment

The ESBWR main steam line break (MSLB) outside containment assumes that the largest steamline instantaneously ruptures outside containment downstream of the outermost isolation valve. The plant is designed to automatically detect the break and initiate isolation of all main steamlines, including the faulted line. Mass flow would initially be limited by the flow restrictor in the upstream reactor steam nozzle and the flow restrictors in the three unbroken main steam lines feeding the downstream end of the break. Closure of the main steam isolation valves would terminate the mass flow out of the break.

No fuel damage would occur during this event. The only sources of activity are the concentrations present in the reactor coolant and steam before the break. The mass releases used to determine the activity available for release presume maximum instrumentation delays and isolation valve closing times. Iodine and noble gas activities in the water and steam masses discharged through the break are assumed to be released directly to the environs without hold-up or filtration. The calculated doses given in Chapter 15 of the DCD are based on activity releases that assume:

MSLB Outside Containment Parameters	
Duration of accident	2 hours
Main steam isolation valve closure	5 seconds
MSIV Response time	0.5 second
Mass release from break:	
steam	4705 kg (10,373 lbs)
Water	82,328 kg (181,502 lbs)
Reactor coolant maximum equilibrium activity	based on 0.2 mCi/gm Dose Equivalent I-131
Pre-existing iodine spike	4.0 mCi/gm Dose Equivalent I-131
Fuel damage	none

The activity released to the environment for the maximum equilibrium activity and pre-existing iodine spike is shown in Table 7.1-205. The GGNS site-specific doses were calculated using the EAB χ/Q values given in Table 2.7-201. The calculated doses for the maximum allowed equilibrium activity at full power operation are shown in Table 7.1-206. For this case, the doses at the EAB and LPZ are a small fraction of the 25 rem TEDE guidelines of 10 CFR 50.34 in accordance with NUREG-0800 Standard Review Plan 15.6.4. The calculated doses for the pre-existing iodine spike are shown in Table 7.1-206. The doses at the EAB and LPZ are within the 25 rem TEDE guideline of 10 CFR 50.34 in accordance with NUREG-0800.

7.1.4.4 Control Rod Drop Accident

The design of the ESBWR fine motion control rod drive system includes several new unique features compared with current BWR locking piston control rod drives. The new design precludes the occurrence of rod drop accidents. Therefore, as stated in DCD Section 15.4.6, no radiological consequence analysis is required.

7.1.4.5 Feedwater Line Break Outside Containment

The postulated break of the feedwater line, representing the largest liquid line outside the containment, provides the envelope evaluation for this type of break. The break is assumed to be instantaneous, circumferential and downstream of the outermost isolation valve. The break is isolated by closure of the feedwater check valves. The main steamlines are isolated on water level 2, and the automatic depressurization system (ADS) and the gravity-driven cooling system (GDCS) together restore the reactor water level to the normal elevation. The fuel is covered throughout the transient and there is no pressure or temperature transient sufficient to cause fuel damage. For the feedwater line break outside the containment, the worst single failure does not result in core uncovery, and there would be no fuel damage.

There is no fuel damage as a consequence of this accident. In addition, an insignificant quantity of activity (compared to that existing in the main condenser hotwell prior to the occurrence of the break) is released from the contained piping system prior to isolation closure. The iodine concentration assumed is that of the maximum equilibrium reactor water concentration used for the MSLB, subject to a 2 percent carryover of iodine in the water to steam condensate. Noble gas activity in the condensate is negligible because the air ejectors remove all noble gases from the condenser.

The transport pathway consists of liquid release from the break, carryover to the turbine building atmosphere due to flashing, and partitioning and unfiltered release to the environment through the turbine building ventilation system. The parameters used to calculate the dose in Chapter 15 of the DCD for this event are:

FW Line Break Outside Containment Parameters

Total mass of coolant released	259,654 kg (572,439 lbm)
Percent of coolant flashed to steam	22 percent
Demineralizer efficiency	99 percent
Iodine water concentration	0.2 mCi/g Dose Equivalent I-131
Iodine plateout fraction	0
Building release rate	Instantaneous
Meteorology	EAB χ/Q values given in Table 2.7-201.

Taking no credit for holdup, decay or plate-out during transport through the turbine building, the release of activity to the environment is presented in Table 7.1-207. The calculated exposures for the analysis are presented in Table 7.1-208, and are less than the regulatory guideline exposures.

7.1.4.6 Failure of Small Lines Carrying Primary Coolant Outside of Containment

This event consists of a small steam or liquid line break inside or outside the primary containment, but within a controlled release structure. To bound the event, it is assumed that a small instrument line, instantaneously and circumferentially, breaks at a location where it may not be able to be isolated and where detection is not automatic or apparent.

The following assumptions and conditions are the basis for the mass loss during the release period of this event.

- The instrument line releases coolant into the reactor building for 30 minutes at normal operating temperature and pressure. Following this time period, the operator detects the event, scrams the reactor and initiates reactor depressurization.

- Reactor coolant is released to the reactor building, until the reactor is depressurized.

- The flow from the instrument line is limited by reactor pressure and a 6-mm (0.25-inch) diameter flow restricting orifice inside the drywell. The Moody critical blowdown model is applicable, and the flow is critical at the orifice.

All iodine in the flashed water is assumed to be transported to the environs by the HVAC system without prior treatment. The iodine activity in the coolant is assumed to be at the maximum equilibrium Technical Specification limit for continuous operation. All other isotopes in the reactor water make only small contributions to the off-site dose. The doses calculated in Chapter 15 of the DCD are based on activity releases that assume:

Instrument Line Break Outside Containment Parameters

Duration of accident	6 hours
Reactor building release rate	500 percent/hour
Mass of reactor coolant released	14,785 kilograms (32,565 lbm)
Mass of fluid flashed to steam	4007 kilograms (8,825 lbm)
Iodine plateout fraction	0.0
Reactor coolant activity	based on 4.0 mCi/g Dose Equivalent I-131
Fuel damage	none

The calculated time-dependent radionuclide releases to the environment are shown in Table 7.1-209. These releases were used along with the χ/Q values given in Table 2.7-201 to determine the off-site doses. The TEDE doses for the failure of small lines carrying primary coolant outside containment are shown in Table 7.1-210. These doses are a small fraction of the 25 rem TEDE guidelines of 10 CFR 50.34 as per NUREG-0800, Standard Review Plan 15.6.2.

7.1.4.7 RWCU/SDC System Line Failure Outside Containment

To evaluate liquid process line pipe breaks outside containment, the failure of a cleanup water line is assumed to evaluate the response of the plant design to this postulated event. The postulated break of the cleanup water line, representing the most significant liquid line outside containment, provides the envelope evaluation for this type of break. The break is assumed to be instantaneous, circumferential and downstream of the outermost isolation valve. The fuel is covered throughout the transient and there are no pressure or temperature transients sufficient to cause fuel damage.

At the initiation of this accident it is assumed that the total non-filtered inventory in both the regenerative and non-regenerative heat exchangers is released through the break. Inventory in the demineralizer is prevented from being released by back flow check valves. A break on the downstream side of the demineralizer would be bounded due to the demineralizer action. Isolation of the line is conservatively analyzed based upon actuation of the flow differential pressure instrumentation. This instrumentation has a built-in 45-second time delay so that, for the initial 45 seconds of the accident, full flow exists through the line. After the initial 45-second flow, motor-operated isolation valves close over a period of 30 seconds. During this period of 75 seconds, flow of reactor water is assumed at the maximum equilibrium reactor water concentration, with flashing to steam at reactor temperature and pressure. In addition, iodine spiking is assumed. Noble gas activity in the reactor coolant is negligible and is therefore ignored in this analysis. Significant analysis input parameters used in the DCD Chapter 15 analysis are:

RWCU/SDC Line Break Outside Containment Parameters

Iodine plateout fraction	0.0
Reactor coolant activity:	
Equilibrium iodine activity	0.2 mCi/g Dose Equivalent I-131
Pre-incident spike activity	4.0 mCi/g Dose Equivalent I-131
Water-to-Steam Flashing Fractions	
RPV Coolant Blow-down	0.38
RWCU/SDC System RHX	0.28
RWCU/SDC System NRHX	0.074
Water Mass Released	
RPV Coolant Blow-down	128,650 kg (283,620 lbm)
RWCU/SDC System RHX	975 kg (2150 lbm)
RWCU/SDC System NRHX	3651 kg (8050 lbm)
Reactor Building Flow rate percent/hour	Instantaneous
Meteorology – EAB χ/Q values	Table 2.7-201

Fission product releases to the environment are presented in Table 7.1-211. The calculated exposures for the analysis are presented in Table 7.1-212 and are less than the regulatory guideline exposures.

7.1.4.8 Spent Fuel Cask Drop Accident

The fuel building design is such that a spent fuel cask drop height of 9.2 m, as specified in SRP 15.7.5, is not exceeded. This feature, along with administrative procedures limiting the travel range of the Fuel Building crane during cask handling activities, precludes damage of equipment or release of radioactivity due to dropping of a spent fuel shipping cask. Therefore, the radiological consequences of this accident are not evaluated. (See DCD Subsection 15.4.10)

7.1.5 REFERENCES

201 Federal Guidance Report 11, “Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion”, Second Printing 1989.

202 Federal Guidance Report 12, “External Exposure to Radionuclides in Air, Water, and Soil,” 1993.

TABLE 7.1-201
FHA ISOTOPIC RELEASE TO ENVIRONMENT

Isotope	Activity (Ci)	Activity (MBq)
I-131	1.36E+02	5.02E+06
I-132	9.12E-02	3.37E+03
I-133	8.48E+01	3.14E+06
I-134	1.04E-06	3.84E-02
I-135	1.41E+01	5.21E+05
Kr-85m	2.41E+02	8.93E+06
Kr-85	4.58E+02	1.69E+07
Kr-87	1.84E-02	6.81E+02
Kr-88	3.76E+01	1.39E+06
Xe-133	3.31E+04	1.22E+09
Xe-135	2.01E+03	7.42E+07

Source: 26A6642BP Rev. 04, ESBWR Design Control Document, Tier 2, Table 15.4-3a.

TABLE 7.1-202
FHA ANALYSIS RESULTS

Exposure Location and Time Duration	Maximum Calculated TEDE (rem)	10 CFR 50.34(a)(1) Acceptance Criterion TEDE (rem)
EAB for a 2-hour duration	0.13	6.3
Outer boundary of LPZ for the duration of the accident (30 days)	1.83E-02	6.3

Notes:

1. Since the release lasts only two hours, dispersion factors > 2 hours do not impact the calculated doses.

2. To convert rem to Sv, divide by 100.

TABLE 7.1-203 (SHEET 1 OF 3)
LOCA INSIDE CONTAINMENT INTEGRATED ENVIRONMENT RELEASE (MBq)

Nuclide	0.5 hr	2 hr	8 hr	12 hrs	24 hrs	4 d	7 d	30 d
Co-58	0.00E+00	1.00E+02	8.00E+02	1.20E+03	2.40E+03	7.20E+03	1.00E+04	2.50E+04
Co-60	0.00E+00	9.90E+01	7.80E+02	1.20E+03	2.40E+03	7.10E+03	1.00E+04	2.70E+04
Kr-85	3.50E+03	3.50E+05	1.00E+07	2.20E+07	9.20E+07	1.10E+09	2.80E+09	1.80E+10
Kr-85m	7.00E+04	5.70E+06	9.20E+07	1.50E+08	2.30E+08	2.60E+08	2.60E+08	2.60E+08
Kr-87	1.00E+05	5.30E+06	2.80E+07	3.00E+07	3.10E+07	3.10E+07	3.10E+07	3.10E+07
Kr-88	1.80E+05	1.30E+07	1.60E+08	2.20E+08	2.70E+08	2.70E+08	2.70E+08	2.70E+08
Rb-86	3.30E+02	5.10E+03	3.40E+04	5.00E+04	1.00E+05	2.80E+05	3.80E+05	7.30E+05
Sr-89	0.00E+00	1.60E+05	1.20E+06	1.90E+06	3.80E+06	1.10E+07	1.60E+07	3.80E+07
Sr-90	0.00E+00	1.60E+04	1.20E+05	1.90E+05	3.80E+05	1.10E+06	1.60E+06	4.30E+06
Sr-91	0.00E+00	1.80E+05	1.10E+06	1.50E+06	2.10E+06	2.50E+06	2.50E+06	2.50E+06
Sr-92	0.00E+00	1.40E+05	5.50E+05	6.10E+05	6.50E+05	6.50E+05	6.50E+05	6.50E+05
Y-90	0.00E+00	2.10E+02	5.30E+03	1.10E+04	4.40E+04	3.70E+05	7.40E+05	3.30E+06
Y-91	0.00E+00	2.10E+03	1.70E+04	2.60E+04	5.50E+04	1.70E+05	2.50E+05	6.00E+05
Y-92	0.00E+00	9.20E+03	2.70E+05	4.10E+05	5.60E+05	5.80E+05	5.80E+05	5.80E+05
Y-93	0.00E+00	2.20E+03	1.40E+04	1.90E+04	2.80E+04	3.30E+04	3.30E+04	3.30E+04
Zr-95	0.00E+00	2.90E+03	2.30E+04	3.40E+04	6.90E+04	2.00E+05	2.90E+05	7.00E+05
Zr-97	0.00E+00	2.80E+03	1.90E+04	2.70E+04	4.40E+04	6.30E+04	6.30E+04	6.30E+04
Nb-95	0.00E+00	2.90E+03	2.30E+04	3.40E+04	6.90E+04	2.10E+05	3.00E+05	7.80E+05
Mo-99	0.00E+00	3.70E+04	2.80E+05	4.20E+05	8.00E+05	1.80E+06	2.10E+06	2.40E+06
Tc-99m	0.00E+00	3.00E+04	2.50E+05	3.80E+05	7.50E+05	1.80E+06	2.10E+06	2.30E+06
Ru-103	0.00E+00	3.00E+04	2.40E+05	3.50E+05	7.10E+05	2.10E+06	3.00E+06	6.80E+06
Ru-105	0.00E+00	1.50E+04	7.70E+04	9.40E+04	1.10E+05	1.10E+05	1.10E+05	1.10E+05
Ru-106	0.00E+00	1.10E+04	8.20E+04	1.20E+05	2.50E+05	7.50E+05	1.10E+06	2.80E+06
Rh-105	0.00E+00	1.80E+04	1.40E+05	2.10E+05	3.80E+05	7.40E+05	7.90E+05	8.10E+05
Sb-127	0.00E+00	4.10E+04	3.10E+05	4.70E+05	9.00E+05	2.20E+06	2.70E+06	3.20E+06
Sb-129	0.00E+00	9.50E+04	4.80E+05	5.80E+05	6.70E+05	6.80E+05	6.80E+05	6.80E+05
Te-127	0.00E+00	3.90E+04	3.10E+05	4.70E+05	9.40E+05	2.40E+06	3.00E+06	4.40E+06
Te-127m	0.00E+00	5.50E+03	4.30E+04	6.50E+04	1.30E+05	3.90E+05	5.70E+05	1.50E+06

TABLE 7.1-203 (SHEET 2 OF 3)
LOCA INSIDE CONTAINMENT INTEGRATED ENVIRONMENT RELEASE (MBq)

Nuclide	0.5 hr	2 hr	8 hr	12 hrs	24 hrs	4 d	7 d	30 d
Te-129	0.00E+00	6.80E+04	5.10E+05	6.70E+05	9.60E+05	1.70E+06	2.10E+06	4.00E+06
Te-129m	0.00E+00	1.80E+04	1.40E+05	2.20E+05	4.40E+05	1.30E+06	1.80E+06	4.10E+06
Te-131m	0.00E+00	5.50E+04	4.00E+05	5.80E+05	1.00E+06	1.80E+06	1.90E+06	2.00E+06
Te-132	0.00E+00	5.60E+05	4.30E+06	6.30E+06	1.20E+07	2.90E+07	3.50E+07	4.00E+07
I-131	1.40E+05	2.70E+06	1.90E+07	2.80E+07	5.60E+07	1.70E+08	2.50E+08	4.60E+08
I-132	1.70E+05	2.80E+06	1.30E+07	1.60E+07	2.30E+07	4.30E+07	4.90E+07	5.50E+07
I-133	2.90E+05	5.30E+06	3.30E+07	4.70E+07	8.10E+07	1.30E+08	1.40E+08	1.40E+08
I-134	1.90E+05	1.70E+06	2.90E+06	2.90E+06	2.90E+06	2.90E+06	2.90E+06	2.90E+06
I-135	2.50E+05	4.40E+06	2.30E+07	2.90E+07	3.80E+07	4.10E+07	4.10E+07	4.10E+07
Xe-133	5.80E+05	5.60E+07	1.60E+09	3.50E+09	1.40E+10	1.30E+11	2.60E+11	5.80E+11
Xe-135	1.80E+05	1.70E+07	4.10E+08	7.60E+08	1.80E+09	3.10E+09	3.10E+09	3.10E+09
Cs-134	2.70E+04	4.30E+05	2.90E+06	4.30E+06	8.60E+06	2.50E+07	3.50E+07	9.00E+07
Cs-136	9.50E+03	1.50E+05	9.90E+05	1.50E+06	2.90E+06	7.90E+06	1.10E+07	1.90E+07
Cs-137	1.80E+04	2.80E+05	1.90E+06	2.80E+06	5.60E+06	1.60E+07	2.30E+07	5.90E+07
Ba-139	0.00E+00	1.20E+05	3.10E+05	3.20E+05	3.20E+05	3.20E+05	3.20E+05	3.20E+05
Ba-140	0.00E+00	2.80E+05	2.20E+06	3.30E+06	6.60E+06	1.80E+07	2.50E+07	4.50E+07
La-140	0.00E+00	4.30E+03	1.40E+05	3.00E+05	1.10E+06	8.50E+06	1.50E+07	3.70E+07
La-141	0.00E+00	2.00E+03	9.50E+03	1.10E+04	1.30E+04	1.30E+04	1.30E+04	1.30E+04
La-142	0.00E+00	1.20E+03	3.30E+03	3.40E+03	3.40E+03	3.40E+03	3.40E+03	3.40E+03
Ce-141	0.00E+00	6.70E+03	5.30E+04	7.90E+04	1.60E+05	4.70E+05	6.60E+05	1.50E+06
Ce-143	0.00E+00	6.10E+03	4.50E+04	6.50E+04	1.20E+05	2.20E+05	2.30E+05	2.30E+05
Ce-144	0.00E+00	5.50E+03	4.30E+04	6.50E+04	1.30E+05	3.90E+05	5.60E+05	1.50E+06
Pr-143	0.00E+00	2.50E+03	1.90E+04	2.90E+04	6.00E+04	1.80E+05	2.60E+05	4.90E+05
Nd-147	0.00E+00	1.10E+03	8.30E+03	1.30E+04	2.50E+04	6.90E+04	9.40E+04	1.60E+05
Np-239	0.00E+00	7.60E+04	5.70E+05	8.50E+05	1.60E+06	3.50E+06	4.00E+06	4.30E+06
Pu-238	0.00E+00	1.30E+01	1.10E+02	1.60E+02	3.20E+02	9.60E+02	1.40E+03	3.70E+03
Pu-239	0.00E+00	1.60E+00	1.30E+01	1.90E+01	3.90E+01	1.20E+02	1.70E+02	4.50E+02

TABLE 7.1-203 (SHEET 3 OF 3) LOCA INSIDE CONTAINMENT INTEGRATED ENVIRONMENT RELEASE (MBq)

Nuclide	0.5 hr	2 hr	8 hr	12 hrs	24 hrs	4 d	7 d	30 d
Pu-240	0.00E+00	2.10E+00	1.60E+01	2.50E+01	5.00E+01	1.50E+02	2.20E+02	5.80E+02
Pu-241	0.00E+00	6.10E+02	4.80E+03	7.20E+03	1.50E+04	4.40E+04	6.30E+04	1.70E+05
Am-241	0.00E+00	2.80E-01	2.20E+00	3.30E+00	6.60E+00	2.00E+01	2.90E+01	8.40E+01
Cm-242	0.00E+00	6.40E+01	5.00E+02	7.60E+02	1.50E+03	4.60E+03	6.60E+03	1.70E+04
Cm-244	0.00E+00	3.10E+00	2.40E+01	3.70E+01	7.50E+01	2.20E+02	3.20E+02	8.60E+02

Source: 26A6642BP Rev. 04, ESBWR Design Control Document, Tier 2, Table 15.4-7.

TABLE 7.1-204
LOCA INSIDE CONTAINMENT ANALYSIS RESULTS

Exposure Location	Maximum Calculated TEDE (rem)	10 CFR 50.34(a)(1) Acceptance Criterion TEDE (rem)
EAB	0.4	25
Outer boundary of LPZ		
0-8 hrs[1]	0.15	25
8-24 hrs[1]	0.30	
1-4 days[1]	0.70	
4-30 days[1]	1.55	

Notes:

1. The values listed do not account for an additional 20 minutes of decay during the coolant release phase; therefore, the times listed correspond to time after fuel damage (not from the onset of the event).

2. To convert rem to Sv, divide by 100.

**TABLE 7.1-205 (SHEET 1 OF 2)
MSLB ISOTOPIC RELEASE TO THE ENVIRONMENT**

Isotope	Maximum Equilibrium Activity (MBq)	Pre-Existing Iodine Spike Activity (MBq)	Isotope	Maximum Equilibrium Activity (MBq)	Pre-Existing Iodine Spike Activity (MBq)
Co-58	1.4E+03	1.4E+03	Te-131m	1.3E+03	1.3E+03
Co-60	2.7E+03	2.7E+03	Te-132	1.4E+02	1.4E+02
Kr-85	1.7E+00	1.7E+00	I-131	2.4E+05	4.9E+06
Kr-85m	4.4E+02	4.4E+02	I-132	2.3E+06	4.6E+07
Kr-87	1.4E+03	1.4E+03	I-133	1.7E+06	3.4E+07
Kr-88	1.4E+03	1.4E+03	I-134	4.2E+06	8.5E+07
Rb-86	0.0E+00	0.0E+00	I-135	2.4E+06	4.7E+07
Sr-89	1.4E+03	1.4E+03	Xe-133	5.9E+02	5.9E+02
Sr-90	9.4E+01	9.4E+01	Xe-135	1.6E+03	1.6E+03
Sr-91	5.2E+04	5.2E+04	Cs-134	3.7E+02	3.7E+02
Sr-92	1.2E+05	1.2E+05	Cs-136	2.4E+02	2.4E+02
Y-90	9.4E+01	9.4E+01	Cs-137	9.7E+02	9.7E+02
Y-91	5.5E+02	5.5E+02	Ba-139	0.0E+00	0.0E+00
Y-92	7.6E+04	7.6E+04	Ba-140	5.5E+03	5.5E+03
Y-93	5.2E+04	5.2E+04	La-140	5.5E+03	5.5E+03
Zr-95	1.1E+02	1.1E+02	La-141	0.0E+00	0.0E+00
Zr-97	0.0E+00	0.0E+00	La-142	0.0E+00	0.0E+00
Nb-95	1.1E+02	1.1E+02	Ce-141	4.0E+02	4.0E+02
Mo-99	2.7E+04	2.7E+04	Ce-143	0.0E+00	0.0E+00
Tc-99m	2.7E+04	2.7E+04	Ce-144	4.0E+01	4.0E+01
Ru-103	2.7E+02	2.7E+02	Pr-143	0.0E+00	0.0E+00
Ru-105	0.0E+00	0.0E+00	Nd-147	0.0E+00	0.0E+00

TABLE 7.1-205 (SHEET 2 OF 2)
MSLB ISOTOPIC RELEASE TO THE ENVIRONMENT

Isotope	Maximum Equilibrium Activity (MBq)	Pre-Existing Iodine Spike Activity (MBq)	Isotope	Maximum Equilibrium Activity (MBq)	Pre-Existing Iodine Spike Activity (MBq)
Ru-106	4.0E+01	4.0E+01	Np-239	1.1E+05	1.1E+05
Rh-105	0.0E+00	0.0E+00	Pu-238	0.0E+00	0.0E+00
Sb-127	0.0E+00	0.0E+00	Pu-239	0.0E+00	0.0E+00
Sb-129	0.0E+00	0.0E+00	Pu-240	0.0E+00	0.0E+00
Te-127	0.0E+00	0.0E+00	Pu-241	0.0E+00	0.0E+00
Te-127m	0.0E+00	0.0E+00	Am-241	0.0E+00	0.0E+00
Te-129	0.0E+00	0.0E+00	Cm-242	0.0E+00	0.0E+00
Te-129m	5.5E+02	5.5E+02	Cm-244	0.0E+00	0.0E+00

Source: 26A6642BP Rev. 04, ESBWR Design Control Document, Tier 2, Table 15.4-12.

TABLE 7.1-206
MSLB ANALYSIS RESULTS

Exposure Location and Time Period/ Duration	Maximum Calculated TEDE (rem)	Acceptance Criterion TEDE (rem)
EAB for the Entire Period of the Radioactive Cloud Passage		
Pre-incident Spike	0.4	25
Equilibrium Iodine Activity	0.02	2.5
Outer Boundary of LPZ for the Entire Period of the Radioactive Cloud Passage		
Pre-incident Spike	0.4	25
Equilibrium Iodine Activity	0.02	2.5

Notes:

1. LPZ χ/Q assumed to be the same as the EAB χ/Q as in the ESBWR DCD.

2. To convert rem to Sv, divide by 100.

TABLE 7.1-207
FEEDWATER LINE BREAK OUTSIDE CONTAINMENT ISOTOPIC RELEASE TO THE ENVIRONMENT

Isotope	Activity (MBq)
I-131	1.3E+02
I-132	1.2E+03
I-133	8.7E+02
I-134	2.2E+03
I-135	1.2E+03

Source: 26A6642BP Rev. 04, ESBWR Design Control Document, Tier 2, Table 15.4-15.

TABLE 7.1-208
FEEDWATER LINE BREAK OUTSIDE CONTAINMENT ANALYSIS RESULTS

Exposure Location and Time Period/ Duration	Maximum Calculated TEDE (rem)	Acceptance Criterion TEDE (rem)
EAB for the Entire Period of the Radioactive Cloud Passage	1.10E-05	2.5
Outer Boundary of LPZ for the Entire Period of the Radioactive Cloud Passage	1.10E-05	2.5

Notes:

1. LPZ χ/Q assumed to be the same as the EAB χ/Q as in the ESBWR DCD.

2. To convert rem to Sv, divide by 100.

TABLE 7.1-209 (SHEET 1 OF 2)
FAILURE OF SMALL LINE CARRYING PRIMARY COOLANT OUTSIDE CONTAINMENT RELEASE TO THE ENVIRONMENT (MBq)

Time (hr)	0.02	0.17	0.5	1	2	4	8	12
Co-58	1.2E-03	8.7E-02	7.4E-01	2.6E+00	8.2E+00	2.4E+01	4.8E+01	5.9E+01
Co-60	2.4E-03	1.7E-01	1.5E+00	5.1E+00	1.6E+01	4.8E+01	9.6E+01	1.2E+02
Rb-86	5.2E-01	3.7E+01	3.1E+02	1.1E+03	3.5E+03	1.0E+04	2.0E+04	2.5E+04
Sr-89	1.2E-03	8.7E-02	7.4E-01	2.6E+00	8.2E+00	2.4E+01	4.8E+01	5.9E+01
Sr-90	8.4E-05	6.0E-03	5.1E-02	1.8E-01	5.6E-01	1.7E+00	3.3E+00	4.0E+00
Sr-91	4.6E-02	3.3E+00	2.8E+01	9.7E+01	3.1E+02	9.2E+02	1.8E+03	2.2E+03
Sr-92	1.1E-01	7.9E+00	6.7E+01	2.3E+02	7.5E+02	2.2E+03	4.4E+03	5.3E+03
Y-90	8.4E-05	6.0E-03	5.1E-02	1.8E-01	5.6E-01	1.7E+00	3.3E+00	4.0E+00
Y-91	4.9E-04	3.5E-02	3.0E-01	1.0E+00	3.3E+00	9.7E+00	1.9E+01	2.3E+01
Y-92	6.8E-02	4.8E+00	4.1E+01	1.4E+02	4.6E+02	1.4E+03	2.7E+03	3.3E+03
Y-93	4.6E-02	3.3E+00	2.8E+01	9.7E+01	3.1E+02	9.2E+02	1.8E+03	2.2E+03
Zr-95	9.8E-05	7.0E-03	5.9E-02	2.0E-01	6.6E-01	1.9E+00	3.9E+00	4.7E+00
Nb-95	9.8E-05	7.0E-03	5.9E-02	2.0E-01	6.6E-01	1.9E+00	3.9E+00	4.7E+00
Mo-99	2.4E-02	1.7E+00	1.5E+01	5.1E+01	1.6E+02	4.8E+02	9.6E+02	1.2E+03
Tc-99m	2.4E-02	1.7E+00	1.5E+01	5.1E+01	1.6E+02	4.8E+02	9.6E+02	1.2E+03
Ru-103	2.4E-04	1.7E-02	1.5E-01	5.1E-01	1.6E+00	4.8E+00	9.6E+00	1.2E+01
Ru-106	3.5E-05	2.5E-03	2.1E-02	7.4E-02	2.4E-01	7.0E-01	1.4E+00	1.7E+00
Te-129m	4.9E-04	3.5E-02	3.0E-01	1.0E+00	3.3E+00	9.7E+00	1.9E+01	2.3E+01
Te-131m	1.2E-03	8.5E-02	7.2E-01	2.5E+00	8.0E+00	2.4E+01	4.7E+01	5.7E+01
Te-132	1.2E-04	8.7E-03	7.4E-02	2.6E-01	8.2E-01	2.4E+00	4.8E+00	5.9E+00
I-131	4.3E+00	3.1E+02	2.6E+03	9.1E+03	2.9E+04	8.6E+04	1.7E+05	2.1E+05
I-132	4.1E+01	2.9E+03	2.5E+04	8.6E+04	2.8E+05	8.2E+05	1.6E+06	2.0E+06
I-133	3.0E+01	2.1E+03	1.8E+04	6.3E+04	2.0E+05	6.0E+05	1.2E+06	1.4E+06
I-134	7.5E+01	5.4E+03	4.5E+04	1.6E+05	5.1E+05	1.5E+06	3.0E+06	3.6E+06
I-135	4.2E+01	3.0E+03	2.6E+04	8.8E+04	2.8E+05	8.4E+05	1.7E+06	2.0E+06
Cs-134	3.3E-04	2.3E-02	2.0E-01	6.8E-01	2.2E+00	6.5E+00	1.3E+01	1.6E+01

TABLE 7.1-209 (SHEET 2 OF 2)
FAILURE OF SMALL LINE CARRYING PRIMARY COOLANT OUTSIDE CONTAINMENT RELEASE TO THE ENVIRONMENT (MBq)

Time (hr)	0.02	0.17	0.5	1	2	4	8	12
Cs-136	2.2E-04	1.6E-02	1.3E-01	4.6E-01	1.5E+00	4.3E+00	8.6E+00	1.0E+01
Cs-137	8.7E-04	6.2E-02	5.2E-01	1.8E+00	5.8E+00	1.7E+01	3.4E+01	4.2E+01
Ba-140	4.9E-03	3.5E-01	3.0E+00	1.0E+01	3.3E+01	9.7E+01	1.9E+02	2.3E+02
La-140	4.9E-03	3.5E-01	3.0E+00	1.0E+01	3.3E+01	9.7E+01	1.9E+02	2.3E+02
Ce-141	3.5E-04	2.5E-02	2.1E-01	7.4E-01	2.4E+00	7.0E+00	1.4E+01	1.7E+01
Ce-144	3.5E-05	2.5E-03	2.1E-02	7.4E-02	2.4E-01	7.0E-01	1.4E+00	1.7E+00
Np-239	9.8E-02	7.0E+00	5.9E+01	2.0E+02	6.6E+02	1.9E+03	3.9E+03	4.7E+03

Source: 26A6642BP Rev. 04, ESBWR Design Control Document, Tier 2, Table 15.4-18.

TABLE 7.1-210
FAILURE OF SMALL LINE CARRYING PRIMARY COOLANT OUTSIDE CONTAINMENT ANALYSIS RESULTS

Exposure Location and Time Period/Duration	Maximum Calculated TEDE (rem)	10 CFR 50.34(a)(1) Acceptance Criterion TEDE (rem)
EAB for the Entire Period of the Radioactive Cloud Passage	4.9E-03	2.5
Outer Boundary of LPZ for the Entire Period of the Radioactive Cloud Passage		
0-8 hrs	1.88E-03	2.5
8-24 hrs	2.43E-03	2.5
1-4 days	2.43E-03	2.5
4-30 days	2.43E-03	2.5

Notes:

1. To convert rem to Sv, divide by 100.

**TABLE 7.1-211 (SHEET 1 OF 2)
RWCU/SDC LINE BREAK ACCIDENT ISOTOPIC
RELEASE TO ENVIRONMENT**

Isotope	Coincident Spike (MBq)	Pre-incident Spike (MBq)
I-131	1.46E+05	2.92E+06
I-132	1.38E+06	2.77E+07
I-133	1.01E+06	2.02E+07
I-134	2.54E+06	5.09E+07
I-135	1.42E+06	2.84E+07
Cs-134	1.68E+03	3.37E+04
Cs-136	1.12E+03	2.24E+04
Cs-137	4.49E+03	8.97E+04
Co-58	8.40E+02	8.40E+02
Co-60	1.63E+03	1.63E+03
Sr-89	6.36E+03	1.27E+05
Sr-90	4.49E+02	8.97E+03
Y-90	4.49E+02	8.97E+03
Sr-91	2.39E+05	4.79E+06
Sr-92	5.61E+05	1.12E+07
Y-91	2.47E+03	4.94E+04
Y-92	3.48E+05	6.95E+06
Y-93	2.39E+05	4.79E+06
Zr-95	4.86E+02	9.72E+03
Nb-95	4.86E+02	9.72E+03
Mo-99	1.23E+05	2.47E+06
Tc-99m	1.23E+05	2.47E+06

**TABLE 7.1-211 (SHEET 2 OF 2)
RWCU/SDC LINE BREAK ACCIDENT ISOTOPIC
RELEASE TO ENVIRONMENT**

Isotope	Coincident Spike (MBq)	Pre-incident Spike (MBq)
Ru-103	1.23E+03	2.47E+04
Ru-106	1.87E+02	3.74E+03
Te-129m	2.47E+03	4.94E+04
Te-131m	5.98E+03	1.20E+05
Te-132	5.98E+02	1.20E+04
Ba-140	2.47E+04	4.94E+05
La-140	2.47E+04	4.94E+05
Ce141	1.87E+03	3.74E+04
Ce-144	1.87E+02	3.74E+03
Np-239	4.86E+05	9.72E+06

Source: 26A6642BP Rev. 04, ESBWR Design Control Document, Tier 2, Table 15.4-22.

TABLE 7.1-212
RWCU/SDC LINE BREAK ANALYSIS RESULTS

Exposure Location and Time Period/Duration	Maximum Calculated TEDE (rem)	Acceptance Criterion TEDE (rem)
Coincident Iodine Spike		
EAB for the Entire Period of the Radioactive Cloud Passage	1.59E-02	2.5
Outer Boundary of LPZ for the Entire Period of the Radioactive Cloud Passage	2.20E-03	2.5
Pre-incident Iodine Spike		
EAB for the Entire Period of the Radioactive Cloud Passage	3.18E-01	25
Outer Boundary of LPZ for the Entire Period of the Radioactive Cloud Passage	4.36E-02	25

Notes:

1. To convert rem to Sv, divide by 100.

TABLE 7.1-213
DESIGN BASIS ACCIDENT DOSES

Accident	Unit 3 Dose (rem) EAB	Unit 3 Dose (rem) LPZ	Review Criterion TEDE in rem[a]
Main Steam Line Break			
Pre-Existing Iodine Spike	0.4	0.4	25 [b]
Maximum Equilibrium Iodine Activity	0.02	0.02	2.5 [c]
Loss-of-Coolant Accident	0.4	1.55	25 [b]
Failure of Small Lines Carrying Primary Coolant Outside Containment	4.9E-03	2.43E-03	2.5 [c]
Fuel Handling	0.13	1.83E-02	6.3 [b]
Feedwater Line Break	1.1E-05	1.1E-05	2.5 [c]
RWCU/SDC Line Break (Coincident Iodine Spike)	1.59E-02	2.20E-03	2.5 [c]
RWCU/SDC Line Break (Pre-incident Spike)	3.18E-01	4.36E-02	25 [c]

Notes:

(a) To convert rem to Sv, divide by 100.

(b) 10 CFR 50.34(a)(1); 10 CFR 100.11; 10 CFR 100.21.

(c) NUREG-0800 Standard Review Plan criterion.

EAB = exclusion area boundary

LPZ = low population zone

TEDE = total effective dose equivalent

7.2 SEVERE ACCIDENTS

The information for this section is provided in the ESP Application Part 3 – Environmental Report, Section 7.2. In response to an NRC request for additional information (RAI) dated May 19, 2004 (Reference 202), a site-specific analysis of the potential environmental consequences of postulated severe accidents at the Grand Gulf ESP site was performed using the source term for the ABWR and the MACCS2 computer code for the analysis. Results of the analysis were submitted to the NRC in a letter dated August 10, 2004 (Reference 201).

The NRC evaluated information provided in the ESP application and the RAI response provided by SERI and concluded in NUREG-1817 Subsection 5.10.2 that the probability weighted consequences of severe accidents at the Grand Gulf ESP site are of SMALL significance for an advanced LWR. In NUREG-1817 Subsection 5.10.3, the NRC indicated that the probability weighted consequences of severe accidents for an ESBWR are expected to be bounded by those for an ABWR, and that the potential environmental impacts from a postulated accident from the operation of one or more additional nuclear power units would be SMALL for the advanced LWRs. The following supplemental information is provided.

A re-evaluation of severe accident consequences was performed to confirm the ABWR was bounding, as expected in NUREG-1817, Subsection 5.10.3, for the ESBWR. This confirmatory analysis used the MACCS2 analysis code and the ESBWR thermal power of 4500 MWt (see Table 3.0-201 for PPE Section 17.3). The analysis confirmed the conclusion of NUREG-1817 that the ABWR severe accident consequences are bounding for the ESBWR, and thus the associated environmental impacts for this advanced LWR are considered SMALL. No additional information was identified for this section.

7.2.1 REFERENCES

201 System Energy Resources, Inc., “Response to Request for Additional Environmental Information Related to Early Site Permit Application (Partial Response No. 4),” Docket 52-009, CNRO-2004-00050, August 10, 2004 (ADAMS Accession No. ML050380162).

202 USNRC, Request for Additional Information Related to the Staffs Review of the Environmental Report for the Grand Gulf Early Site Permit Application (TAC No. MCI 379), CNRI-2004-00007, dated May 19, 2004 (ADAMS Accession No. ML041420530).

7.3 SEVERE ACCIDENT MITIGATION ALTERNATIVES

Information for this section is not provided in the ESP Application Part 3 – Environmental Report; the following supplements are provided.

7.3.1 INTRODUCTION AND BACKGROUND

This subsection updates the GE-Hitachi (GEH) Severe Accidents Mitigation Design Alternatives (SAMDA) discussion provided in NEDO-33306 (Reference 202) with Grand Gulf Nuclear Station (GGNS) Unit 3 site and regional data. The GGNS site-specific analysis demonstrates that the severe accident mitigation design alternatives determined not to be cost beneficial by GEH are also not cost beneficial when GGNS site-specific data are considered.

The NRC staff has expanded the concept of SAMDAs to encompass design alternatives to prevent severe accidents, as well as to mitigate them. By doing so, the Staff makes the set of SAMDAs considered under the National Environmental Policy Act (NEPA) the same as the set of SAMDAs considered in satisfaction of the Commission's severe accident requirements and policies.

In performing the PRA for the ESBWR design, GEH identified and evaluated a number of severe accident sequences. Only the sequences with frequencies greater than 1E-9 per reactor year were considered. For each sequence considered, the analysis identified an initiating event and traced the accident's progression to its end. For sequences resulting in core damage, off-site consequences were estimated. The complete radiological consequence analysis of the dominant sequences can be found in the GEH SAMDA analysis, NEDO-33201 (Reference 201). Sequences with probabilities of occurrence less than 1E-9 were considered remote and speculative.

As stated in NEDO-33201, the environmental effects of severe accidents for plants of ESBWR design represent a low and acceptable risk to the population and to the environment. For the ESBWR design, all reasonable steps have been taken to reduce the occurrence of a severe accident involving substantial damage to the core and to mitigate the consequences of such an accident should one occur. No further cost-effective modifications to the ESBWR design have been identified to reduce the risk from a severe accident involving substantial damage to the core. No further evaluation of severe accidents for the ESBWR design is required to demonstrate compliance with the Commission's severe accident requirements or policy, SECY-90-016 (Reference 205).

The GEH SAMDA analysis, which was based on the ESBWR PRA, NEDO-33201, (Reference 201), determined that severe accident impacts are small and that all potential mitigating design alternatives that are cost-effective are already incorporated into the plant design. The analysis in this section provides assurance that there are no additional cost-beneficial design alternatives that would need to be implemented at the GGNS site to further mitigate the already small severe accident impacts.

7.3.2 THE SAMA ANALYSIS PROCESS

Design or procedural modifications that could mitigate the consequences of a severe accident are known as severe accident mitigation alternatives (SAMAs). SAMAs are somewhat broader than SAMDAs, which primarily focus on design changes and do not consider procedural modifications. The GEH analysis in NEDO-33306 is a SAMDA analysis. For an existing plant with a well-defined design and established procedural controls, the normal evaluation process for identifying and analyzing potential SAMAs includes four steps:

1. Define the base case – The base case is the dose-risk and cost-risk of severe accidents before implementation of any SAMAs. The plant-specific probabilistic risk assessment is a primary source of data in calculating the base case. The base case risks are converted to a monetary value to use as screening values for subsequent SAMA evaluations.

2. Identify and screen potential SAMAs – Potential SAMAs can be identified from the Individual Plant Examination, the probabilistic risk assessment, and the results of other plants' SAMA analyses. This list of potential SAMAs is assigned a conservatively low implementation cost based on historical costs, similar design changes and/or engineering judgment, and is then compared to the base case screening value. SAMAs with higher implementation cost than the base case are not evaluated further.

3. Determine the cost of each SAMA – A detailed engineering cost evaluation is developed using current plant engineering processes for each SAMA remaining after Step 2. If the SAMA cost is lower than the screening value, Step 4 is performed.

4. Determine the benefit associated with each screened SAMA – Each SAMA that passes the screening in Step 3 is evaluated using the probabilistic risk assessment model to determine the reduction in risk associated with implementation of the proposed SAMA. The reduction in risk benefit is then monetized and compared to the detailed cost estimate. Those SAMAs with reasonable cost-benefit ratios are considered for implementation.

In the absence of a completed plant with established procedural controls, the current analysis is limited to demonstrating that the GGNS site is bounded by the GEH SAMDA analysis and determining what magnitude of plant-specific design or procedural modification would be cost effective. The base case benefit value is calculated by assuming the current dose risk of the unit could be reduced to zero and assigning a defined dollar value for this change in risk. Any design or procedural change cost that exceeded the benefit value would not be considered cost effective. The dose-risk and cost-risk results are monetized in accordance with methods established in NUREG/BR-0184, "Regulatory Analysis Technical Evaluation Handbook," 1997. NUREG/BR-0184 presents methods for determination of the value of decreases in risk, using the following attributes: public health, occupational health, off-site property, replacement power costs, and on-site property. Any SAMAs in which the conservatively low implementation cost exceeds the base case monetization would not be expected to pass the screening in Step 2. If the baseline analysis produces a value that is below that expected for implementation of any reasonable SAMA, no matter how inexpensive to implement, then the remaining steps of the SAMA analysis are not necessary.

7.3.3 THE ESBWR SAMDA ANALYSIS

GEH Licensing Topical Report NEDO-33306 provided a list of severe accident mitigation design candidates that were compiled from the list of SAMA issues from GE Report 25A5680, the Technical Support Document for the ABWR (Reference 203), and from a generic list compiled for license renewal environmental reports (Reference 204). This list was screened to eliminate activities that do not apply to the ESBWR design or have no significant benefit. The following screening criteria were applied:

1. Not applicable.

   An issue that only pertains to another class of reactors, even on a functional level.

2. Already incorporated into the ESBWR design.

   Cases where the risk-beneficial design features have already been applied to the ESBWR.

3. Not a design alternative.

   The proposed activity does not involve a design change; it is for procedural or administrative changes only.

4. Excessive implementation cost.

   If a SAMA requires extensive changes that obviously would exceed the maximum averted risk benefit, it is not retained.

5. Very low benefit.

   If the change in reliability is known to have a negligible effect on risk, it is not retained.

6. Candidate for cost-benefit consideration.

   If a SAMA is not eliminated by application of the above criteria, it would then become a candidate for cost-benefit analysis.

The initial list of 177 items identified in NEDO-33306 was analyzed by GEH to determine if there are cost-beneficial design alternatives that should be considered for the ESBWR. The screening analysis identified 42 alternatives which are not applicable, primarily due to issues involving either loss of reactor coolant pump seals, which is an issue with current PWRs, or BWR-specific issues, for example, reactor core isolation cooling pump operations. There were 65 design alternatives that are similar to, or are already incorporated into, the ESBWR design. A summary of these types of design features is provided in NEDO-33306. There are 29 items identified in NEDO-33306 that are procedural or administrative, and thus are not design features. The benefits offered by these changes were deemed not likely to exceed those for the design modifications that were evaluated. Twenty-six of the issues were not feasible because their cost would clearly outweigh any risk-benefit consideration. The final 15 issues were considered to have very low benefit due to their insignificant contribution to reducing risk. As a result, no further SAMA design modifications were considered. Several design enhancements relative to severe accident mitigation have already been incorporated into the ESBWR design. Potential design enhancements from generic BWR SAMA analyses and from the ABWR have been evaluated on a risk-benefit basis. The economic impacts of radiological consequences, when combined with the probability of a severe accident, yield an overall risk that is significantly lower than current operating reactors. Therefore, no additional design modifications yield a positive cost-benefit.

7.3.4 COST-BENEFIT EVALUATION

7.3.4.1 Cost-Benefit Standard for Evaluation of ESBWR SAMDAs

The cost-benefit ratio of $2000 per person-rem averted is viewed by the NRC and the nuclear industry as an acceptable standard for the purposes of evaluating SAMDAs. This standard was used by GEH as a surrogate for all off-site costs in the cost-benefit evaluation of SAMDAs to plants of ESBWR design. In order to accurately reflect the costs associated with prevention of severe accidents, averted on-site costs were incorporated for SAMDAs that were at least partially preventive in nature. On-site costs resulting from a severe accident include replacement power, on-site cleanup costs, and economic loss of the facility. A plant life time of 60 years was assumed to maximize the reduction in residual risk.

7.3.4.2 Cost Estimates of Potential Modifications to the ESBWR Design

All previous evaluations of design alternatives (e.g., the Limerick and Comanche Peak FES Supplements, the Peach Bottom license renewal, and the ABWR SAMDA (Reference 203), and NUREG-1437) have reported design alternative costs which, at a minimum, are in the hundreds of thousands of dollars. The high cost of design alternatives which have the potential to provide risk reduction is also demonstrated in several state-of-the-art surveys (e.g., NUREG/CR-3908, NUREG/CR-4025 and NUREG/CR-4920). In fact, most proposed design alternatives cost in the millions of dollars to implement.

The analysis in NEDO-33306 uses a representative design alternative best estimate implementation cost of $4628 (which is below the cost of all design alternatives which would be expected to provide a non-negligible reduction in risk) to determine if additional analysis needs to be performed for plants of ESBWR design. The upper bound total maximum averted cost given in NEDO-33306 is $41,383. The NEDO maximum averted cost assumes a discount rate of 7 percent.

ESBWR design alternatives that provide only severe accident mitigation must cost less than $4628 which is the minimum cost for a design alternative that has the potential for a measurable reduction in severe accident risk. This low cost limitation is a result of the ESBWR providing adequate protection to the public and the environment. A more detailed analysis of specific design alternatives is not warranted because none of the identified alternatives have an estimated cost lower than $4628. Therefore, ESBWR plants do not require additional SAMDA evaluations.

7.3.5 MONETIZATION OF THE GGNS BASE CASE

A site-specific analysis to determine the probability weighted consequences of severe accidents for an ESBWR at the Grand Gulf ESP Site was performed using the source term for the ESBWR reactor, and site-specific data from Reference 206, updated as necessary to reflect current information. The probability weighted consequences of severe accidents for an ESBWR are bounded by those for an ABWR evaluated and reported in NUREG-1817.

The principal inputs to the site specific monetization calculations are the release frequency, dose-risk and dollar-risk, dollars per person-rem ($2000 as provided by NRC in NUREG/BR-0184), licensing period, and economic discount rate (7 percent and 3 percent are NRC precedents). With these inputs, the monetized value of reducing the base case core damage frequency to zero is presented in Table 7.3-201. The monetized value, known as the maximum averted cost-risk, is conservative because no SAMDA can reduce the core damage frequency to zero. The maximum averted cost-risk of $1088 for a single ESBWR at the GGNS site is so low that there are no design changes, over those already incorporated into the ESBWR design, that could be determined to be cost-effective. Even with a conservative 3 percent discount rate, the valuation of the averted risk is only $2412.

The value of $1088 compares to the GEH generic analysis results of $4628 based on a 7 percent discount rate. The plant-specific analysis used actual population and meteorological characteristics that result in lower impacts than did the conservative values used in GEH's generic SAMDA analysis. Accordingly, further evaluation of design-related SAMAs is not warranted for Unit 3.

7.3.6 NON-DESIGN RELATED SAMAs

Further evaluation of non-design-related SAMAs for Unit 3 is not warranted. Due to the costs associated with processing procedural and administrative changes (including training costs), administrative changes are likely to cost more than the maximum averted cost-risk. Furthermore, since procedural and administrative changes would likely have a small impact on risk, the reduction in risk benefit from such changes will likely be substantially less than the cost of the administrative changes. Evaluation of procedural and administrative controls would not be appropriate until a plant design is finalized and plant administrative processes and procedures are being developed. At that time, appropriate administrative controls on plant operations would be incorporated into the plant's management systems as part of its baseline.

7.3.7 REFERENCES

201 GEH Licensing Topical Report NEDO-33201, Revision 2, “ESBWR Certification Probabilistic Risk Assessment.”

202 GEH Licensing Topical Report NEDO-33306, Revision 1, “ESBWR Severe Accident Management Design Alternatives.”

203 GE Nuclear Technology, “Technical Support Document for the ABWR,” 25A5680, Revision 1, January 1995.

204 “License Renewal Application – Peach Bottom Atomic Power Station, Units 2 and 3,” July 2001.

205 SECY-90-016, January 12, 1990, “Evolutionary Light Water Reactor (LWR) Certification Issues and Their Relationship to Current Regulatory Requirements.”

206 System Energy Resources, Inc., "Response to Request for Additional Environmental Information Related to Early Site Permit Application (Partial Response No. 4)," Docket 52-009, CNRO-2004-00050, August 10, 2004 (ADAMS Accession No. ML050380162).

TABLE 7.3-201
MAXIMUM AVERTED RISK BENEFIT

	Generic ESBWR	GGNS Site	
	Best Estimate 7% Discount Rate[1]	Best Estimate 7% Discount Rate	Best Estimate 3% Discount Rate
Averted Public Exposure Cost:	$366	$13	$33
Averted Off-site Property Damage Cost:	$157	$12	$30
Averted Occupational Exposure Cost:	$38	$15	$41
Averted On-site Cost:	$1167	$429	$958
Replacement Power Cost:	$2900	$618	$1350
Total (Maximum Averted Cost Benefit):	$4628	$1088	$2412

NOTES:

1. NEDO-33306, Revision 1, Licensing Topical Report, ESBWR Severe Accident Mitigation Design Alternatives.

7.4 TRANSPORTATION ACCIDENTS

See Section 3.8 of this report.

CHAPTER 8 NEED FOR POWER

8.0 NEED FOR POWER

This ER chapter describes the methods utilized to assess the need for power for the proposed project. The evaluation of need for power is described in the following sections:

- Description of Power System (Section 8.1)
- Power Demand (Section 8.2)
- Power Supply (Section 8.3)
- Assessment of Need for Power (Section 8.4)

8.1 DESCRIPTION OF POWER SYSTEM

Information for this section is not provided in the Early Site Permit (ESP) Application Part 3 – Environmental Report (ER); the following supplements are provided.

The proposed location of the new facility is near Port Gibson, Mississippi, on the Grand Gulf Nuclear Station (GGNS) site. GGNS Unit 1 is operated by Entergy Operations Inc. and is interconnected to load by the transmission system of Entergy Mississippi Inc. (EMI). EMI is a member of the Entergy Electric System (EES). Other members of the EES are Entergy Arkansas Inc. (EAI), Entergy Louisiana LLC (ELL), Entergy New Orleans Inc. (ENO), Entergy Gulf States Louisiana LLC (EGSL) and Entergy Texas Inc. (ETI) (collectively the “Entergy Operating Companies”).

The EES is located within the SERC Reliability Corporation (SERC). The SERC is the regional entity responsible for promoting, coordinating and ensuring the reliability and adequacy of the bulk power supply systems in the area served by the member systems. SERC promotes the development of reliability and adequacy arrangements among the systems, participates in the establishment of reliability standards, administers a regional compliance and enforcement program, and provides a mechanism to resolve disputes on reliability issues (Reference 201). Figure 8.1-201 is a map indicating the boundaries of the SERC region within the North American Electric Reliability Council. The SERC region is divided into five subregions: Entergy, Gateway, Southern, TVA, and VACAR.

8.1.1 SERVICE AREA OVERVIEW

The Entergy Operating Companies are operated on an integrated, coordinated basis as a single electric system under the provisions of the System Agreement. The current version of the System Agreement was approved by the Federal Energy Regulatory Commission (FERC) in 1985 and has been amended from time to time since then. Unless otherwise noted, historical load data and projections of future electric load requirements provided in this Chapter are for the EES.

EAI has provided notice to terminate its participation in the System Agreement effective 96 months from December 19, 2005 or such earlier date as authorized by the FERC. EMI has provided notice to terminate its participation in the System Agreement effective 96 months from November 8, 2007 or such earlier date as authorized by the FERC. EAI and EMI will remain as Entergy Operating Companies. Power production and consumption by EAI and EMI will remain along the trends as forecast later in this chapter. EAI and EMI terminating their participation in the System Agreement may affect how they interact with the other EES members with respect to purchases, sales and rates. Successor arrangements will be considered by the Entergy Operating Committee during the second half of 2008. However, whether EAI and EMI continue to participate in successor arrangements with the other Operating Companies should have little effect on total regional power supply and demand.

Figure 8.1-202 is a regional map of the EES which shows the relevant service area of the system, including major transmission connections to neighboring utility systems. The relevant service area is defined as the service areas of all Entergy Operating Companies within the EES as shown by highlighted regions. GGNS Unit 3 will be connected to EMI, and will supply power to EMI and the other owning or purchasing Entergy Operating Companies via the EES transmission system. Figure 8.1-203 highlights the service areas within the EES further. The region served by EMI includes Jackson, MS, Vicksburg, MS, and areas of western Mississippi.

The EES is interconnected with the Southwestern Power Administration, Associated Electric Cooperatives, Inc., Missouri Utilities, Union Electric Company, Tennessee Valley Authority, Mississippi Power Company, Central Louisiana Electric Company, Southwestern Electric Power Company, Oklahoma Gas and Electric Company, Empire District Electric Company, and Arkansas Electric Cooperative Corporation. To the east, EES interconnects with Tennessee Valley Authority at West Memphis, Arkansas, and West Point, Mississippi. It interconnects to the west with Oklahoma Gas and Electric at Fort Smith, Arkansas. Other system connections exist at 345 kV, 230 kV, 161 kV, and 115 kV voltages (Reference 202).

Tables 8.1-201 through 8.1-205 provide annual sales for each Operating Company for the period 1994 through 2006 as reported in Entergy's general ledger. The tables list sales by customer class in both MWH and by percentage of total sales. In the tables, the data for “Wholesale sales” include sales to both Associated companies (Entergy Affiliates) and Non-Associated companies. Data for “Interdepartmental sales” represent electrical energy used by the Operating Companies’ gas business units. Data for "Lighting" represents sales of electrical energy used in lighting applications, such as street or highway illumination.

Based on data presented in Tables 8.1-201 through 8.1-205, 2006 sales for the EES (combining 2006 data for each operating company) totaled slightly in excess of 120 million MWh. EGS, serving portions of Texas and Louisiana (illustrated in Figure 8.1-203), accounted for the largest fraction of those sales (i.e., approximately 33 percent). EAI, EMI, and ELL each serve portions of their respective states, as shown in Figure 8.1-203. EAI and ELL made up about 25 percent each of total EES 2006 sales. EMI's portion was approximately 12 percent. ENO, serving the city of New Orleans, except Algiers, accounted for less than 5 percent in 2006.

8.1.2 REFERENCES

201 SERC Reliability Corporation. 2006 About the Region. Website available at: http://www.serc1.org/Application/ContentPageView.aspx?ContentId=24, accessed 7/23/07.

202 Grand Gulf Unit 1 Updated Final Safety Analysis Report (UFSAR), dated June 2007, Chapter 8.0, Electric Power.

TABLE 8.1-201
EAI ANNUAL SALES BY CUSTOMER CLASS (MWH AND PERCENTAGE OF ENERGY SOLD TO EACH CLASS)

Year	Residential	Commercial	Industrial	Lighting	Governmental	Wholesale	Interdepartmental
1994	5,521,794	4,147,156	5,940,649	64,549	166,994	15,501,824	
	17.6%	13.2%	19.0%	0.2%	0.5%	49.5%	0.0%
1995	5,867,479	4,267,287	6,314,098	65,711	177,178	13,451,621	
	19.5%	14.2%	20.9%	0.2%	0.6%	44.6%	0.0%
1996	6,022,826	4,390,358	6,487,151	67,288	166,858	17,190,436	
	17.5%	12.8%	18.9%	0.2%	0.5%	50.1%	0.0%
1997	5,988,297	4,445,068	6,646,562	69,764	169,312	16,384,550	
	17.8%	13.2%	19.7%	0.2%	0.5%	48.6%	0.0%
1998	6,613,558	4,773,306	6,836,749	72,214	160,590	12,447,623	
	21.4%	15.4%	22.1%	0.2%	0.5%	40.3%	0.0%
1999	6,492,924	4,880,194	7,053,935	74,050	162,568	12,460,205	
	20.9%	15.7%	22.7%	0.2%	0.5%	40.0%	0.0%
2000	6,791,425	5,063,402	7,239,730	75,758	163,006	12,049,849	
	21.6%	16.1%	23.1%	0.2%	0.5%	38.4%	0.0%
2001	6,912,359	5,160,404	7,165,757	76,634	168,701	12,125,819	
	21.9%	16.3%	22.7%	0.2%	0.5%	38.4%	0.0%
2002	7,049,464	5,221,181	7,074,252	75,873	179,319	11,880,474	
	22.4%	16.6%	22.5%	0.2%	0.6%	37.7%	0.0%
2003	7,057,090	5,328,042	6,998,773	74,684	191,246	12,435,011	
	22.0%	16.6%	21.8%	0.2%	0.6%	38.8%	0.0%
2004	7,027,994	5,427,761	7,004,259	74,821	199,680	12,348,692	
	21.9%	16.9%	21.8%	0.2%	0.6%	38.5%	0.0%
2005	7,653,320	5,730,359	7,333,653	75,406	212,317	8,657,656	
	25.8%	19.3%	24.7%	0.3%	0.7%	29.2%	0.0%
2006	7,655,291	5,816,121	7,587,187	75,565	197,686	10,607,974	
	24.0%	18.2%	23.8%	0.2%	0.6%	33.2%	0.0%

TABLE 8.1-202
EGSI ANNUAL SALES BY CUSTOMER CLASS (MWH AND PERCENTAGE OF ENERGY SOLD TO EACH CLASS)

Year	Residential	Commercial	Industrial	Lighting	Governmental	Wholesale	Interdepartmental
1994	7,351,363	6,088,734	15,026,405	84,034	213,730	3,511,557	231,812
	22.6%	18.7%	46.2%	0.3%	0.7%	10.8%	0.7%
1995	7,698,897	6,218,555	15,393,276	84,553	226,255	5,147,221	102,774
	22.1%	17.8%	44.1%	0.2%	0.6%	14.8%	0.3%
1996	8,035,034	6,417,338	16,660,548	85,694	352,696	2,803,276	44,552
	23.4%	18.7%	48.4%	0.2%	1.0%	8.1%	0.1%
1997	8,177,716	6,574,900	18,038,484	86,823	394,233	1,916,710	
	23.2%	18.7%	51.3%	0.2%	1.1%	5.4%	0.0%
1998	8,903,380	6,975,328	18,157,721	87,208	473,087	4,080,726	
	23.0%	18.0%	46.9%	0.2%	1.2%	10.6%	0.0%
1999	8,928,647	7,310,108	17,684,464	88,334	336,360	4,085,288	
	23.2%	19.0%	46.0%	0.2%	0.9%	10.6%	0.0%
2000	9,405,201	7,660,226	17,959,908	90,932	358,796	4,629,158	
	23.5%	19.1%	44.8%	0.2%	0.9%	11.5%	0.0%
2001	9,059,246	7,667,790	16,658,012	91,496	360,080	4,392,549	
	23.7%	20.1%	43.6%	0.2%	0.9%	11.5%	0.0%
2002	9,501,615	7,893,573	15,887,250	91,852	385,634	5,099,021	
	24.5%	20.3%	40.9%	0.2%	1.0%	13.1%	0.0%
2003	9,739,406	8,174,395	15,417,052	92,771	381,897	4,542,848	
	25.4%	21.3%	40.2%	0.2%	1.0%	11.8%	0.0%
2004	9,802,567	8,444,081	16,596,469	93,622	338,360	4,700,346	
	24.5%	21.1%	41.5%	0.2%	0.8%	11.8%	0.0%
2005	10,023,899	8,485,910	14,966,734	94,587	346,587	6,016,649	
	25.1%	21.2%	37.5%	0.2%	0.9%	15.1%	0.0%
2006	10,110,183	8,837,611	15,065,280	93,479	360,700	6,154,902	
	24.9%	21.8%	37.1%	0.2%	0.9%	15.2%	0.0%

TABLE 8.1-203
ELL ANNUAL SALES BY CUSTOMER CLASS (MWH AND PERCENTAGE OF ENERGY SOLD TO EACH CLASS)

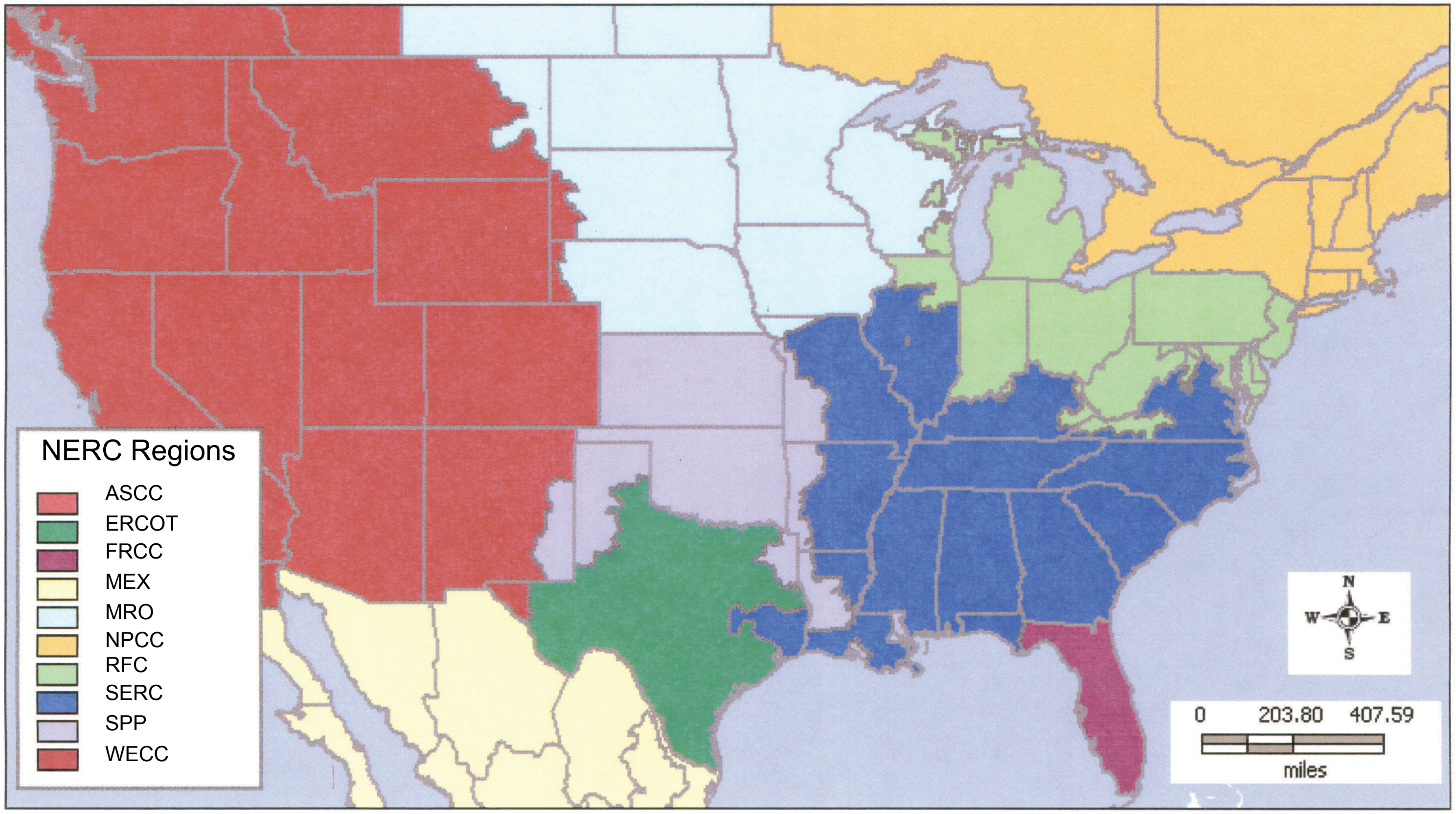
Year	Residential	Commercial	Industrial	Lighting	Governmental	Wholesale	Interdepartmental
1994	7,449,214	4,631,241	16,560,325	112,796	310,019	786,443	
	25.0%	15.5%	55.5%	0.4%	1.0%	2.6%	0.0%
1995	7,855,344	4,786,321	16,970,892	113,429	325,296	1,337,078	
	25.0%	15.2%	54.1%	0.4%	1.0%	4.3%	0.0%
1996	7,893,292	4,845,843	17,647,060	114,431	342,219	1,125,497	
	24.7%	15.2%	55.2%	0.4%	1.1%	3.5%	0.0%
1997	7,826,013	4,905,439	16,390,339	114,382	345,767	908,934	
	25.7%	16.1%	53.8%	0.4%	1.1%	3.0%	0.0%
1998	8,477,063	5,264,999	14,781,421	116,511	364,709	1,240,392	
	28.0%	17.4%	48.9%	0.4%	1.2%	4.1%	0.0%
1999	8,354,190	5,221,419	15,051,633	117,169	351,247	1,245,680	
	27.5%	17.2%	49.6%	0.4%	1.2%	4.1%	0.0%
2000	8,647,787	5,366,805	15,183,756	116,829	364,664	782,406	
	28.4%	17.6%	49.8%	0.4%	1.2%	2.6%	0.0%
2001	8,254,832	5,369,253	14,401,455	119,060	379,385	714,779	
	28.2%	18.4%	49.3%	0.4%	1.3%	2.4%	0.0%
2002	8,780,158	5,538,479	14,737,545	120,756	389,387	284,943	
	29.4%	18.6%	49.4%	0.4%	1.3%	1.0%	0.0%
2003	8,795,215	5,622,219	12,870,061	118,910	372,149	1,475,891	
	30.1%	19.2%	44.0%	0.4%	1.3%	5.0%	0.0%
2004	8,841,949	5,761,604	13,140,000	121,413	317,575	1,251,274	
	30.0%	19.6%	44.6%	0.4%	1.1%	4.3%	0.0%
2005	8,558,912	5,553,940	12,347,669	116,722	311,532	2,559,527	
	29.1%	18.9%	41.9%	0.4%	1.1%	8.7%	0.0%
2006	8,557,866	5,714,381	12,770,061	121,790	318,711	2,470,480	
	28.6%	19.1%	42.6%	0.4%	1.1%	8.2%	0.0%

TABLE 8.1-204
EMI ANNUAL SALES BY CUSTOMER CLASS (MWH AND PERCENTAGE OF ENERGY SOLD TO EACH CLASS)

Year	Residential	Commercial	Industrial	Lighting	Governmental	Wholesale	Interdepartmental
1994	4,013,640	3,151,614	2,985,101	66,876	263,354	1,590,653	
	33.2%	26.1%	24.7%	0.6%	2.2%	13.2%	0.0%
1995	4,233,001	3,367,646	3,044,302	71,306	264,447	1,651,427	
	33.5%	26.7%	24.1%	0.6%	2.1%	13.1%	0.0%
1996	4,354,617	3,508,149	3,063,315	71,483	274,606	1,888,950	
	33.1%	26.7%	23.3%	0.5%	2.1%	14.4%	0.0%
1997	4,322,913	3,673,434	3,089,456	72,088	260,535	2,329,152	
	31.4%	26.7%	22.5%	0.5%	1.9%	16.9%	0.0%
1998	4,799,743	4,015,211	3,162,512	73,104	274,098	2,908,244	
	31.5%	26.4%	20.8%	0.5%	1.8%	19.1%	0.0%
1999	4,753,342	4,155,622	3,245,509	74,227	289,146	2,199,433	
	32.3%	28.2%	22.1%	0.5%	2.0%	14.9%	0.0%
2000	4,975,796	4,306,704	3,188,694	74,891	301,390	1,588,285	
	34.5%	29.8%	22.1%	0.5%	2.1%	11.0%	0.0%
2001	4,867,086	4,322,232	3,050,912	74,816	306,397	2,016,743	
	33.2%	29.5%	20.8%	0.5%	2.1%	13.8%	0.0%
2002	5,092,000	4,445,079	2,910,241	75,361	306,729	1,320,565	
	36.0%	31.4%	20.6%	0.5%	2.2%	9.3%	0.0%
2003	5,091,849	4,476,355	2,939,081	52,318	331,618	442,711	
	38.2%	33.6%	22.0%	0.4%	2.5%	3.3%	0.0%
2004	5,084,819	4,518,023	2,976,785	97,780	322,273	697,797	
	37.1%	33.0%	21.7%	0.7%	2.4%	5.1%	0.0%
2005	5,333,039	4,630,233	2,966,479	78,056	333,085	935,772	
	37.4%	32.4%	20.8%	0.5%	2.3%	6.6%	0.0%
2006	5,386,994	4,745,716	2,927,485	82,206	334,706	899,872	
	37.5%	33.0%	20.4%	0.6%	2.3%	6.3%	0.0%

TABLE 8.1-205
ENO ANNUAL SALES BY CUSTOMER CLASS (MWH AND PERCENTAGE OF ENERGY SOLD TO EACH CLASS)

Year	Residential	Commercial	Industrial	Lighting	Governmental	Wholesale	Interdepartmental
1994	1,896,161	2,031,146	518,055	54,507	896,466	294,302	2,552
	33.3%	35.7%	9.1%	1.0%	15.7%	5.2%	0.0%
1995	2,049,442	2,079,205	536,701	54,120	928,821	445,804	1,914
	33.6%	34.1%	8.8%	0.9%	15.2%	7.3%	0.0%
1996	1,997,728	2,072,531	481,468	973,761	-	278,061	2,552
	34.4%	35.7%	8.3%	16.8%	0.0%	4.8%	0.0%
1997	1,970,506	2,072,262	483,952	198,149	796,244	475,852	2,552
	32.8%	34.5%	8.1%	3.3%	13.3%	7.9%	0.0%
1998	2,141,134	2,148,775	514,240	54,902	982,462	569,844	2,552
	33.4%	33.5%	8.0%	0.9%	15.3%	8.9%	0.0%
1999	2,101,652	2,207,776	513,825	54,467	1,016,461	621,918	2,552
	32.2%	33.9%	7.9%	0.8%	15.6%	9.5%	0.0%
2000	2,177,828	2,260,300	383,717	53,803	1,004,609	711,560	2,552
	33.0%	34.3%	5.8%	0.8%	15.2%	10.8%	0.0%
2001	1,980,932	2,184,743	414,191	53,354	963,407	174,236	2,552
	34.3%	37.8%	7.2%	0.9%	16.7%	3.0%	0.0%
2002	2,158,084	2,255,283	409,152	52,108	1,000,667	176,363	2,552
	35.6%	37.3%	6.8%	0.9%	16.5%	2.9%	0.0%
2003	2,132,976	2,261,498	411,606	52,989	982,643	1,339,665	2,552
	29.7%	31.5%	5.7%	0.7%	13.7%	18.6%	0.0%
2004	2,138,663	2,316,256	575,195	45,744	978,839	1,539,188	2,552
	28.2%	30.5%	7.6%	0.6%	12.9%	20.3%	0.0%
2005	1,615,771	1,798,124	498,316	58,943	741,179	2,041,327	1,701
	23.9%	26.6%	7.4%	0.9%	11.0%	30.2%	0.0%
2006	913,892	1,666,327	547,171	25,257	606,666	1,298,113	2,339
	18.1%	32.9%	10.8%	0.5%	12.0%	25.7%	0.0%

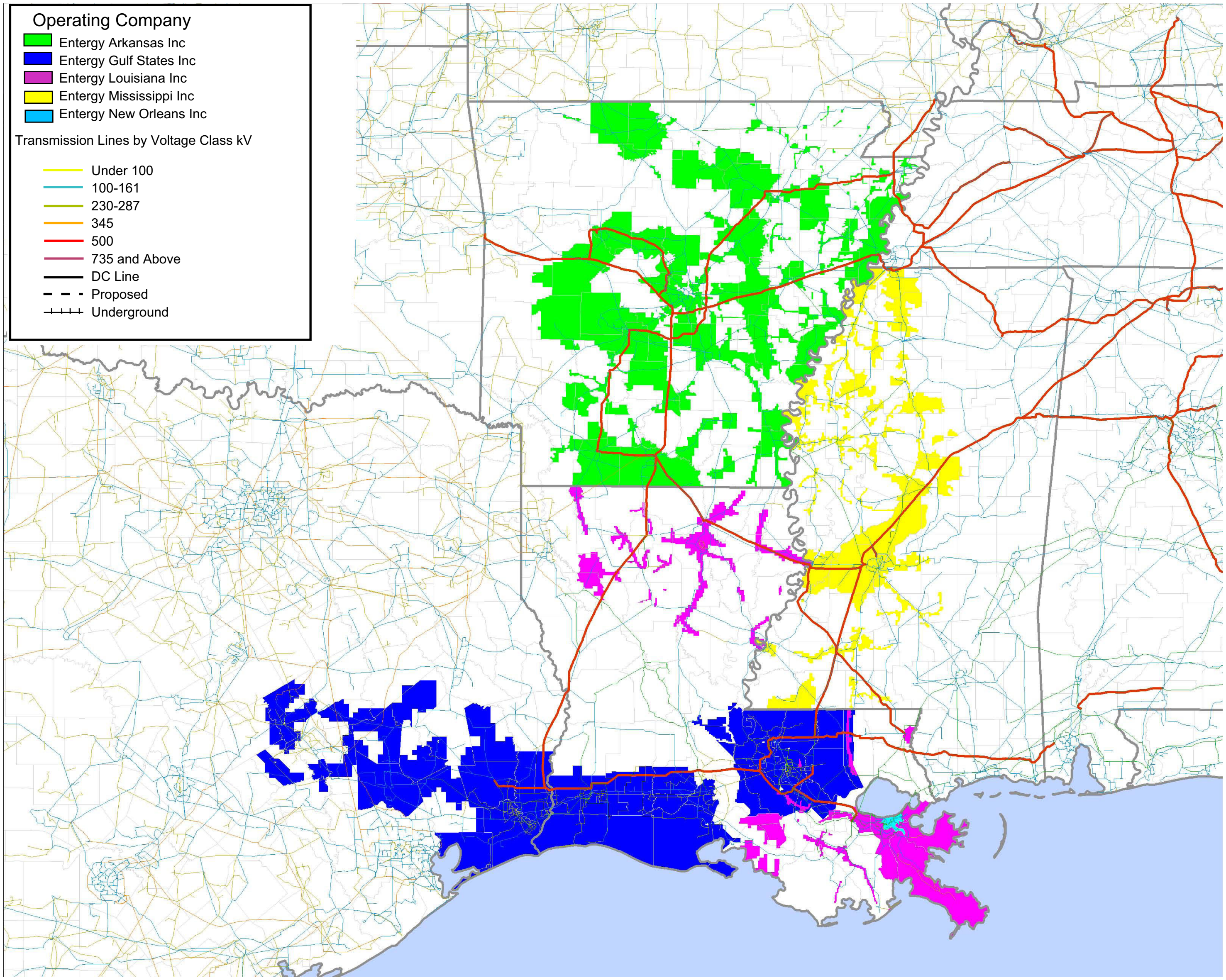


Source: Global Energy Decisions Inc. Energy Velocity

Legend:

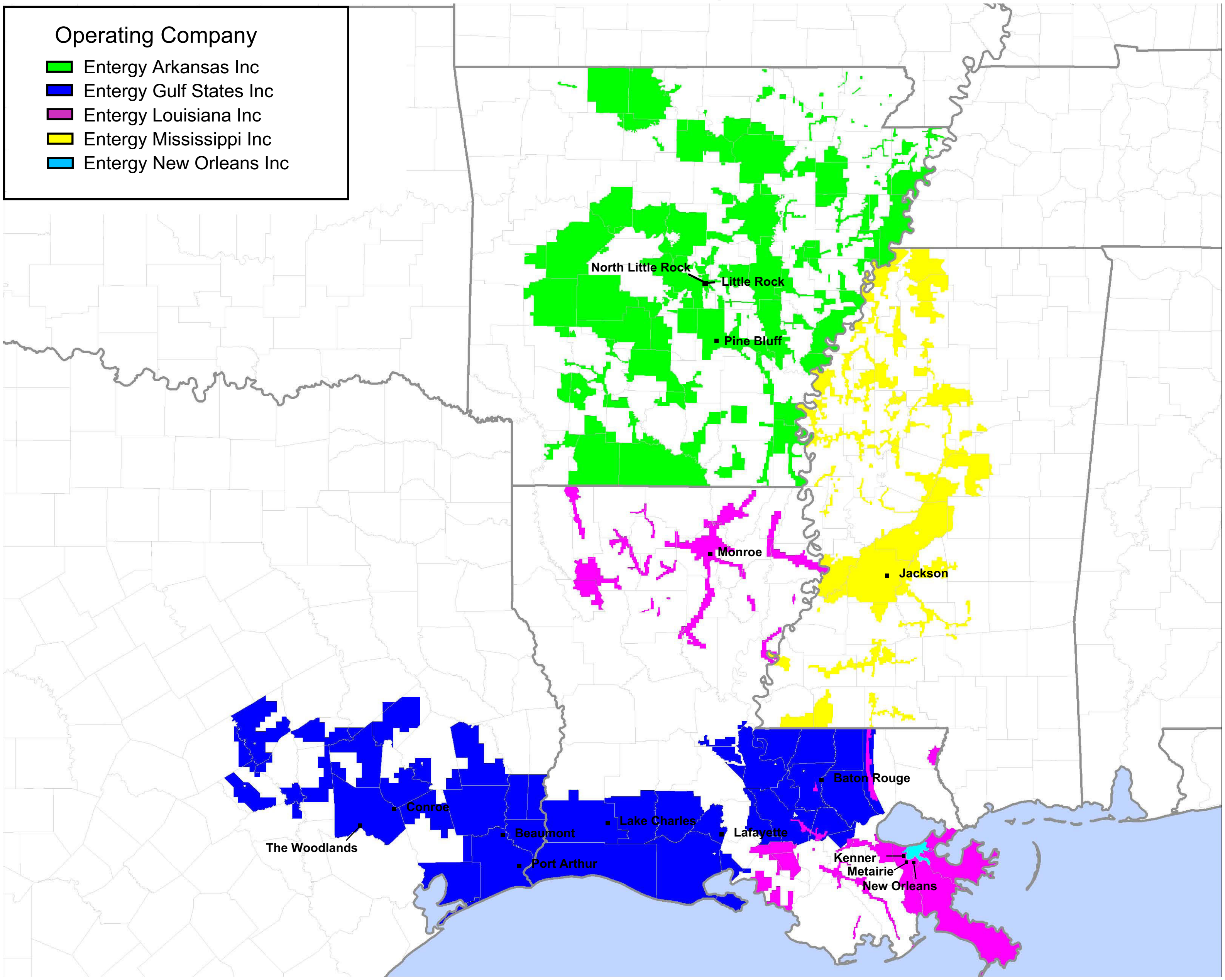
ASCC – Alaska Systems Coordinating Council
ERCOT – Electric Reliability Council of Texas
FRCC – Florida Reliability Coordinating Council
MEX - Mexico
MRO – Midwest Reliability Organization
NPCC – Northeast Power Coordinating Council
RFC – Reliability First Corporation
SERC – Southern Electric Reliability Council
SPP - Southwest Power Pool
WECC – Western Electricity Coordinating Council

Figure 8.1-201. NERC Regions



Source: Global Energy Decisions Inc. Energy Velocity

Figure 8.1-202. Regional Transmission Lines & Entergy Service Territories



Source: Global Energy Decisions Inc. Energy Velocity

Figure 8.1-203. Entergy Service Territories With Major Load Centers (Cities > 50,000 Population) **Revision 0**

8.2 POWER DEMAND

Information for this section is not provided in the ESP Application Part 3 – Environmental Report; the following supplements are provided.

The electrical power distribution system considered in this need for power evaluation is described in Section 8.1, including the definition of the service area considered. For the purposes of this need for power evaluation, the approximate target schedule for commercial operation is the 2nd quarter of 2015.

A detailed evaluation was performed to determine peak load and hourly load levels for the EES. The EES System Planning and Operations (SPO) Department reviews and evaluates electrical energy resources to support the Operating Companies' strategic planning. The EES Strategic Supply Resource Plan (SSRP) ("the plan") (Reference 201) projects the peak load for the coming year and 10 years into the future (the current SSRP is for 2007-2016). The plan considers historical and projected electrical energy use and the availability of purchased power in forecasting the need for new generation to meet the demand for power in the EES service area. These factors are considered when evaluating the power and energy requirements and the potential growth of demand for resource planning purposes. The plan is submitted for review to various local and state regulators, and is available as a public record. The plan is not subject to approval by the regulators.

Proper resource planning includes a long-term hourly load forecast. The SPO Department annually develops a 10-year hour-by-hour load forecast. The forecast covers each of the Entergy Operating Companies and the total Entergy System. This forecast may be updated during a given year if major events occur (for example, the load forecast developed in August 2005 was replaced with a new forecast following Hurricane Katrina and again following Hurricane Rita). The EES SPO forecast is used in this need for power evaluation.

8.2.1 POWER AND ENERGY REQUIREMENTS

Data related to the electrical energy demand by major customer categories (residential, commercial, government, and industrial) are used to forecast retail energy consumption and wholesale contract requirements and as an input to the decision to add new generating resources. The total electrical energy used by the major customer categories has increased by an average of 1.2 percent per year from 1994 to 2005. The approximate apportionment of total EES retail energy sales by major customer categories for 2006 is as follows: Residential: 33 percent, Commercial: 26 percent, Industrial: 40 percent and Government: 2 percent. The apportionment has remained essentially constant since 2002. The percentages for each Entergy Operating Company are provided in Tables 8.1-201 through 8.1-205.

8.2.1.1 Historical Projections

The historical data of what has been previously forecast is shown in Table 8.2-201. When compared to tables of actual energy demand, this table shows growth has been consistently forecast. The planning forecast for the period 2007 – 2016 projects continued growth in energy demand.

The planning information is usually developed a year in advance of the relevant planning horizon. In some cases, the forecast may include information for the remainder of the year in which it was developed. For example, the 2007 forecast information was developed in mid-2006 and included a forecast for the remainder of 2006. In other cases, the plan may not include the current year. Thus, the starting year for each forecast shown in Table 8.2-201 may vary. In some cases, multiple forecasts are developed for the same year, as changing conditions warrant.

The total annual kilowatt-hour sales starting from 1994 are shown in Table 8.2-202. The data in Table 8.2-202 show that actual total annual sales have increased from 1995 through 2005 at an average of 1.2 percent per year. Table 8.2-203 provides the total EES actual sales, the weather-adjusted sales, and the year-to-year growth rates. Weather-adjusted sales are actual sales that have been adjusted to a normal weather period (month or year). The absolute change in weather-adjusted retail sales compared to the actual retail sales was added or subtracted, as appropriate, to the Intra-System Billing (ISB) sales to calculate the weather-adjusted ISB sales. These data show that weather-adjusted sales have increased by an average of 0.8 percent per year from 1995 through 2005. Comparisons of the historical projections and the actual values of electricity sales demonstrate that the projection model is accurate.

8.2.1.2 Forecast Methodology

The EES SPO Department uses computer software from Itron to develop annually a 10-year, hour-by-hour load forecast. Itron is a metering and consulting services company that produces the MetrixND and MetrixLT software (Reference 201 and 202) that the Entergy System uses for energy forecasting, weather normalization (mostly MetrixND), and hourly load forecasting and peak load forecasting (MetrixLT). MetrixND is a package for running regression analyses to establish the relationships of energy usage to various economic variables and weather. MetrixLT is used for applying load shapes to the energy forecast. Both versions of Metrix software are used widely in the utility industry, to the point where they may be considered industry standards. The forecast covers each of the Entergy Operating Companies and the total EES load. The forecast uses key inputs from several sources.

The Monthly Retail Energy Sales Forecast, prepared by EES Sales & Marketing, is developed using an econometric model (MetrixND) for each revenue class by operating company. EAI, ELL, ENO, EGSL, ETI, and EMI are broken out separately in this model. The econometric model is a regression analysis that uses various national, state, and local variables as drivers in the forecast. Sales are forecasted at the revenue class level, i.e., residential, commercial, industrial and governmental. Econometric sales forecasts for each of the four classes for each operating company are derived from separate usage per customer (UPC) and customer count models, the outputs of which are multiplied together on a monthly basis to produce total gigawatt-hour sales. The key drivers for the UPC models are generally gross area economic output (similar to national gross domestic product) or real income, while customer count models are typically based on drivers such as population or households. Key macroeconomic inputs are supplied by Moody's Economy.com. Sales and customer count data are loaded directly into the software as well as customized economic data (income, households, gross product, etc.).

From Tables 8.1-201 through 8.1-205, the data over the longer period (1994-2006) show that growth has been predominately occurring from residential and commercial customer demand. The major factors involved in this growth are increases in population and income. Future growth is expected to follow this trend. Note that ENO was severely impacted by Hurricane Katrina, which struck the area on August 29, 2005. ENO is currently recovering from the effects of the hurricane so its growth in 2007 is likely to be larger than typical; however, the absolute level of demand at ENO for all sectors except industrial is likely to be below the 2004 levels for several years. ENO, which is limited to the city of New Orleans, excluding Algiers, makes up a small percentage of the entire Entergy system.

Entergy's largest industrial customers' load (approximately 150 customers) are forecasted individually based on Entergy's specific relationship and knowledge of the account. Some of the industrial customers have interruptible and/or curtailable contracts. These interruptible customers are identified and each has an hourly load shape profile that is aggregated to the Operating Company level so that the hourly load forecast that is generated can be at the total level or at the firm[1] only load level. This individual forecasting tailored to these accounts defines the total load shape to a degree beyond macro economic forecasting alone.

In addition to the largest customers, other models of forecast hourly load are developed. The Monthly Wholesale Energy Sales Forecast is prepared by EES Sales & Marketing for each wholesale customer. Each wholesale customer is assigned an appropriate load shape or in some cases multiple load shapes depending upon the contractual requirement and the customer class composition of the wholesale customers being served.

Once the inputs are collected, ten-year "typical weather" is used to convert historical load shapes into typical load shapes. "Typical Weather" is determined as described below. SPO then uses two ITRON models to construct an hourly energy and peak load forecast for each operating company and the Entergy System.

The actual load shapes are influenced by the weather during the year the actual load is recorded. A weather response function in the MetrixND software adjusts the load shapes to reflect typical weather. For example, if the actual July load for Entergy Arkansas residential customers came from a month where weather was very mild, this would flatten the load shape. The Weather Response function adjusts the load shape to reflect typical weather. Each customer class in each operating company responds differently to weather so each has its own weather response function. For energy forecasting and weather normalization, the Entergy System has developed its own models using the Itron software. Sales and customer count data are loaded directly into the software as well as customized economic data (income, households, gross product, etc.) that is received from Moody's Economy.com and weather data received from the National Weather Service. The weather data are processed first to transform it into degree days, but otherwise the data are not transformed before use. MetrixND is then used to create a 10-year energy forecast. Ten years of historical weather is then used to determine what is considered typical weather. MetrixND then adjusts the historical load shapes provided by Load Research by this typical weather to produce the load shapes in which the energy forecast will be applied to create the 10-year hourly load forecast.

To estimate the final retail and wholesale sales, the MetrixLT – ITRON model is used. The MetrixLT Model combines the forecasted load shapes that come out of the MetrixND model

1. Sales of power to the customers, which cannot be interrupted except in certain circumstances. A utility plans to have adequate resources to serve these customers.

with the Retail and Wholesale Monthly Forecast to produce the final 8760-hour curve. Internal company use is a forecast add-on to the Retail and Wholesale Forecasts to finalize the projected demand for production. MetrixLT then adds up sales by jurisdiction to produce a total Entergy system hourly load forecast. As the energy forecasts are input “at the meter,” a transmission/distribution factor for each revenue class by jurisdiction is used to produce a forecast of load required at the generator. The load at the generator is higher than the load at the meter to account for the need to produce power sufficient to cover line losses.

Because there is a lag between when energy is generated and consumed and when it is billed, and because the Retail Energy Forecast is based on billed energy, the energy must be adjusted to arrive at a generator based load forecast. In historical forecasts (those prior to the forecast for the period beginning in 2008), monthly retail energy is assumed to have been generated and consumed in the prior month. In other words, January 2007 billed sales MWs roughly are equal to December generation. Beginning with the forecast for the period starting in 2008, a model has been developed to more accurately convert the billed energy to generated energy.

The historical weather-adjusted annual peak load data are shown in Table 8.2-205. From the data projected for the 1995 forecast shown in Table 8.2-201, it can be seen that the peak loads predicted for 2004 and 2005 were 21,150 MW and 21,501 MW, respectively, as compared to the weather-adjusted values shown in Table 8.2-205 of 21,652 MW and 21,391 MW. The significant decrease from the 1995 forecast of energy use for 2005 as compared to the actual weather adjusted sales shown in Table 8.2-203 is largely attributable to Hurricanes Katrina and Rita. When looking at the comparison between forecast and weather-adjusted sales, notwithstanding the 2005 actual as predicted in the 1995 Historic Forecast, the long term forecast is accurate.

As shown in Table 8.2-204, load factors have been historically constant from 1994 to 2006 (ranging from 60 percent to 64 percent). The forecast load factors through 2018 are expected to Proprietary be {{{ }}}. The normalized (weather-adjusted only) regional system peak loads are shown in Table 8.2-205. The historical peak load data (1999 to 2006) indicate that there has been little difference between the actual peak loads, as shown on Table 8.2-204, and the weather adjusted data as shown on Table 8.2-205.

Load duration curves for 2007 and 2015 (the current year and projected first year of new unit operation) are shown in Figures 8.2-201 and 8.2-202. The minimum hourly loads for these Proprietary curves are forecast to be {{{ }}} for 2007 and {{{ }}} for 2015.

The results of these forecasts indicate that the demand for power will continue to increase over the next 10 years, which the EES considers when planning for future needs. The SSRP concludes that additional electric resources will be required to meet these needs.

8.2.2 FACTORS AFFECTING GROWTH OF DEMAND

The SSRP includes the results of the analyses of data for the EES service area for estimated population growth, per capita income growth, manufacturing output growth, known availability of gas and oil, growth of the real price of electricity and rate structures for major customer classes. As described above, the detailed data are input into the forecasting software to develop a macroeconomic model. The analyses show continued growth of energy demand in the future.

One of the most difficult factors when forecasting demand is the unknown effect of weather. Table 8.2-205 shows the actual historical weather-adjusted peak load data, as far back as they are available, for the system. The historical peak load data (1999 to 2006) indicate that the largest difference between the actual peak loads and the weather-adjusted peak loads, with the average adjustment of 566 MW, has been just over one gigawatt. In addition, the forecast data for 1999 to 2006 from Table 8.2-201 compared to the weather-adjusted peak values indicate that the forecasting model is fairly accurate.

Data related to the electrical energy used by major customer categories (residential, commercial, government, and industrial) are used to forecast energy usage, forecast load demand and support the decision to add new generating facilities. Data related to the electrical energy used provide direct input to forecast electrical demand. Data related to alternate energy use are considered in the forecast indirectly through the input of macroeconomic data.

Entergy Corporation promotes electrical energy conservation and has participated in an EPA/DOE sponsored conservation program (Reference 204) since 2004. Entergy provides conservation and energy efficiency information to customers on its website and in brochures distributed at a wide range of community events. In addition, members of the EES administer energy efficiency and conservation programs within their respective service areas. Entergy is also a member of the leadership group for the National Action Plan for Energy Efficiency (NAPEE). NAPEE is a joint effort between the EPA/DOE and utilities, regulators, state agencies, large energy users, consumer advocates, energy service providers, and environmental organizations designed to promote a sustainable national commitment to energy efficiency. EES does consider conservation and energy efficiency in its planning process; however, demand and consumption of electric energy is projected to grow throughout the forecast period. Entergy's forecast of ongoing growth despite conservation and energy efficiency is consistent with the Department of Energy's Annual Energy Outlook 2007 (Reference 205) which also concludes that demand and consumption will continue to grow throughout the forecast period.

Cost of energy also has an impact on demand. Since 2000 there has been a significant increase in the commodity price of fuels including natural gas, residual fuel oil and to a lesser extent coal prices. These higher costs have driven up the cost of electricity production and have been passed on to the end user. As a consequence, these higher costs may have resulted in a reduction in the growth of demand and consumption of electric energy. While isolating and measuring the specific effects of such price changes are difficult and uncertain, historical usage patterns reflect such trends and are incorporated into EES' planning process. Furthermore, historical data indicates that increases in the cost of energy have caused temporary reductions in end-use energy consumption, but over the longer term, demand continues to increase as customers adjust to cost changes. The particular pricing regime for electric generating markets, whether prices are regulated or deregulated, appears to have little if any affect on the demand and consumption of electric energy. The growth in demand is illustrated by Table 8.2-203. Table 8.2-206 shows that despite the increase in the price of natural gas, oil, and coal, the required electrical supply has been steady. The cost of natural gas and oil has risen from 2000 to 2005 and EES has reduced its production by owned resources and has relied upon purchased power to economically meet the demand.

Sensitivity studies are used to determine the impact of a change in growth rate on forecast load data. Table 8.2-207 shows the forecast load for base load, peak firm load, and peak firm load plus margin to 2017. Each year, growth is predicted based upon the inputs as previously discussed. From annual growth, the yearly rate can be determined, and a 0.5 percent factor applied to that value to determine the impact from a change in the predicted growth rate. As can be seen from the 2017 values, the forecast is relatively unaffected by this uncertainty. The AEO2007 (Reference 205) predicts an increase in total electricity consumption through 2030 at an average rate of 1.5 percent, thus it is reasonable to conclude that the growth forecast resulting from the detailed analysis of SPO is a reasonable prediction.

8.2.3 REFERENCES

201 Plan Summary Document, Entergy Electric System Strategic Supply Resource Plan For the Planning Period 2007 – 2016, October 20, 2006.

202 MetrixND, Version 4.0, Itron Inc., website available at: http://www.itron.com/pages/products_detail.asp?id=itr_000482.xml, accessed 7/31/07.

203 MetrixLT, Version 4.0, Itron Inc., website available at: http://www.itron.com/pages/products_detail.asp?id=itr_000485.xml, accessed 7/31/07.

204 Energy Star, Website, http://www.energystar.gov/index.cfm?c=about.ab_index, accessed 7/23/07.

205 Energy Information Administration/ Annual Energy Outlook 2007 (AEO2007), available at: http://www.eia.doe.gov/oiaf/aeo/index.html, accessed 7/23/07.

TABLE 8.2-201 (SHEET 1 OF 2)
HISTORICAL FORECASTS FOR EES TOTAL SALES AND PEAK LOAD

	Planning Year											
	1995		1996		1997		1998		1999		2000	
Forecast Year	Total Load (GWh)	Peak Load (MW)	Total Load (GWh)	Peak Load (MW)	Total Load (GWh)	Peak Load (MW)	Total Load (GWh)	Peak Load (MW)	Total Load (GWh)	Peak Load (MW)	Total Load (GWh)	Peak Load (MW)
1995	101,679	18,682	103,368	18,913								
1996	101,679	18,682	103,368	18,913								
1996	103,665	19,017	106,180	19,347	107,162	19,710						
1997	104,578	19,207	107,668	19,655	107,724	19,972						
1998	105,949	19,496	109,303	20,093	109,309	20,359	110,790	19,239				
1999	107,324	19,813	109,023	20,199	110,973	20,769	112,267	19,649	110,421	20,394	112,185	21,152
2000	107,976	19,964	107,815	20,212	110,273	20,908	110,771	19,623	111,259	20,551	114,360	21,516
2001	108,653	20,125	110,564	20,688	113,355	21,491	113,489	20,160	112,672	20,898	114,761	21,773
2002	110,531	20,453	113,417	21,182	116,483	22,088	116,291	20,684	113,877	21,165	117,071	22,202
2003	112,440	20,786	116,347	21,687	119,707	22,703	118,566	21,159	111,702	21,046	114,248	22,032
2004	114,571	21,150	119,371	22,207	123,041	23,333	120,858	21,602	112,769	21,298	116,005	22,346
2005	116,575	21,501	122,474	22,737	126,467	23,990	123,653	22,169	115,087	21,769	118,410	22,637
2006					130,004	24,665	126,513	22,733	117,385	22,185	120,742	23,304
2007							129,445	23,299	119,855	22,615	123,252	23,771
2008							132,517	23,864	122,378	23,017	125,812	24,187
2009									124,964	23,520	128,433	24,735

TABLE 8.2-201 (SHEET 2 OF 2)
HISTORICAL FORECASTS FOR EES TOTAL SALES AND PEAK LOAD

	Planning Year													
	2001		2002		2002		2003		2004		2005		2006	
Forecast Year	Total Load (GWh)	Peak Load (MW)	Total Load (GWh)	Peak Load (MW)	Total Load (GWh)	Peak Load (MW)	Total Load (GWh)	Peak Load (MW)	Total Load (GWh)	Peak Load (MW)	Total Load (GWh)	Peak Load (MW)	Total Load (GWh)	Peak Load (MW)
2000	114,610	21,156												
2001	116,535	21,562	113,080	21,460										
2002	118,243	21,884	114,148	21,720	112,251	21,048								
2003	115,034	21,382	113,198	21,730	111,186	20,707	113,919	20,270						
2004	117,108	21,720	113,535	21,825	114,743	21,289	116,210	20,698	115,301	21,318				
2005	119,182	22,166	114,497	22,159	115,515	21,487	117,723	21,053	117,749	22,007	116,537	21,605		
2006	121,232	22,412	116,742	22,595	115,958	21,554	118,723	21,232	118,344	22,203	117,514	21,749	113,542	20,778
2007	123,264	22,934	118,941	23,019	117,814	21,901	120,679	21,573	120,218	22,522	118,632	22,115	115,133	21,273
2008	125,277	23,240	121,048	23,340	119,819	22,194	122,762	21,970	122,157	22,937	120,333	22,536	117,498	21,844
2009	127,261	23,665	123,207	23,852	121,865	22,625	123,349	22,235	123,936	23,177	121,567	22,775	119,279	22,204
2010	129,281	24,052	125,461	24,281	123,952	23,013	125,611	22,651	124,404	23,468	122,311	23,089	120,799	22,542
2011			127,792	24,720	126,080	23,418	127,921	23,082	126,492	23,980	124,098	23,332	122,743	22,732
2012					128,257	23,790	130,281	23,483	128,625	24,378	125,925	23,800	125,001	23,172
2013							132,691	23,998	130,804	24,949	127,792	24,325	127,238	23,730
2014									133,029	25,421	129,700	24,794	129,464	24,226
2015											131,650	25,079	131,801	24,658
2016													134,037	24,885

TABLE 8.2-202
EES ANNUAL INCREASE IN TOTAL SALES[1]

Year	Energy (GWh)	Annual Increase (GWh)
1994	100,299	
1995	105,281	4982
1996	108,788	3507
1997	109,283	495
1998	113,289	4006
1999	111,258	(2030)
2000	115,689	4431
2001	110,911	(4778)
2002	114,491	3579
2003	113,154	(1336)
2004	116,476	3322
2005	113,418	(3058)

Notes:

1. These sales numbers represent the net area requirement from Entergy's Intra System Billing (ISB) report and differ slightly from the total of the Operating Companies' reflected in the EES general ledger, which are given in Tables 8.1-201 through 8.1-205. For purposes of planning, EES uses energy or load at the generator as opposed to sales numbers at the meter.

TABLE 8.2-203
EES WEATHER-ADJUSTED ISB SALES GROWTH RATE

Year	Actual ISB Sales (GWh)	Weather-Adjustment Factor (GWh)	Weather-Adjusted Sales (GWh)	Weather-Adjusted Annual Growth Rate
1995	105,281	(932)	104,349	--
1996	108,788	(903)	107,885	3.4%
1997	109,283	(268)	109,015	1.0%
1998	113,289	(2,661)	110,628	1.5%
1999	111,258	349	111,607	0.9%
2000	115,689	(766)	114,923	3.0%
2001	110,911	897	111,808	-2.7%
2002	114,491	(529)	113,962	1.9%
2003	113,154	257	113,411	-0.5%
2004	116,476	794	117,270	3.4%
2005	113,418	(390)	113,028	-3.6%

{{{***Proprietary Information – Withheld Under 10 CFR 2.390(a)(4)***}}}
(see COL Application – Part 9)

TABLE 8.2-204
EES ACTUAL (1994-2006) AND FORECAST (2007-2018)
LOAD FACTORS

Year	Peak (MW)	Load Factor
1994	18,028	64%
1995	19,590	61%
1996	19,444	64%
1997	19,545	64%
1998	20,656	63%
1999	20,664	61%
2000	22,052	60%
2001	20,315	62%
2002	20,419	64%
2003	20,162	64%
2004	21,174	63%
2005	21,391	61%
2006	20,887	62%

{{{Proprietary Information – Withheld Under 10 CFR 2.390(a)(4)}}}

Note: Peak load forecast for the period 2007-2018 does not include factor of reserve margin.

TABLE 8.2-205
HISTORICAL WEATHER-ADJUSTED ANNUAL PEAK LOAD DATA

	Year	Actual Peak (MW)	Weather-Adjusted Peak (MW)
Actual	1997	19,545	Data Not Available
Actual	1998	20,656	Data Not Available
Actual	1999	20,664	20,349
Actual	2000	22,052	20,961
Actual	2001	20,315	21,235
Actual	2002	20,419	21,144
Actual	2003	20,162	21,125
Actual	2004	21,174	21,652
Actual	2005	21,391	21,391
Actual	2006	20,887	20,697

TABLE 8.2-206
ENTERGY ELECTRIC SYSTEM'S SUPPLY MIX 2000-2005

(GWh)	2000	2001	2002	2003	2004	2005
Purchases	24,188	19,466	27,328	37,687	37,967	40,190
Gas / Oil	43,073	38,873	35,195	22,797	22,619	21,388
Coal	14,799	14,586	13,743	14,057	15,359	13,502
Nuclear	37,059	41,038	40,917	40,628	41,710	38,432
Hydro	133	154	164	115	151	97
Total	119,252	114,117	117,337	115,284	117,806	113,609

{{{***Proprietary Information – Withheld Under 10 CFR 2.390(a)(4)***}}}
(see COL Application – Part 9)

TABLE 8.2-207
FORECAST BASE LOAD AND PEAK LOAD DEMAND (MW)

{{{Proprietary Information - Withheld Under 10 CFR 2.390(a)(4)}}}
(See COL Application - Part 9)

Figure 8.2-201. Entergy System Forecast Firm Load for 2007

{{{Proprietary Information - Withheld Under 10 CFR 2.390(a)(4)}}}
(See COL Application - Part 9)

Figure 8.2-202. Entergy System Forecast Firm Load for 2015

8.3 POWER SUPPLY

Information for this section is not provided in the ESP Application Part 3 – Environmental Report; the following supplements are provided.

As described in the SSRP (Reference 201), the supply needs that determine the resource requirements of the operating companies (OPCOs) are driven by six basic resource supply objectives. These objectives are to:

- Provide adequate resources to meet peak load demands reliably.
- Provide low-cost resources to serve base load requirements.
- Provide efficient, dispatchable load following resources to serve the time varying load shape levels that are above the base load supply requirement.
- Provide a generation portfolio that is more efficient and avoids an over-reliance on aging resources.
- Mitigate the exposure to price volatility associated with uncertainties in fuel and purchased power costs.
- Mitigate the exposure to major supply disruptions that could occur from concentrated or systematic risks, for example, outages of a single generation facility.

Within its planning process, the System plans over three resource planning horizons: annual planning (1 year), tactical planning (1 - 3 years), and strategic planning (10 years). The SSRP addresses the 10-year planning horizon. For long-term capacity planning purposes, the System determines its capacity requirement by comparing projected peak load plus a reserve margin with long-term resources (owned or contracted). The System is presently short {{{ }}} based on this criterion.

Proprietary

The System is also presently short of base load capacity relative to its base load planning guideline. As a planning guideline, the SSRP envisions that base load capacity should be sufficient to meet load levels projected to exist in approximately 75 - 85 percent of hours. While not a reliability requirement, this guideline seeks to mitigate exposure to price volatility. The units that serve this role are expected to operate at high average capacity factors and to be dispatched at or near maximum capacity on-peak. Some units have the ability to turn down during off-peak hours to take advantage of attractive off-peak purchase opportunities.

8.3.1 EXISTING AND FORECAST GENERATION

The 2007 resource requirements and capability for EES are shown in Table 8.3-201. The values for “Requirements” represent forecasted firm load plus a 16.8 percent reserve margin. The values for “Resources” are for currently owned and long-term contracted resources only. Table 8.3-201 shows a total generation capacity deficit of almost {{{ }}} for 2007. This

Proprietary

indicates a need for EES to purchase power.

A listing of each long-term generator and purchase power contract in EES for 2007 is provided in Table 8.3-202.

The forecast total peak load (which includes firm and nonfirm[1] load, but no margin) is shown in Table 8.2-204. For planning, the SSRP uses forecast firm peak load plus a reserve margin of 16.8 percent. The planned generating capacity at the expected annual firm peak load plus margin is
Proprietary shown in Table 8.3-203. The forecast peak load is expected to increase {{{ }}} percent during the
period from 2007 to 2016. However, owned resources for 2016, as shown in Table 8.3-203,
Proprietary fall short of meeting the 2016 forecast firm peak load by approximately {{{ }}}. Including
definitive long-term purchased power agreement (PPA) resources, the capacity deficit is
Proprietary approximately {{{ }}}. Assuming no long-term base load resources are added to the
Proprietary System, the utility base load deficit is expected to increase to approximately {{{ }}} (see
Table 8.2-207) by 2016. SSRP planning scenarios presently assume that approximately 2560 MW of solid fuel, base load resources will be added in the 10-year planning horizon, as shown in Table 8.3-203.

The EES–owned resources are comprised of coal, gas, oil, hydroelectric and nuclear generation. The historical classification of generation by function and purchased power from 2000 to 2005 is
Proprietary provided in Table 8.2-206. For 2007, the predicted base load resources are {{{ }}} and the total
Proprietary predicted resources are {{{ }}}. This results in a historical ratio of base load resources to total
Proprietary resources of {{{ }}}. The addition of a new nuclear plant is shown in 2015 for planning purposes.

EES's present and planned generating capability and purchased power contracts are established based on the EES's Strategic Supply Resource Plan (planning horizon of 10 years), Tactical Supply Resource Plan (planning horizon of 3 years), and Annual Resource Plan (planning horizon of 1 year). The availability of all generating capability and purchased power contracts is subject to a number of general risk factors. These factors include plant mechanical condition, emissions limits, fuel supply and transmission outlet capacity. For EES plants that are included in the Resource Plans, plant capital and O&M budgets are developed. These budgets include sufficient funding levels to maintain fleetwide plant mechanical condition, standards and requirements such that the fleetwide mechanical availability is within industry norms. In addition, EES maintains its plants to meet established emissions limits. Likewise, EES plans fuel supply and transmission outlet capacity to support the anticipated operation of its plants. SSRP planning includes a provision for unit deactivations (see Table 8.3-203). The data for "Provision for ERS/IR units" represent an estimate of capacity levels that might be moved into extended reserve shutdown or into inactive reserve based on the System's assessment of unit condition and current utilization levels.

Table 8.3-204 shows the forecast annual net firm and nonfirm System load through 2016. The forecast data indicate that total annual sales will continue to increase within the Entergy Electric System. EES seeks to provide reliable, low cost power to meet the its customers' demand, while also seeking to mitigate customers' exposure to supply and fuel risks. EES plans to use a mix of owned generating resources, including nuclear, and long and short term power contracts to supply these forecasted needs.

1. Sales to customers that usually receive a lower rate for power in exchange for power that can be interrupted.

8.3.2 REFERENCES

201 Plan Summary Document, Entergy Electric System Strategic Supply Resource Plan For the Planning Period 2007 – 2016, October 20, 2006.

{{{***Proprietary Information – Withheld Under 10 CFR 2.390(a)(4)***}}}
(see COL Application – Part 9)

TABLE 8.3-201
EES RESOURCE REQUIREMENTS AND LONG-TERM CAPABILITY FOR 2007

TABLE 8.3-202 (Sheet 1 of 8)
2007 OWNED AND LONG-TERM CONTRACTED RESOURCES CATEGORIZED TO TYPE, FUEL, AND FUNCTION

Name[1]	Load Role	Fuel	Operating Company	Capacity 2007 (MW)
Big Cajun 2, 3	Base Load	Coal	EGS	242
Independence 1	Base Load	Coal	EAI	263
Independence 1	Base Load	Coal	EMI	209
Independence 2	Base Load	Coal	EMI	211
Roy S. Nelson 6	Base Load	Coal	EGS	385
White Bluff 1	Base Load	Coal	EAI	465
White Bluff 2	Base Load	Coal	EAI	470
ANO 1	Base Load	Nuclear	EAI	843
ANO 2	Base Load	Nuclear	EAI	995
Grand Gulf	Base Load	Nuclear	EAI	411
Grand Gulf	Base Load	Nuclear	ELL	160
Grand Gulf	Base Load	Nuclear	EMI	377
Grand Gulf	Base Load	Nuclear	ENO	194
River Bend 70	Base Load	Nuclear	EGS	679
Waterford 3	Base Load	Nuclear	ELL	1,157
Attala	Other	Gas	EMI	455
Perryville CCGT	Other	Gas	EGS	401

TABLE 8.3-202 (Sheet 2 of 8)
2007 OWNED AND LONG-TERM CONTRACTED RESOURCES CATEGORIZED TO TYPE, FUEL, AND FUNCTION

Name[1]	Load Role	Fuel	Operating Company	Capacity 2007 (MW)
Perryville CCGT	Other	Gas	ELL	134
Baxter Wilson 1	Other	Gas	EMI	500
Baxter Wilson 2	Other	Gas	EMI	700
Gerald Andrus	Other	Gas	EMI	741
Lake Catherine 4	Other	Gas	EAI	547
Lewis Creek 1	Other	Gas	EGS	229
Lewis Creek 2	Other	Gas	EGS	230
Little Gypsy 1	Other	Gas	ELL	238
Little Gypsy 2	Other	Gas	ELL	415
Little Gypsy 3	Other	Gas	ELL	545
Michoud 2	Other	Gas	ENO	230
Michoud 3	Other	Gas	ENO	530
Ninemile 3	Other	Gas	ELL	125
Ninemile 4	Other	Gas	ELL	730
Ninemile 5	Other	Gas	ELL	740
Perryville CT	Other	Gas	EGS	117
Perryville CT	Other	Gas	ELL	39
Rex Brown 3	Other	Gas	EMI	70

TABLE 8.3-202 (Sheet 3 of 8)
2007 OWNED AND LONG-TERM CONTRACTED RESOURCES CATEGORIZED TO TYPE, FUEL, AND FUNCTION

Name[1]	Load Role	Fuel	Operating Company	Capacity 2007 (MW)
Rex Brown 4	Other	Gas	EMI	203
Roy S .Nelson 3	Other	Gas	EGS	153
Roy S .Nelson 4	Other	Gas	EGS	500
Sabine 1	Other	Gas	EGS	212
Sabine 2	Other	Gas	EGS	212
Sabine 3	Other	Gas	EGS	390
Sabine 4	Other	Gas	EGS	530
Sabine 5	Other	Gas	EGS	470
Sterlington 6	Other	Gas	ELL	212
Waterford 1	Other	Gas	ELL	411
Waterford 2	Other	Gas	ELL	405
Blakely	Other	Hydro	EAI	11
Buras 8	Other	Gas	ELL	12
Carpenter 1	Other	Hydro	EAI	29
Carpenter 2	Other	Hydro	EAI	30
Cecil Lynch 2	Other	Gas	EAI	60
Cecil Lynch 3	Other	Gas	EAI	110
Cecil Lynch Diesel	Other	Oil	EAI	5

TABLE 8.3-202 (Sheet 4 of 8)
2007 OWNED AND LONG-TERM CONTRACTED RESOURCES CATEGORIZED TO TYPE, FUEL, AND FUNCTION

Name[1]	Load Role	Fuel	Operating Company	Capacity 2007 (MW)
Degray	Other	Hydro	EAI	10
Delta 1	Other	Gas	EMI	97
Delta 2	Other	Gas	EMI	95
Hamilton Moses 1	Other	Gas	EAI	70
Hamilton Moses 2	Other	Gas	EAI	70
Harvey Couch 1	Other	Gas	EAI	12
Harvey Couch 2	Other	Gas	EAI	125
LA Station 10	Other	Gas	EGS	40
LA Station 11	Other	Gas	EGS	40
LA Station 12	Other	Gas	EGS	58
Lake Catherine 1	Other	Gas	EAI	0
Lake Catherine 2	Other	Gas	EAI	0
Lake Catherine 3	Other	Gas	EAI	0
Mabelvale 1	Other	Gas	EAI	14
Mabelvale 2	Other	Gas	EAI	14
Mabelvale 3	Other	Gas	EAI	14
Mabelvale 4	Other	Gas	EAI	14
Michoud 1	Other	Gas	ENO	0

TABLE 8.3-202 (Sheet 5 of 8)
2007 OWNED AND LONG-TERM CONTRACTED RESOURCES CATEGORIZED TO TYPE, FUEL, AND FUNCTION

Name[1]	Load Role	Fuel	Operating Company	Capacity 2007 (MW)
Monroe 10	Other	Gas	ELL	0
Monroe 11	Other	Gas	ELL	0
Monroe 12	Other	Gas	ELL	0
Natchez	Other	Gas	EMI	0
Ninemile 1	Other	Gas	ELL	50
Ninemile 2	Other	Gas	ELL	60
Remmel 1	Other	Hydro	EAI	4
Remmel 2	Other	Hydro	EAI	0
Remmel 3	Other	Hydro	EAI	4
Rex Brown 1	Other	Gas	EMI	15
Rex Brown 5	Other	Oil	EMI	11
Robert Ritchie 1	Other	Gas	EAI	300
Robert Ritchie 3	Other	Gas	EAI	16
Sterlington 7A	Other	Gas	ELL	180
Toledo Bend	Other	Hydro	EGS	46
Toledo Bend	Other	Hydro	ELL	23
Vidalia	Other	Hydro	ELL	64
Willow Glen 1	Other	Gas	EGS	152

TABLE 8.3-202 (Sheet 6 of 8)
2007 OWNED AND LONG-TERM CONTRACTED RESOURCES CATEGORIZED TO TYPE, FUEL, AND FUNCTION

Name[1]	Load Role	Fuel	Operating Company	Capacity 2007 (MW)
Willow Glen 2	Other	Gas	EGS	205
Willow Glen 3	Other	Gas	EGS	450
Willow Glen 4	Other	Gas	EGS	540
Willow Glen 5	Other	Gas	EGS	485
EAI WBL Sale (2003-2005) - ANO 1	Base Load	Nuclear	EAI	-46
EAI WBL Sale (2003-2005) - ANO 1	Base Load	Nuclear	EGS	0
EAI WBL Sale (2003-2005) - ANO 1	Base Load	Nuclear	ELL	23
EAI WBL Sale (2003-2005) - ANO 1	Base Load	Nuclear	EMI	0
EAI WBL Sale (2003-2005) - ANO 1	Base Load	Nuclear	ENO	23
EAI WBL Sale (2003-2005) - ANO 2	Base Load	Nuclear	EAI	-54
EAI WBL Sale (2003-2005) - ANO 2	Base Load	Nuclear	EGS	0
EAI WBL Sale (2003-2005) - ANO 2	Base Load	Nuclear	ELL	27
EAI WBL Sale (2003-2005) - ANO 2	Base Load	Nuclear	EMI	0

TABLE 8.3-202 (Sheet 7 of 8)
2007 OWNED AND LONG-TERM CONTRACTED RESOURCES CATEGORIZED TO TYPE, FUEL, AND FUNCTION

Name[1]	Load Role	Fuel	Operating Company	Capacity 2007 (MW)
EAI WBL Sale (2003-2005) - ANO 2	Base Load	Nuclear	ENO	27
EAI WBL Sale (2003-2005) - Grand Gulf	Base Load	Nuclear	EAI	-56
EAI WBL Sale (2003-2005) - Grand Gulf	Base Load	Nuclear	EGS	0
EAI WBL Sale (2003-2005) - Grand Gulf	Base Load	Nuclear	ELL	28
EAI WBL Sale (2003-2005) - Grand Gulf	Base Load	Nuclear	EMI	0
EAI WBL Sale (2003-2005) - Grand Gulf	Base Load	Nuclear	ENO	28
EAI WBL Sale (2003-2005) - Independence 1	Base Load	Coal	EAI	-14
EAI WBL Sale (2003-2005) - Independence 1	Base Load	Coal	EGS	0
EAI WBL Sale (2003-2005) - Independence 1	Base Load	Coal	ELL	7
EAI WBL Sale (2003-2005) - Independence 1	Base Load	Coal	ENO	7
EAI WBL Sale (2003-2005) - White Bluff 1	Base Load	Coal	EAI	-25
EAI WBL Sale (2003-2005) - White Bluff 1	Base Load	Coal	ELL	13

TABLE 8.3-202 (Sheet 8 of 8)
2007 OWNED AND LONG-TERM CONTRACTED RESOURCES CATEGORIZED TO TYPE, FUEL, AND FUNCTION

Name[1]	Load Role	Fuel	Operating Company	Capacity 2007 (MW)
EAI WBL Sale (2003-2005) - White Bluff 1	Base Load	Coal	ENO	13
EAI WBL Sale (2003-2005) - White Bluff 2	Base Load	Coal	EAI	-25
EAI WBL Sale (2003-2005) - White Bluff 2	Base Load	Coal	ELL	13
EAI WBL Sale (2003-2005) - White Bluff 2	Base Load	Coal	ENO	13
EPI - ISES 2	Base Load	Coal	ELL	50
EPI - ISES 2	Base Load	Coal	ENO	50
River Bend 30%	Base Load	Nuclear	ELL	196
River Bend 30%	Base Load	Nuclear	ENO	98

Notes:

1. WBL = Wholesale Base Load

{{{***Proprietary Information – Withheld Under 10 CFR 2.390(a)(4)***}}}
(see COL Application – Part 9)

TABLE 8.3-203 (Sheet 1 of 2)
SUMMARY OF PLANNED RESOURCES 2007-2016

{{{***Proprietary Information – Withheld Under 10 CFR 2.390(a)(4)***}}}

(see COL Application – Part 9)

TABLE 8.3-203 (Sheet 2 of 2)
SUMMARY OF PLANNED RESOURCES 2007-2016

{{{***Proprietary Information – Withheld Under 10 CFR 2.390(a)(4)***}}}
(see COL Application – Part 9)

TABLE 8.3-204
ANNUAL FORECAST NET POWER SALES (IN MWh)

8.4 ASSESSMENT OF NEED FOR POWER

Information for this section is not provided in the ESP Application Part 3 – Environmental Report; the following supplements are provided.

8.4.1 BASE LOAD DEMAND

The EES SSRP (Reference 201) comprehends a set of planning objectives and principles for long-term generation supply resource planning. The planning process determines the type of generation needed to meet customer requirements by analysis of expected customer load. For long-term planning purposes EES has adopted the guideline that base load capacity should be sufficient to meet load levels projected to exist in 85 percent of hours. Based on that criterion,
Proprietary EES currently has a base load deficit of approximately {{{ }}}. That deficit is expected to increase over time with load growth as shown in Table 8.2-207. See Figure 8.4-201.

EES must add base load generating capacity to meet the current and projected supply role deficit. Additional long-term base load capacity is needed to ensure a reliable supply of base load energy, meet base load energy needs at an economic price, and reduce the risk for price volatility associated with reliance on gas-fueled generation and power purchases. EES plans to meet these requirements largely with long-term resources, whether owned assets or long-term power purchase agreements.

8.4.2 RESERVE MARGIN

The EES SSRP (Reference 201) comprehends a set of planning objectives and principles for long-term generation supply resource planning. The SSRP envisions that EES will maintain sufficient generating capacity to meet its reliability requirement, expressed as peak load plus an adequate provision for reserves. EES presently estimates its reserve requirement to be 16.8 percent based on a criterion that loss of load probability should not exceed one day in ten years. Table 8.2-207 presents the forecasted firm peak demand and the total reliability power need (peak demand plus the reserve requirement) from 2007 through 2017. For example, in 2007, the
Proprietary firm peak demand is just under {{{ }}}. With a reserve margin of 16.8 percent (or
Proprietary {{{ }}}), the total reliability need is approximately {{{ }}}.

Proprietary As shown in Table 8.3-201, EES currently has a reliability deficit of almost {{{ }}}, when compared to existing owned and long-term contracted resources. That deficit is expected to increase as load grows. EES plans to meet these requirements largely from long-term resources, whether owned assets or long-term power purchase agreements.

8.4.3 CONCLUSION

EES needs to add long-term generating capacity in order to meet both reliability requirements and base load supply needs. The EES SSRP for the period 2007 – 2016 systematically and comprehensively provides the analysis of future power needs and concludes that additional supply resources will be required to meet the need for power. The SSRP has been shown to be responsive to forecasting uncertainty and is provided for review to the operating companies' retail regulators for information purposes.

8.4.4 REFERENCES

201 Plan Summary Document, Entergy Electric System Strategic Supply Resource Plan for the Planning Period 2007-2016, October 20, 2006.

{{{Security-Related Information - Withheld Under 10 CFR 2.390(a)(4)}}}
(See COL Application - Part 9)

Figure 8.4-201. Need For Power

CHAPTER 9 ALTERNATIVES TO THE PROPOSED ACTION

9.0 ALTERNATIVES TO THE PROPOSED ACTION

Chapter 9 describes the alternatives to the proposed action of constructing and operating Grand Gulf Nuclear Station (GGNS) Unit 3. This chapter is divided into four subsections:

The No Action Alternative (Section 9.1)

Energy Alternatives (Section 9.2)

Alternative Sites (Section 9.3)

Alternative Plant and Transmission Systems (Section 9.4)

9.0.1 REFERENCES

None.

9.1 NO-ACTION ALTERNATIVE

The definition and evaluation of the no-action alternative at the Early Site Permit (ESP) stage was provided in the ESP Application Part 3 – Environmental Report (ER), Section 9.1, and associated impacts are resolved in NUREG-1817 Section 8.1; the following supplemental information is provided.

This section defines and describes the no-action alternative, as well as the impacts that would result if the no-action alternative is chosen (i.e. need for power is not satisfied by construction of Unit 3). Chapter 8 addresses the need for power. Section 10.4 summarizes and evaluates the overall benefit and cost of constructing and operating the proposed new nuclear facility.

Section 8.1 of NUREG-1817 describes the no-action alternative considered for the ESP application as NRC denial of the ESP and consequently no construction of the proposed nuclear generating facility at the GGNS site.

The no-action alternative, in the context of a COL application, means that some portion of the necessary federal, state, or other required approvals, licenses, and/or permits for the project would be denied. As a result, it is assumed that the Applicant would not proceed with the construction and operation of the proposed Unit 3 facility, even though the need for power is demonstrated in Chapter 8.

Consistent with the guidance of NUREG-1555 (Section 9.1), the no-action alternative would result in the proposed Unit 3 not being built, and no other facility would be built or other strategy implemented to take its place. This strict definition and consideration of the no-action alternative would mean that the electric power generation capacity to be provided by Unit 3 would not become available. Per NUREG-1555 guidance, the no-action alternative also presupposes that no additional conservation measures would be enacted to decrease the amount of electrical capacity that would otherwise be required.

As evaluated in Chapter 8 and summarized in Section 8.4, it is shown that the Entergy Electric System (EES) must add base load generating capacity to meet current and projected supply role deficit. The cancellation of this project along with no action to replace (owner-controlled) capacity or purchase power could (1) prevent EES from ensuring a reliable supply of base load energy, (2) compromise its ability to meet base load energy needs at an economic price, and (3) could increase EES's exposure to price volatility associated with reliance on gas-fueled generation and power purchases.

Given the need for power demonstrated in Chapter 8, in the absence of the proposed generation capability, EES would act to meet its reliability goals and service area power needs, thus mitigating adverse impacts to consumers and to the broader economic productivity of the region. Therefore, EES would pursue: (1) appropriate power purchase agreements and/or (2) construction of new owner-controlled generation assets at other sites. Both alternatives are addressed below regarding prior environmental impact analyses. In addition, as a matter of completeness, energy conservation and efficiency measures (that is, demand side management) are also discussed below.

- Environmental considerations of the power purchase alternative were evaluated in the ESP Environmental Report (ER) Subsection 9.2.1, along with other alternatives "not requiring new generation." NUREG-1817, Subsection 8.2.1, reviewed power purchase and other alternatives not requiring new generation. This issue is considered resolved. (See also Section 9.2 of this report.)

- Options pursuing new generation capacity, including coal, natural gas, and oil-fired electrical power generation were evaluated in ESP ER Subsection 9.2.2. This evaluation included consideration of possible combinations of alternate energy sources to meet the need for power. NUREG-1817, Subsection 8.2.2, reviewed alternatives requiring new generating capacity, including combinations thereof, and this issue is considered resolved. (See also Section 9.2 of this report.)

- Energy conservation and efficiency (that is, demand side management) programs typically consist of a wide range of planning, implementing, communication, and monitoring activities that are designed to encourage consumers to modify their level and pattern of electrical usage. Entergy already has active programs in place that encourage conservation and offer public education information and tools to assist residential and commercial clients to improve energy use efficiency. However, given the magnitude of current and projected need for power, it is reasonable to conclude that energy conservation and related demand side management programs could offset only a small fraction of the required base load power need. NUREG-1817, Subsection 8.2, indicates that the NRC determined that conservation or demand side management programs are not a reasonable alternative to a base load nuclear power plant and that the conservation alternative need not be considered further.

Section 10.4 evaluates the overall benefit and cost of the proposed new facility. As concluded in Subsection 10.4.3, on balance, the benefits of construction and operation of Unit 3 significantly outweigh the associated economic, environmental, and social costs. If the unit were not constructed or operated, then the associated costs would not be incurred. However, given the overall assessment that the project represents a significant outweighing benefit, it follows that net benefit would not be realized under the no-action alternative.

9.1.1 REFERENCES

None.

9.2 ENERGY ALTERNATIVES

The information for this section is provided in the ESP Application Part 3 – Environmental Report, Section 9.2, and associated impacts are resolved in NUREG-1817, Subsection 8.2.5; no new and significant information has been identified.

9.2.1 REFERENCES

None.

9.3 ALTERNATIVE SITES

The information for this section is provided in the ESP Application Part 3 – Environmental Report, Section 9.3, and associated impacts are resolved in NUREG-1817, Section 9.3; no new and significant information has been identified.

9.3.1 REFERENCES

None.

9.4 ALTERNATIVE PLANT AND TRANSMISSION SYSTEMS

The information for this section is provided in the ESP Application Part 3 – Environmental Report, Section 9.4, and the associated alternatives analysis is not fully resolved in NUREG-1817; the following supplemental information is provided.

9.4.1 HEAT DISSIPATION SYSTEMS

NUREG-1817, Subsection 8.3.1 contains the following statement: “Based on the NRC staff's 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 one or more new nuclear units or units 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.”

The selected cooling system design, as discussed in Sections 3.4 and 5.3, provides the normal heat sink through the use of a natural draft cooling tower in combination with a mechanical draft cooling tower. Although the final selection of the cooling system was not made at the time of the ESP, the conclusions made by the NRC staff resolved that wet natural draft and wet mechanical draft cooling towers are suitable for the Unit 3 site. A review of new technology revealed no new and significant information that would change the determination made in ESP ER Subsection 9.4.1 that there are no environmentally preferable alternatives to wet cooling towers for the Unit 3 normal heat sink.

9.4.2 CIRCULATING WATER SYSTEMS

The circulating water system is a closed-loop design that will use a natural draft cooling tower in combination with a mechanical draft cooling tower to provide heat dissipation. The following NUREG-1817 subsections resolved the issues dealing with the circulating water system.

NUREG-1817, Subsection 8.3.2.1, “Intake Systems” states with regard to riverbed structure intake or diversionary channel intake alternatives: “The staff found no basis to suggest that these two water intake alternatives would be environmentally preferable to SERI's proposed intake system.” The proposed Unit 3 intake structure is described in Subsection 3.4.2.1. There is no new and significant information that would change the intake selected.

NUREG-1817, Subsection 8.3.2.2, “Discharge Systems” states: “The staff found no basis to suggest that the two discharge alternatives would be environmentally preferable to SERI's proposed discharge system.” There is no new and significant information that would change the discharge selected.

The Unit 3 makeup water will be supplied by the Mississippi River. NUREG-1817, Subsection 8.3.2.3, “Water Supply” states: “The staff did not identify any other environmentally preferable water supply.” There is no new and significant information that would change the water supply selected.

9.4.3 TRANSMISSION SYSTEMS

The GGNS site was previously evaluated for two nuclear units; Unit 1 was completed and is currently operating while Unit 2 was cancelled and construction suspended. Five transmission routes were evaluated in the original site environmental report: GGNS to Baxter Wilson, Franklin, Ray Braswell, Sterlington, and a tie-in or “tap” from GGNS to the North-South EHV Trunkline. The GGNS to Baxter Wilson, Franklin, and Ray Braswell transmission lines were selected for construction to support Units 1 and 2 operations. (Reference 201) The Baxter Wilson and Franklin lines were constructed and are currently in use. Most of the Ray Braswell route right-of-way was acquired, but no construction was started on this route due to the cancellation of Unit 2.

Entergy Mississippi Inc. (EMI) will provide service to move the energy generated by Unit 3 to the regional transmission grid and the ultimate consumers. EMI will construct a 500-kV line from one of its existing substations to the Unit 3 switchyard for the interconnection. As discussed in Section 2.2, the final selection of a route will be the responsibility of EMI, and the construction will be permitted by the Mississippi Public Service Commission (MPSC) in the form of a Certificate of Convenience and Necessity. EMI has responsibility for transmission systems. In order to address the alternative transmission issue associated with Unit 3, four options considered feasible are presented below. However, they have not been fully evaluated or endorsed by EMI. These four options are shown in Figure 9.4-201.

The Perryville Option consists of approximately 19 mi. of new 150-ft. ROW adjacent to the existing Baxter Wilson 500-kV line and approximately 77 mi. of new 200 ft. ROW parallel to an existing 500-kV line connecting the Baxter Wilson Substation to the Perryville Substation. The original Sterlington route considered for Units 1 & 2 would not be suitable for Unit 3 due to the construction of the Perryville Substation in the interim between then and today. The Perryville Option represents a shorter and more practical route for a westerly connection to the grid as opposed to routing to Sterlington.

The Baxter Wilson Option consists of 19 mi. of new 150-ft. ROW adjacent to an existing 500-kV line connecting Unit 1 to the Baxter Wilson Substation and an additional 38 mi. of 150-ft. ROW adjacent to an existing 500-kV line connecting the Ray Braswell and Baxter Wilson Substations.

The Franklin-Trunkline Option consists of approximately 33 mi. of new 200-ft. ROW extending from the GGNS site due east to the existing Franklin Trunkline 500-kV line connecting the Franklin and Ray Braswell Substations and another 24 mi. of new 150-ft. ROW adjacent to the existing line extending north to the Ray Braswell Substation. This option is equivalent to the originally considered North-South EHV Trunkline tap as a due east line but eliminates the substation which would have been constructed in the earlier concept and replaces it with a parallel line routed north to the Ray Braswell Substation adjacent to the existing Trunkline ROW.

The Ray Braswell Option consists of approximately 25 mi. of new 200-ft. 500-kV ROW extending from the GGNS site northeast to the existing 500-kV line connecting the Baxter Wilson and Ray Braswell Substations and, from that point, another 30 mi. of new 200-ft. ROW parallel to that existing ROW extending east to the Ray Braswell Substation, as described in Subsection 3.7.1.

Both the Baxter Wilson Option and the Perryville Option involve an expansion of the existing Baxter Wilson 500-kV ROW that currently serves Unit 1, thus, involving an effectively “shared”

ROW from GGNS to Baxter Wilson. Due to the fact that both options involve transmission lines serving GGNS running in close proximity, and one event could cause failures in both lines, neither option would be prudent from a reliability standpoint. In order to separate the lines to the extent that one failure would not cause the other to fail, it would be necessary to separate the lines into parallel rather than shared ROWs for the segment between the GGNS site and the Baxter Wilson Substation, resulting in greater impacts and costs as compared to the shared ROW model. In addition, the Perryville Option initially routes the power to the west in order to connect to the grid. This option places the energy on the grid nearly 150 mi. from the load center, burdening the grid to wheel this power back to the east where it is needed. (See Figure 9.4-201.) For these reasons, the Perryville and Baxter Wilson Options were eliminated from further consideration.

The remaining alternatives for transmission line routing (Franklin-Trunkline Option and Ray Braswell Option) were analyzed on the basis of the relative impacts to habitats and land use using the GIS analysis procedure described in Section 2.2. The results of that analysis are shown in Table 9.4-201. The remaining alternatives involve both new ROW components and either shared or adjacent ROW components. Assuming a straight-line corridor from GGNS to the existing Franklin Trunkline, the Ray Braswell Option has a slightly higher acreage impact than the Franklin Trunkline Option although there are minor differences in categories of land use or habitats affected. While precise cost estimates are not provided, the similarities in length, forested areas to be cleared, and developed areas impacted would indicate that the estimated costs of the two options are similar and would not indicate a preferred selection. However, EMI reports that much of the ROW for the Ray Braswell Option was acquired during the planning for Units 1 and 2. ROW acquisition is an expensive and time consuming activity. Given that a large portion of the new ROW for the Ray Braswell Option has been acquired, and that any new ROW acquired for the Franklin-Trunkline Option would occur at more expensive present-day real estate prices, this would greatly favor the selection of the Ray Braswell Option as the preferred option in the absence of other differentiating factors available for this analysis. With regard to threatened and endangered species, Entergy observes practices and processes intended to provide appropriate, prudent measures for protection of environmentally sensitive areas that could be involved in the planning and construction of transmission lines or substations (as discussed in Subsection 2.4.1). Given these measures would apply equally to both alternatives, there is no reason to distinguish between the alternatives with regard to impacts to threatened and endangered species for this level of analysis. Therefore, the Ray Braswell Option is the preferred option as described in Section 3.7, and there are no other viable, environmentally preferable alternatives.

9.4.4 REFERENCES

201 Mississippi Power and Light Company (MP&L). Grand Gulf Nuclear Station Units 1 and 2 Final Environmental Report (FER), as amended through Amendment No. 8. Jackson, Mississippi. 1973.

TABLE 9.4-201
IMPACT ANALYSIS OF TRANSMISSION LINE ALTERNATIVES

Land Use/Habitat Description	Franklin Trunkline		Ray Braswell	
	Acres[1]	Percent[2]	Acres[1]	Percent[2]
Open Water	7.5	0.6	5.5	0.4
Developed, Open Space	0	0	1.5	0.1
Developed, Low Intensity	0	0	2.4	0.2
Developed, Medium Intensity	0	0	0.2	0
Bare Rock/Sandy Clay	0.6	<0.1	0	0
Unconsolidated Shore	0	0	0.6	<0.1
Transitional	0.5	<0.1	24.2	1.8
Deciduous Forest	215.7	17.6	382.6	28.7
Evergreen Forest	142.1	11.6	36.6	2.7
Mixed Forest	218.4	17.9	280.1	21.0
Pasture/Hay	449.6	36.8	442.4	33.2
Cultivated Crops	172.4	14.1	63.5	4.8
Small Grain Row Crops	0	0	0	0
Urban/Recreational Grasses	0	0	0	0
Palustrine Forested Wetland	13.5	1.1	93.6	7.0
Emergent Herbaceous Wetland	2.6	0.2	0	0
Totals	1222.9	99.9	1333.3	99.9

Notes:

1. Number of acres of land use/habitat type contained within the ROW.
2. Approximate percent of total number of acres contained within the ROW.

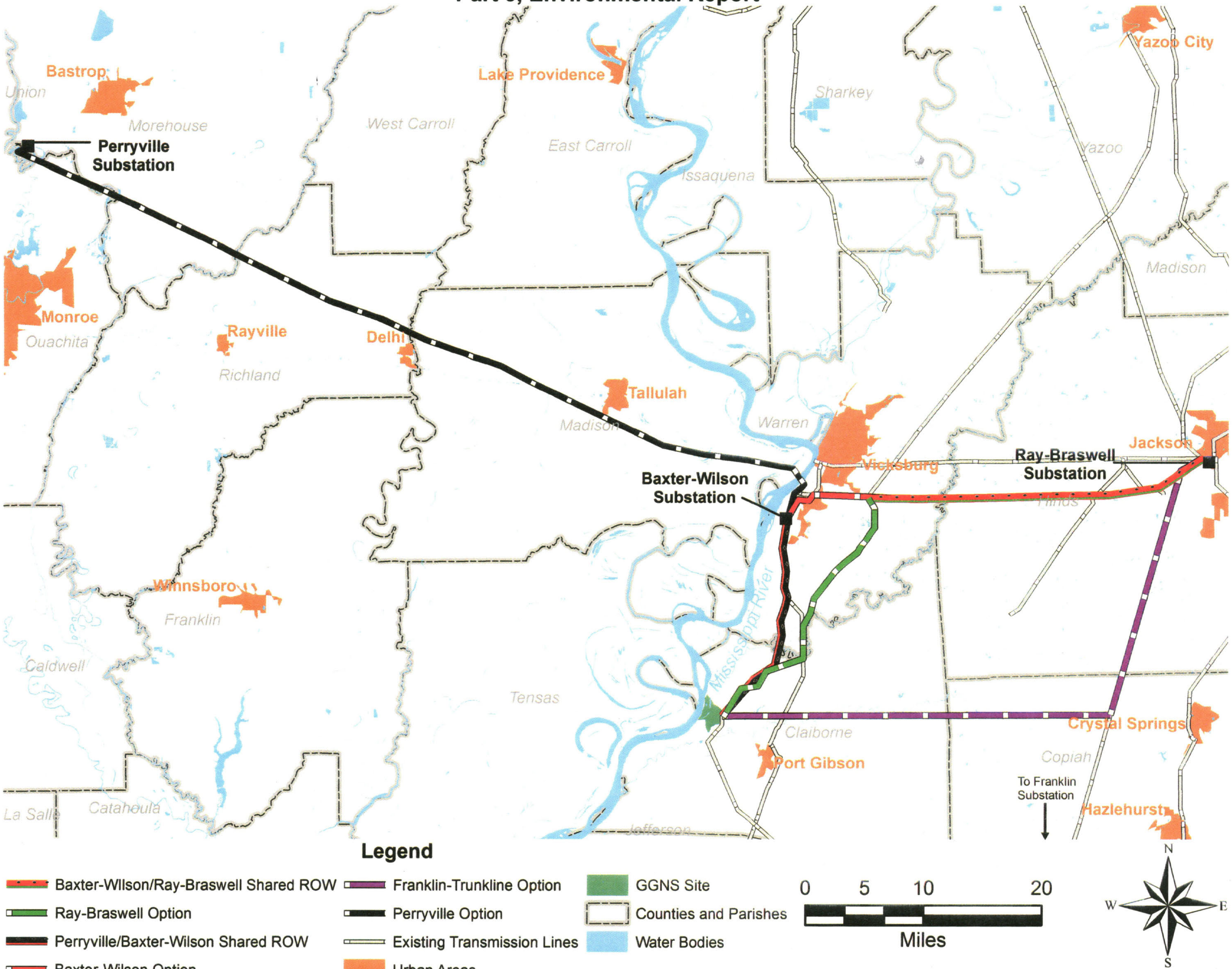


Figure 9.4-201. Unit 3 Transmission Line Alternatives

CHAPTER 10 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

10.1 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

Information for this section is provided in the Early Site Permit (ESP) Application Part 3 – Environmental Report (ER), Section 10.1 and in NUREG-1817 Section 10.1; the following supplemental information is provided.

This section presents the potential environmental consequences of constructing and operating Unit 3 at the Grand Gulf Nuclear Station (GGNS). Unavoidable adverse impacts are predicted adverse environmental impacts that remain after all practical mitigation measures have been taken. This section considers unavoidable adverse impacts from construction and operation of Unit 3 and its new transmission system.

10.1.1 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS OF CONSTRUCTION

Construction impacts are described in detail in Chapter 4. Table 4.6-201 summarizes those impacts, and briefly describes the measures and controls that would be implemented to reduce or eliminate them. The mitigation measures are frequently implemented through permitting requirements, and plans and procedures developed for the construction activities. For some of the impacts related to construction activities, mitigation measures that would be applied are referred to as best management practices (BMPs). BMPs are designed to address the specific types of activities that are to be performed.

Some of these impacts cannot be avoided and there are no practical means for mitigation. These expected impacts and the mitigation measures that are available to reduce these impacts are summarized in Table 10.1-201. Unavoidable adverse impacts from construction of the new unit and on-site and off-site transmission corridors for Unit 3 include the loss of previously undeveloped land that includes wetlands and provides habitat for wildlife, and the use of water during construction that would not be available for other uses. The unavoidable adverse impacts and mitigation measures described in Table 10.1-201 are supplemental to those provided in the ESP Application Part 3 – Environmental Report, Subsection 10.1.1, and NUREG-1817, Subsection 10.1.1.

10.1.2 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS OF OPERATIONS

Operational impacts of Unit 3 are discussed in detail in Chapter 5. Table 5.10-201 summarizes those impacts, and briefly describes measures and controls that would be implemented to reduce or eliminate them. Some of these impacts cannot be avoided, and there are no practical means for mitigation. These expected impacts and the mitigation measures that are available to reduce these impacts are summarized in Table 10.1-202. Unavoidable adverse impacts from the operation of the new unit at GGNS include the loss of aquatic biota at the intake structure and temporary impacts to the aquatic ecosystem due to periodic maintenance dredging. The unavoidable adverse impacts and mitigation measures described in Table 10.1-202 are supplemental to those provided in the ESP Application Part 3 – Environmental Report, Subsection 10.1.2, and NUREG-1817, Subsection 10.1.2.

10.1.3 REFERENCES

None.

TABLE 10.1-201 (SHEET 1 OF 2)
CONSTRUCTION-RELATED UNAVOIDABLE ADVERSE IMPACTS

Impact Category	Adverse Impacts Based on Applicant's Proposal	Actions to Mitigate Impacts[1]	Unavoidable Adverse Impacts
Land Use	During construction, 234 ac. of land would be altered and converted, with the potential for erosion (Subsection 4.1.1); 132 ac. would be permanently occupied by structures and impervious surfaces (Subsection 4.1.1). This land would not be available for other uses. Impacts would include the removal of existing vegetation, large volumes of construction spoils/ borrow, dewatering, dredging, grading, and excavation.	Adjust grade elevations in the parking, construction laydown, and batch plant areas to minimize net gain/loss of spoils materials. Deposit materials on the GGNS site and follow best-management practices in the handling of the material.	The construction of Unit 3 would temporarily or permanently altered 234 ac. of habitat; 132 ac. would be occupied on a long-term basis by the nuclear power plant and associated infrastructure.
	Construction of off-site transmission right-of-way corridor in previously undisturbed land. It is estimated that 1333 ac. will be affected (Table 2.2-201).	Control dust and operate heavy machinery during daylight hours. Use of best management and standard industry practices, and following applicable laws and regulations pertaining to ground-disturbing activities, such as forest and wetlands protection and stormwater controls.	The conversion of previously undisturbed land into a transmission corridor would be an unavoidable adverse impact.

TABLE 10.1-201 (SHEET 2 OF 2)
CONSTRUCTION-RELATED UNAVOIDABLE ADVERSE IMPACTS

Impact Category	Adverse Impacts Based on Applicant's Proposal	Actions to Mitigate Impacts[1]	Unavoidable Adverse Impacts
Hydrological and Water Use	Construction is expected to require water amounts between approximately 129,600 gpd and 162,000 gpd. (Subsection 4.2.2)	No mitigation recommended at this time.	Water used for construction would not be available for other uses.
Ecological			
Terrestrial	A relatively small loss of high quality upland habitat from clearing along the on-site and off-site transmission corridor ROW.	No mitigation recommended at this time.	The loss of upland habitat would be an unavoidable adverse impact.
	Loss of "candidate trees" for potential black bear dens is considered to be a small to negligible impact.	Pre-construction monitoring to identify black bear use of the candidate trees in the construction area.	The loss of potential black bear den sites would be an unavoidable adverse impact.

Notes:

1. The mitigation measures and controls described herein are supplemental to those provided in the ESP ER.

TABLE 10.1-202
OPERATIONS-RELATED UNAVOIDABLE ADVERSE IMPACTS

Impact Category	Adverse Impacts	Actions to Mitigate Impacts[1]	Unavoidable Adverse Impacts
Ecological			
Aquatic	Uptake of aquatic biota and river debris through the intake structure.	Intake screens are designed to be placed at an elevation above the dredge base of the embayment, intake velocity is designed to be less than 0.5 ft/s to minimize uptake, entrainment, and impingement, and intake flow rate is commensurate with that of a closed-cycle cooling system.	The loss of aquatic biota would be an unavoidable impact; however the mitigation measures will likely reduce these impacts such that they would not have an adverse environmental impact on the balanced indigenous populations of aquatic biota.
	Entrainment and impingement of aquatic biota.	See above entry.	See above entry.
	Dredging of the embayment may impact ecosystems.	Spoils are disposed according to U.S. Army Corps of Engineers, MDEQ, and applicable permit requirements.	Dredging would result in temporary unavoidable adverse impacts due to increased sediment loads, alterations of benthic aquatic habitat, and the direct loss of aquatic biota.

Notes:

1. The mitigation measures and controls described herein are supplemental to those provided in the ESP ER.

10.2 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Information for this section is provided in the ESP Application Part 3 – Environmental Report, Section 10.2, and the issue was not resolved in NUREG-1817; the following supplemental information is provided.

This section describes the expected irreversible and irretrievable environmental and material resource commitments used in the construction and operation of Unit 3. The term "irreversible commitments of resources" describes environmental resources that would potentially be changed by the construction or operation of Unit 3 and that could not be restored at some later time to the resource's pre-construction or pre-operation state. Irretrievable resources are generally materials that would be used for the new units in such a way that they could not, by practical means, be recycled or restored for other uses.

Though the issue of irreversible and irretrievable commitments of resources was unresolved in NUREG-1817 Section 10.2, the NRC anticipated that impacts from construction and operation of a new facility at GGNS would be similar to that of any major construction project and classified the expected loss of resources used in construction to be of SMALL consequence, with respect to the availability of such resources. The NRC staff states in Section 10.2 of NUREG-1817 that the main resource irretrievably committed by licensing operation of a new facility at GGNS would be uranium, which is available in sufficient quantities such that the irreversible and irretrievable commitment of uranium would be of SMALL consequence.

However, the NRC left the issue of irreversible and irretrievable commitments of resources unresolved because the proposed action (the approval of the ESP) did not involve a commitment of resources. The NRC states in NUREG-1817 that the actual estimate of construction materials would be performed at the COL stage, based upon the selected reactor design. Therefore, the irreversible and irretrievable commitments of resources resulting from construction and operation of Unit 3 at GGNS are considered below.

A summary of irreversible and irretrievable commitments of resources is presented in Table 10.2-201.

10.2.1 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF ENVIRONMENTAL RESOURCES

Irreversible environmental commitments resulting from the construction and operation of Unit 3 include the dedication of resources as described below.

Hydrological and Water Use

As stated in Sections 2.3, 4.2, and 5.2, groundwater would be withdrawn from the Upland Complex or Mississippi River Alluvium formations, and not the Catahoula Formation as originally stated in the ESP ER. This withdrawn groundwater would be used for the construction and operation of Unit 3 for dust control, potable and sanitary water needs, and landscaping. These uses are expected to require water amounts between approximately 35 gpm and 200 gpm, as stated in Sections 4.2 and 5.2. This amount of water would be considered an irretrievable committed resource.

A small fraction of the Mississippi River surface water would be used during operation of Unit 3, as stated in Section 5.2. A portion of the water used during plant operations would be circulated through the cooling system and converted to vapor or otherwise be consumed in plant processes. Because the resource use is consumptive, it would not be available for other uses, now or in the future. This amount of water would be considered an irreversible committed resource.

In both cases mentioned above, the consumption of water for construction and operation of Unit 3, while irreversible, would be of SMALL consequence with respect to the volume and availability of groundwater and surface water in the plant vicinity. Impacts of water use from construction and operations are described in detail in Sections 4.2 and 5.2, respectively.

Ecological

Construction would temporarily adversely affect the abundance and distribution of local flora and fauna at GGNS. Similar impacts would occur within the new off-site transmission corridor. These impacts would result in the irreversible commitment of these resources as individual organisms. After construction is complete it is reasonable to expect that the local floral and faunal populations would recover in areas that are not affected by operations. A commitment of individual aquatic biota would occur during the operation of Unit 3 as a result of entrainment and impingement at the intake; however these minimal effects would be fairly localized. The construction and operation of Unit 3 is not predicted to result in the extirpation or extinction of any species. Therefore no overall irreversible or irretrievable commitment of these biological resources would be considered likely to occur and the irreversible commitment of those individual organisms would be of SMALL consequence, with respect to the availability of such resources in the region. Ecological impacts of construction and operations are discussed in Sections 4.3 and 5.3, respectively.

After Unit 3 ceases operations and the plant is decommissioned in accordance with NRC requirements, the land that supports the facility could be returned to other industrial or non-industrial uses. Thus, the unavoidable adverse impact to land use identified in Section 10.1 is not considered an irreversible commitment of resources. Upland forested areas of the site and the off-site transmission right-of-way will also be impacted. The woodland habitat to be lost to construction represents a small fraction of the total availability of this habitat in the region of Unit 3, and though irreversible, would be of SMALL consequence, with respect to the availability of such resources in the region.

10.2.2 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF MATERIAL RESOURCES

The irretrievable commitment of material resources during construction of Unit 3 generally would be similar to that of any major construction project. The construction of Unit 3 is estimated to require 354,983 cubic yards of concrete, 70,997 tons of rebar, 6,282,368 linear ft. of cable, and up to 245,507 linear ft. of piping greater than 2.5 in. for a single ESBWR reactor. The irretrievable commitment of construction materials in the quantities associated with those expected for a nuclear power plant would be of SMALL consequence, with respect to the availability of such resources.

As stated in NUREG-1817 Section 10.2, the main resource that would be irreversibly and irretrievably committed during operation of a new unit would be the uranium. The World Nuclear Association, which studies supply and demand of uranium, states that the world's present measured resources of uranium, in the cost category somewhat above present spot prices and used only in conventional reactors, are enough to last for some 70 years. There was very little uranium exploration between 1985 and 2005, so the significant increase in exploration that is currently being conducted could readily double the known economic resources. On the basis of analogies with other metal minerals, a doubling in price from present levels could be expected to create about a tenfold increased in measured resources, over time (Reference 201). As stated in NUREG-1817 Section 10.2 and supported by the information above, the uranium that would be used to generate power at the GGNS, while irretrievable, would be of SMALL consequence with respect to the long-term availability of uranium worldwide.

10.2.3 REFERENCES

201 World Nuclear Association, Supply of Uranium, March, 2007, Website, http://www.world-nuclear.org/info/inf75.html, accessed June 19, 2007.

TABLE 10.2-201
IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

RESOURCE	COMMITMENT
Environmental	
Hydrological and Water Use	During construction and operations, groundwater amounts between approximately 35 gpm and 200 gpm would be used for dust control, potable and sanitary needs, and landscaping. During operations, surface water would be circulated through the cooling tower and used in other plant processes. The surface water use required for Unit 3 is a small amount relative to the total Mississippi River flow. The water used would be considered an irreversible committed resource, although its impact to the resource would be of SMALL consequence.
Ecological	Upland forested areas of the on-site and the off-site transmission right-of-way will be impacted. The woodland habitat to be lost to construction represents a small fraction of the total availability of this habitat in the region of GGNS, and though irreversible, would be of SMALL consequence with respect to the availability of such resources in the region.
Material	
Construction Materials	Construction of Unit 3 would require the irretrievable commitment of large amounts of construction related materials. The commitment of these resources relative to their availability would be of SMALL consequence
Uranium	Uranium used to generate power during the operations of Unit 3 would be an irreversibly and irretrievably committed resource. The amount of uranium used during the life of Unit 3 with respect to the long-term availability the resource would be of SMALL consequence.

10.3 RELATIONSHIP BETWEEN SHORT TERM USES AND LONG TERM PRODUCTIVITY OF THE HUMAN ENVIRONMENT

Information for this section is provided in the ESP Application Part 3 – Environmental Report, Section 10.3, and the issue was not resolved in NUREG-1817; the following supplemental information is provided.

The NRC considered this issue unresolved in NUREG-1817 Section 10.3 because the proposed action, the approval of the ESP, did not involve a short-term use of the environment, and the long-term productivity, the benefits of operating the new unit, were not evaluated at the ESP stage. The NRC states in NUREG-1817 that this assessment would be performed at the CP or COL stage. Therefore, 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 Unit 3 at GGNS is evaluated below.

This section presents a discussion of the Unit 3 short-term uses of the environment and their relationship to long-term environmental productivity. This discussion includes an evaluation of the extent to which the proposed project's use of the environment would preclude options for future use of the environment. For the purposes of this section, “short-term” refers to the period from start of construction to end of plant life, including prompt decommissioning, and “long-term” refers to the period extending beyond the end of plant life, including the period up to and beyond that required for delayed plant decommissioning.

Short-term uses of the environment for the construction and operation of Unit 3 include the unavoidable adverse impacts identified in Section 10.1. These uses include the development of land that would not be available for other uses until the facilities are decommissioned, impacts to lands that provide habitat for wildlife, the consumptive use of water during construction, the loss of aquatic biota at the intake structure during plant operations, and temporary impacts to the aquatic ecosystem due to periodic maintenance dredging during the life of the project. Other short-term uses of the environment include the irreversible and irretrievable commitments of resources identified in Section 10.2, with the exception of those commitments that involve the consumption of depletable resources as a result of plant construction and operation, which would be considered long-term uses of the environment.

As discussed in ESP ER Section 10.3, GGNS was originally developed for two nuclear generating units. Preliminary work for the construction of Units 1 and 2 began around 1970. Unit 1 is licensed to operate until 2022. Construction of Unit 2 was officially cancelled in 1991. The construction of Unit 3 at GGNS is consistent with the intended short-term use of the GGNS site; that is, electrical power generation. The construction and operation of Unit 3 at the site would further extend the short-term preemption of this land. However, as discussed below, the overall benefits of power production and the realization of economic productivity are considered greater than those benefits that would be derived from other likely uses of the site during this period.

Benefits of Construction

The benefits of construction and operation of Unit 3 are evaluated in Section 10.4. The principal short-term benefit of construction and operation of a new unit would be the production of electrical energy and the economic productivity of the site that production of electricity would provide. The jobs created by the construction and operation of a new facility would represent a significant input of resources to the local economy. In addition, tax revenues from the facility would also present an economic stimulus to Claiborne County, the region, and Mississippi.

The areas to be developed for Unit 3 are adjacent to the operating Unit 1 nuclear plant; therefore, the use of the land is precluded from commercial development and agriculture. In the absence of Unit 3, some proposed construction areas at the site could potentially be used for silviculture or wildlife habitat. However, the economic benefit of the electrical production project would be relatively LARGE compared with the productivity from any other potential uses.

Long-Term Productivity Impacts

The maximum long-term impact to productivity from other uses of the land within the GGNS site would result if the facility were not decommissioned in a timely manner. The result of any delay in decommissioning would be that the land occupied by facility structures would not be available for any other use. Compliance with the requirements of 10 CFR Part 50.82 would dictate that a new unit would be decommissioned in a timely manner following the end of its useful life. Typical of current industry approaches for multi-unit sites, the decommissioning of Unit 3 would be expected to include other facilities on site. It is reasonable to expect that the site would be released for unrestricted use and that such actions would be undertaken in a timely manner, thus minimizing the impact to long-term productivity.

The loss of biologically productive woodlands would be considered an impact to the long-term biological productivity of the site because it is unlikely that the current soil productivity supporting this woodland habitat would be restored in a reasonable time frame. It is likely that the site would be used for other industrial uses following decommissioning and not reverted back to use as wildlife habitat.

As stated in Section 10.4, the operation of Unit 3 would also result in a long-term benefit to air quality and greenhouse gas levels through emissions avoidance by not relying on natural gas and coal-fired electrical generation.

Overall, the enhancement of regional productivity resulting from the electrical energy produced by Unit 3 would not be equaled by any other use of the site. In addition, most long-term impacts resulting from land-use preemption by plant structures would be eliminated by removing these structures or by converting them to other productive uses.

Summary of Relationship between Short-Term Uses and Long-Term Productivity of the Human Environment

The short-term and long-term benefits of the construction and operation of Unit 3 outweigh the short-term and long-term impacts to environmental productivity. The short-term benefit of the production of electrical energy and the economic productivity of the site would be relatively

LARGE compared with the productivity of the GGNS site from any other probable uses. The construction and operation of Unit 3 would result in the positive long-term enhancement of regional productivity through the generation of electrical energy, with benefits that would likely extend beyond the life of the project.

Table 10.3-201 compares the project's principal short-term uses to the long-term productivity of the human environment.

10.3.1 REFERENCES

None.

**TABLE 10.3-201 (SHEET 1 OF 2)
SUMMARY OF THE PRINCIPAL SHORT-TERM USES VERSUS THE LONG-TERM PRODUCTIVITY OF THE HUMAN ENVIRONMENT**

	Short-Term Uses and Benefits	Relationship to Maintenance and Enhancement of Long-Term Environmental Productivity
Land Use	The construction and operation of Unit 3 and the new off-site transmission right-of-way would preclude these lands from being available for other uses.	Construction and operation of Unit 3 does not necessarily represent a long-term impact to productivity of the human environment as the land might be available for other uses or returned to a natural state after the reactors are decommissioned.
Hydrological and Water Use	Construction is expected to require water amounts between approximately 129,600 gpd and 162,000 gpd.	The consumptive use of water during construction does not result in any significant long-term impacts to water resources.
Ecological		
– Terrestrial	The construction and operation of Unit 3 and its associated infrastructure results in impacts to habitat for plants and animals.	The construction of Unit 3 and the associated on-site and off-site transmission lines would result in the long-term loss of biologically productive woodlands as soil conditions there could take hundreds of years to redevelop. Region wide this resource is not rare and associated wildlife would likely recover from displacement by the project.
– Aquatic	Impacts to the aquatic ecosystem due to the intake structure and the dredging of the embayment.	The construction and operation of Unit 3 does not result in any significant long-term impacts to biota or their habitats.

TABLE 10.3-201 (SHEET 2 OF 2)
SUMMARY OF THE PRINCIPAL SHORT-TERM USES VERSUS THE LONG-TERM PRODUCTIVITY OF THE HUMAN ENVIRONMENT

	Short-Term Uses and Benefits	Relationship to Maintenance and Enhancement of Long-Term Environmental Productivity
Socioeconomic	Electrical power generation	The long-term benefits of electrical power generation include helping to meet growing industrial, commercial, and residential base load needs; the effects of which are expected to live beyond the life of the project. Additional long-term benefits include air pollution and emissions avoidance by not relying on natural gas and coal-fired electrical generation to meet energy demands.
	Increased tax revenues, plant expenditures, and employee spending in the community results in both short-term and long-term growth in the local economy.	Tax revenues, plant expenditures, and employee spending leads to long-term growth in the local economy, infrastructure, and services that may continue after the reactors are decommissioned.

10.4 BENEFIT-COST BALANCE

The information for this section is not provided in the ESP Application Part 3 – Environmental Report. The following new information is provided.

10.4.1 BENEFITS

The benefits associated with construction and operation of the proposed Unit 3 are described in this section and outlined in Table 10.4-201. The beneficial impacts of avoided air pollutants are summarized in Table 10.4-202. The principal benefits are summarized in Table 10.4-204.

10.4.1.1 Monetary Benefits

The following sections consider the monetary benefits of constructing and operating Unit 3.

10.4.1.1.1 Tax Payments

As stated in NUREG-1817, Subsection 4.5.3.2, the state of Mississippi and the counties surrounding Unit 3 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 at the rate of $2.50 per $1000 on the capital. The state also collects contractor's tax from contractors based on the total contract amount. The contractor tax is typically 3.5 percent, however for construction contracts on manufacturing facilities, the rate is 1.5 percent. If the construction cost is $4.5 billion (Subsection 10.4.2.1.1), the contractor's tax would amount to approximately $68 million.

NUREG-1817, Subsection 4.5.3.2, also states that Mississippi and Claiborne County would benefit from property taxes related to the incremental increase in value to the entire Grand Gulf site from the additional unit. Currently, Unit 1 is taxed under such a unique provision of Mississippi's tax law, it is anticipated that with the addition of a new unit, the Mississippi State Legislature will revisit this law in attempts to clarify the property tax treatment and the distribution of the revenue generated from a new nuclear unit.

Under current Mississippi tax law, nuclear generating plants in Mississippi pay taxes to the Mississippi State Tax Commission, based on the annually assessed value of the generating plant. Based upon this assessment, the generating plant is taxed 2 percent of its assessed value, or $20,000,000, whichever is greater. GGNS currently pays $20,000,000 annually to the Mississippi State Tax Commission. The Tax Commission then distributes this revenue in accordance with the tax law (Reference 201).

Assuming the property tax laws will not change, the Mississippi State Tax Commission finds the ownership of Unit 3 to be separate and apart from the ownership of Unit 1, and the owners would not be able to take advantage of economic incentives, the minimum tax liability for a new unit under the current tax structure would be $20,000,000.

In Mississippi, personal income is taxed at 3 percent for the first $5000; 4 percent for the next $5000; and income greater than $10,000 is taxed at a rate of 5 percent (Reference 202). According to the U.S. Department of Labor, construction workers in the region can be expected to earn $22.96 per hour or about $48,000 annually (Reference 203). During peak construction, 3150 workers will add about $7.5 million in taxes to the state's annual economy. Operational workers would contribute additional taxes to the state's annual economy. NUREG-1817, Table 2-13 lists 700 workers for Unit 1. However, due to the synergistic effects of co-locating two similar units on the same site, it is anticipated for Unit 3 that the approximate number of workers will be 400. The 2006 NEI study (Reference 204) lists an average permanent employee wage of about $69,000 per year. At this wage, 400 operations workers would contribute $1.32 million in annual personal income taxes.

The large tax revenues generated from construction and operation of Unit 3 would benefit the state and local government agencies because they would support the development of infrastructure and services that support the community, and promote further economic development.

10.4.1.1.2 Local and State Economy

The in-migration of construction workers is likely to create new indirect service jobs in the area. When applying a multiplier effect, each dollar spent on goods and services by a construction worker becomes income for the recipients, who save some but re-spend the remainder. The number of times the final increase in consumption exceeds the initial dollar spent is called the “multiplier.” During the period of peak construction, it is anticipated that the project will employ approximately 3150 construction workers. At an annual wage of $48,000 (Reference 203), these workers would be paid over $150 million, which will contribute to the regional economy. When the dollar multiplier is considered, this figure would be increased further. These 3150 direct construction jobs would result in a proportionate number of indirect jobs, which would also benefit the economy.

As noted earlier, the anticipated number of operational employees for Unit 3 is 400. At the average reported wage of about $69,000 for current Grand Gulf permanent employees (Reference 204), GGNS would pay another $27.6 million annually, which would contribute to the economy of the region. These direct operations jobs would also result in a proportionate number of indirect jobs in the region.

Unit 1 jobs pay as much as 50 percent more than the average salaries for Claiborne and Warren counties. The economic activity generated by Unit 1 creates another 150 jobs in the two counties. (Reference 204) The added value from Unit 3 should be similar to the value of Unit 1.

Economic benefits related to construction and operation of Unit 3 are addressed in Sections 4.4 and 5.8, respectively.

10.4.1.2 Non-Monetary Benefits

The following sections consider the non-monetary benefits of constructing and operating Unit 3.

10.4.1.2.1 Net Electrical Generating Benefits

As discussed in Section 8.4, there is a growing baseload deficit (between demand and supply) in the Entergy Electric System (EES). Unit 3 is expected to generate approximately 1520 megawatts electric (MWe) net (Section 1.1). Assuming an average capacity factor of 90 percent, the plant average annual electrical-energy generation is approximately 12,000,000 megawatt hours. This new unit would provide a benefit to the EES by helping to meet the growing industrial, commercial, and residential baseload needs (Section 8.4).

10.4.1.2.2 Fuel Diversity, Dampened Price Volatility, and Enhanced Reliability

Energy diversity is key to providing a reliable and affordable electrical power supply system. Achieving a balanced mix of electrical generation technologies lowers the risk of future price fluctuations and adverse consequences that can result from fossil fuel supply disruptions (Reference 205). History indicates that energy supply systems are more exposed to price fluctuations and potential fuel supply disruptions if there is an over-reliance on any single energy source. Overall, a balanced energy portfolio has been the key to providing the U.S. with a growing supply of affordable electricity for the past 30 years (Reference 206).

Implementing a fuel diversity strategy is primarily a matter of maintaining a balance of fuel mixes. In Entergy's Strategic Supply Resource Plan (Reference 207), it is reported that approximately 20 percent of electricity generated by Entergy subsidiaries in the region was a result of burning coal; 30 percent was generated by natural gas and oil; and 50 percent was generated by nuclear power. The high natural gas prices and the intense, recurring periods of price volatility experienced in recent years have been driven, at least in part, by demand for natural gas used in the electric generation sector. The large number of new gas-fired electric plants built in the U.S. during the last decade has bolstered electric sector demand for natural gas. Natural gas plants have accounted for more than 90 percent of all new electric generating capacity added over the past 5 years. Natural gas has many desirable characteristics and should be part of but not dominate the fuel mix, because “over-reliance on any one fuel source leaves consumers vulnerable to price spikes and supply disruptions.” (Reference 208)

Natural gas fired plants rely on a fuel whose price is subject to change almost on a daily basis. This change in fuel price is directly translated into variable costs for electricity produced. While the price of uranium also changes, nuclear power plants do not rely on replacing fuel on a daily basis. Nuclear fuel costs have many components including uranium mining and milling, conversion to UF6, enrichment services, fuel fabrication, spent fuel management, and disposition. Historically, all of these costs have added up to less than 10 percent of the total nuclear generation cost or approximately 25 percent of the production cost when one considers only fuel and O&M cost (Reference 209). This relatively low percentage of total costs attributed to fuel costs provides a price stability that is not available from generating plants fueled with natural gas. Although nuclear plants are capital-intensive to build, and this fact must be taken into account in cost-effective resource planning, the operating costs are relatively stable. (Reference 208)

Development of a new nuclear power plant at GGNS advances the Congressional goal of obtaining a diversified mix of electrical generating sources. GGNS also furthers the stated goal of creating new nuclear base load generating capacity.

10.4.1.2.3 Effects on Regional Productivity

The construction of the new facility requires about 3150 people, 1575 of which are expected to come from outside the local area (see Table 3.0-201 and Section 4.4 of the ESP ER). Temporary construction workers and their families increase rental and property demand, spending on goods and services, and sales taxes that benefit the local economy. The operation of the plant requires additional people, whose benefit to the region will extend through the life of the plant.

10.4.1.2.4 Air Pollution and Emissions Avoidance

Natural gas and coal-fired electrical generation plants produce air pollutant emissions (e.g., nitrogen oxides, sulfur dioxide, and carbon dioxide) or methyl mercury. With respect to all industrial sources, power plants account for the following emissions in the U.S.:

- Sulfur dioxide: 64 percent
- Nitrogen oxides: 26 percent
- Mercury: 13 percent
- Carbon dioxide: 36 percent

Coal-fired plants generate the majority of power plant emissions (Reference 210).

As presented in ESP ER 9.2 and in NUREG-1817, Section 8.2, modern nuclear reactors produce relatively small levels of pollutant air emissions when compared to the principal, viable energy alternatives, coal and natural gas. Nuclear power generation, therefore, leads to significant local and national air quality benefits, particularly with respect to greenhouse gases (carbon dioxide and other greenhouse gases are produced by generation of electricity from fossil fuels) that contribute to global warming (Reference 211). With respect to aesthetics, nuclear reactors have the benefit that they do not contribute to smog.

Section 9.2 of the ESP ER analyzes alternatives to the proposed action, such as coal- and natural gas-fired plants. The effects of avoided air pollutant emissions from building Unit 3 in lieu of equivalent fossil fuel plants may be seen in the hypothetical comparisons contained in Table 10.4-202.

10.4.1.2.5 Greenhouse Gases and Global Warming Advantages

Fossil fuel air emissions, particularly carbon dioxide, are widely believed by the scientific community to contribute to the greenhouse effect and, consequently, global climate change and global warming. According to one recent study, if environmental policies, agreements, or regulations greatly restrict carbon emissions in the future, the cost of building and operating fossil-fired plants is likely to increase in the future (Reference 212). Currently, nuclear power is the only available and proven technology that provides a viable alternative to fossil-fired plants for base load electrical generation without emitting large volumes of greenhouse gases.

10.4.1.3 Other Benefits

Section 10.3 describes the relationship between short-term uses and long-term productivity of the human environment. Additional benefits of deploying Unit 3 include an associated reduction in dependence on foreign energy sources and vulnerability to energy disruptions.

As the nation's import of liquefied natural gas increases, there is a related impact on the “energy security” of the country (Reference 212). With greater reliance and import of natural gas, there is a related economic impact on the nation's balance of trade. Energy generation from Unit 3 represents a potential for reducing the foreign trade deficit by way of reduced reliance on imported natural gas. Lastly, the deployment of Unit 3 has the effect of reducing the rate of depletion of the nation's finite fossil fuel supplies.

These benefits are described in Table 10.4-201 and summarized in Table 10.4-204.

10.4.2 COSTS

This section identifies both internal and external costs associated with the construction and operation of the proposed Unit 3. The term “internal” generally refers to the monetary costs associated with a project, while the term “external” refers to non-monetary environmental costs of constructing and operating a new plant. These costs are outlined in Table 10.4-203 and summarized in Table 10.4-204.

Cost data presented in this section are based on the referenced studies.

Many of the cost attributes described in this section are detailed in Section 10.1 (Unavoidable Adverse Environmental Impacts), Section 10.2 (Irreversible and Irretrievable Commitments of Resources), and Section 10.3 (Relationship Between Short-term Uses and Long-term Productivity of the Human Environment).

10.4.2.1 Internal Costs

This section describes the monetary costs of constructing and operating Unit 3. Internal costs include capital costs of the plant and transmission lines and operating costs (staffing, maintenance, and fuel) as well as decommissioning costs.

There are many cost studies in the available literature, with a wide range of cost estimates[1]. Due to the depth of their analyses and the fact that other studies tend to be based on them, the following four studies are among the most informative sources:

- Organization for Economic Co-operation and Development (OECD) Study (Reference 213)
- Massachusetts Institute of Technology (MIT) Study (Reference 211)
- University of Chicago (UC) Study (Reference 212)
- Energy Information Administration (EIA) Study (Reference 214)

1. It should be noted that until detailed design engineering is performed for the project, a precise cost estimate cannot be developed.

10.4.2.1.1 Construction

The projected internal monetary costs related to the construction of Unit 3 are provided in Section 3.1 of Part 1 (General and Administrative Information) of this COL Application.

10.4.2.1.2 Operation

Operational expenses will be incurred throughout the life of the plant and include costs for operation and maintenance, fuel, and decommissioning (Reference 211). Operational costs for power plants are frequently expressed as the levelized cost of electricity, which is the price at the busbar needed to cover operating costs and annualized capital costs. Overnight capital costs account for approximately one-third of the levelized cost, and interest costs on the overnight costs account for another 25 percent (Reference 212). Fuel costs, along with fixed and variable operation and maintenance (O&M) costs, account for the remainder.

Specifically regarding fuel costs, the University of Chicago study (Reference 212) provides reasonable estimates of this component of the overall levelized costs of electricity. This study lists fuel costs along with O&M costs under the assumption that no policies benefiting nuclear power are in effect. These costs are included in calculations of the levelized costs of electricity.

This study lists cost parameters for fuel and O&M costs as follows:

- Nuclear Fuel Cost – $4.35 per MWh
- Nuclear Fixed O&M Cost – $60 per installed kW capacity
- Nuclear Variable O&M Cost – $2.10 per MWh

The studies described above show a wide disparity in the range of operational cost estimates. The EIA study (Reference 214) shows the levelized costs of nuclear power exceed that for other fuels, but projects that nuclear operating costs will become competitive with coal and natural gas by the year 2030. The OECD study (Reference 213) lists a range of $21 to $50 per MWe hour (in 2005 dollars). The University of Chicago study (Reference 212) lists a range of $44 to $58 per MWe hour (in 2003 dollars). The MIT study (Reference 211) listed $67 per MWe hour (in 2002 dollars). Factors affecting this range include: choices for discount rate, construction duration, plant lifespan, capacity factor, cost of debt and equity, and the split between debt and equity financing, depreciation time, tax rates, and premium for uncertainty. These estimates also include decommissioning, but due to the effect of discounting a cost that occurs as much as 40 years into the future, decommissioning costs have relatively little effect on the levelized cost. Decommissioning costs are described in Section 5.9. The aforementioned studies suggest a range of $50 to $60 per MWe hour as a reasonable estimate of levelized costs.

The previously cited studies also provide coal- and natural gas-fired generation costs for comparison with nuclear generation costs. The OECD study (Reference 213) shows nuclear costs competitive with those of natural gas and coal. The other studies show nuclear costs exceeding cost estimates for natural gas and coal. Many of the studies in which nuclear cost is considered not to be competitive with other generation sources contain scenarios for which nuclear is shown to be not only competitive but the generation source of choice. The scenarios in these studies include those where natural gas prices exceed the $5 to $7 per million Btu price range, and the event where caps might be placed on the emission of greenhouse gases such as carbon dioxide that would materially affect the cost of operating a coal-fired plant.

The MIT study (Reference 211) indicated that new nuclear power is not economically competitive but suggested steps that the government could take to improve nuclear economic viability. Since the study was published, the government has undertaken these steps as follows:

- U. S. Department of Energy provided financial support for plants testing the U. S. Nuclear Regulatory Commission licensing processes for early site permits and combined operating licenses.

- The U. S. government endorsed nuclear energy as a viable carbon-free generation option.

- The Energy Policy Act of 2005 instituted a production tax credit for the first advanced reactors brought on-line in the U. S. Under Section 638 of this Act, the Secretary of Energy is allowed to enter into contracts for standby support for delays for up to a total of six reactors of no more than three different reactor designs. The Secretary of Energy would pay up to 100 percent of costs related to delays caused by the Nuclear Regulatory Commission for the first two reactors that have received a license and for which construction has begun. The next four reactors would receive up to 50 percent of costs related to such delays. Title XVII of the Act provides for loan guarantees for up to 80 percent of eligible project costs. Eligible projects include those that avoid, reduce, or sequester air pollutants. In addition, the Energy Policy Act of 2005 provides a 1.8 cents per kilowatt-hour production tax credit for qualifying new nuclear generating units. (Reference 216)

Consequently, the recent government steps and incentives have broadly altered the key assumptions in the MIT study. The conclusions of the MIT study do not account for the recent government incentives (Reference 211).

Measures to control adverse impacts related to operation are discussed in Section 5.10. There are monetary costs associated with the design and implementation of these measures which include such activities as training employees in environmental compliance and safety; treatment, storage, and disposal of any hazardous wastes generated; and acquisition and compliance with required operational permits and environmental requirements.

10.4.2.2 External Costs

This section describes the external (non-monetary) environmental and social costs of constructing and operating Unit 3. Impacts of construction and operation of the proposed project at GGNS are described in Sections 4.6 and 5.10. Section 10.1 also provides details regarding potential mitigation and the unavoidable adverse impacts after mitigation has been considered. Many mitigation measures would be built into the project design, such as scheduling to ensure that construction is completed in the shortest possible time; using construction best management practices to limit erosion, fugitive dust, runoff, spills and air emissions; and providing first-aid stations at the construction site.

10.4.2.2.1 Land Use

Unit 3 is designed to occupy 234 ac. of the 2100-ac. Grand Gulf site. About half of the land to be occupied by the new unit has been previously cleared during construction of Units 1 and 2. Most of the remaining land use is upland forest. Loss of this habitat is an external cost of the construction of Unit 3. A detailed description of the land use impacts is provided in Section 4.1 – Land Use Impacts. The cost in land use for a nuclear-powered generating plant is about the same as that for a natural gas-fired plant and less than that for a coal-fired plant of comparable size (ESP ER Table 9.2-1).

10.4.2.2.2 Hydrological and Water Use

Sections 4.2 and 5.2 address hydrologic alterations for construction and operation. As discussed in these sections, there are some costs associated with providing water for various needs during construction and operation. The majority of water used for Unit 3 operations would be surface water drawn from the Mississippi River. As resolved in NUREG-1817 Subsection 5.3.2, this water use represents only a small fraction of available water even at low flow conditions. There are also costs associated with groundwater consumption. The effects related to groundwater use were judged to be SMALL. (See Sections 4.2 and 5.2.) Use of groundwater by the site should not impact off-site users in terms of either water availability or water quality. (See Sections 4.2 and 5.2.)

Relatively small levels of non-radioactive and radioactive effluents are introduced into the Mississippi River (after treatment). Water quality effects of chemical effluents discharged to the Mississippi River during Unit 3 operations are discussed in Subsection 5.2.2 and are judged to be SMALL. NUREG-1817, Subsection 5.9.3.3 resolved that effects upon humans as a result of liquid radiological effluents released from Unit 3, would be SMALL. Cooling water blowdown that discharges to the Mississippi River results in a thermal plume. NUREG-1817, Subsection 5.3.3.1, resolved that effects of a thermal plume on the Mississippi River would be SMALL and localized.

10.4.2.2.3 Air Emissions

As indicated in Table 10.4-202, a new nuclear unit the size of Unit 3 provides a substantial reduction of emissions over natural gas- and coal-powered generation alternatives. Some of the benefits of reduced emissions related to use of nuclear power for electricity generation are offset by emissions related to the uranium fuel cycle (e.g. emissions from mining and processing the fuel). However, similar types of emissions are associated with mining and production of coal and, to some extent, drilling for natural gas.

Diesel generators, auxiliary boilers and equipment, and vehicles would produce air emissions that have a SMALL impact on workers and local residents (ESP ER Subsection 5.5.1.4). Cooling towers would produce drift that deposits some salt on the surrounding vicinity. However, the level is unlikely to result in any measurable impact on plants and vegetation. Cooling towers also produce steam plumes that may partially obstruct the viewscape. These impacts from cooling towers would be SMALL. (ESP ER Subsection 5.1.1)

10.4.2.2.4 Terrestrial and Aquatic Biology

Ecological effects related to plant construction and operation are discussed in Sections 4.3 and 5.3, respectively. Some cost due to mortality of wildlife during construction is anticipated. These losses should not be large enough to affect the long-term stability of wildlife populations. The cooling system, including the makeup water intake structure, is designed to reduce loss of aquatic biota as a result of impingement and entrainment to levels deemed acceptable by MDEQ and EPA. The construction of the new embayment and the intake structures and maintenance dredging of the embayment should result in only minor and temporary effects to aquatic biology. Impacts to terrestrial and aquatic species from nuclear-powered plants with closed-cycle cooling are smaller than impacts from comparably sized coal- or natural gas-fired plants (ESP ER Section 9.2 and Table 9.2-1). In Subsection 5.4.2.6 of NUREG-1817, the NRC determined that effects upon aquatic ecosystems as a result of operations of Unit 3 would be SMALL. NUREG-1817, Subsection 5.4.1.10, resolved that effects on terrestrial ecosystems would be SMALL.

10.4.2.2.5 Hazardous and Non-Radioactive Emissions, Effluents, and Wastes

Relatively small amounts of air emissions from diesel generators, auxiliary boilers and equipment, and vehicles are generated from nuclear power plant operation. Cooling tower drift deposits some salt on the surrounding vicinity, but the level is unlikely to result in any measurable impact on plants and vegetation (NUREG-1817, Subsection 5.4.1.1). Cooling towers also produce an atmospheric vapor plume.

Small amounts of hazardous effluents are components of the proposed plant discharges into the Mississippi River. Relatively small amounts of hazardous wastes would be generated that need to be managed and disposed of pursuant to the Resource Conservation and Recovery Act (RCRA). Section 3.6 and Subsection 2.3.3 discuss non-radioactive waste systems.

10.4.2.2.6 Hazardous and Radioactive Emissions, Effluents, and Wastes

Operation of the proposed plant would include minor radioactive air emissions to the atmosphere (Subsection 5.4.2.2). Relatively small levels of radioactive effluents would be generated and discharged into the Mississippi River after treatment (Subsection 5.4.2.1).

Low-Level radioactive wastes would be generated that need to be stored, treated, and disposed of in a licensed landfill. High-level radioactive spent fuel would be generated that needs to be isolated (or possibly reprocessed) in a geological repository for thousands or tens of thousands of years. Section 3.5 discusses the radioactive waste management system.

10.4.2.2.7 Materials, Energy, and Uranium

Construction of the nuclear unit results in an irreversible and irretrievable commitment of materials and energy (see Section 10.2). Operation of the reactors contributes to the depletion of uranium.

10.4.2.2.8 Postulated Accidents

The potential effects of various types of postulated accidents are discussed in NUREG-1817, Section 5.10. In NUREG-1817 Subsection 5.10.3, the NRC concluded that the potential environmental impacts from a postulated accident from the operation of one or more additional nuclear units at Grand Gulf Nuclear Station site would be SMALL.

10.4.2.2.9 Socioeconomic Costs

Sections 4.4 and 5.8 address socioeconomic costs related to construction and operation of a new unit at GGNS. As stated in NUREG-1817, Subsection 5.5.5, because of the site's industrial nature and its isolated location, impacts on aesthetics and recreation would be SMALL. Impacts on public services and infrastructure would also be SMALL throughout the region unless Claiborne County unexpectedly receives a substantial share of the in-migrating construction workers. Then, impacts on housing and education in Claiborne County could be MODERATE and adverse. However, these impacts likely would be more than offset by LARGE, beneficial tax receipts, primarily from GGNS property taxes (see NUREG-1817, Subsection 5.5.3.2 and Subsection 10.4.1.1.1).

10.4.2.3 Alternatives

10.4.2.3.1 Energy Alternatives

As discussed in Subsection 8.2.5 of NUREG-1817, available information was reviewed on the environmental impacts of power generation alternatives compared to the construction of up to two new nuclear units at the Grand Gulf ESP site. Based on that review, the NRC staff concluded that, from an environmental perspective, none of the viable energy alternatives are obviously superior to construction of a new base load nuclear power generation plant.

10.4.2.3.2 Design Alternatives

Alternatives to proposed system designs were evaluated in Section 8.3 of NUREG-1817. Based on NRC staff findings and the review of design alternatives, as supplemented by information provided in Section 9.4, no environmentally preferable design alternatives were identified.

Based on these conclusions, energy and design alternatives were not further evaluated regarding benefits and costs.

10.4.3 SUMMARY

As discussed in Section 8.4, there is a growing base load demand and growing base load supply shortfall for the region of interest. With the addition of Unit 3, GGNS can continue to meet electric power needs in the region. The large tax revenues generated from construction and operation of Unit 3 would benefit state and local governments by supporting development of infrastructure and services that promote further economic development. These tax benefits should more than offset socioeconomic costs associated with the influx of additional construction and operations workers for the new unit.

Unit 3 is designed to generate electricity that results in significant reduction in emissions with respect to comparably-sized coal- or natural gas-fired alternatives. These reductions outweigh emissions associated with fuel cycle emissions related to mining and processing nuclear fuel. As discussed in this section, Unit 3 also has important strategic implications in terms of lessening dependence of the U.S. on foreign energy supplies, and their potential interruption, as well as vulnerability to volatile price changes or changing political agendas.

On balance, the benefits of construction and operation of Unit 3 significantly outweigh the monetary, environmental, and social costs. Both the principal benefits and costs are summarized in Table 10.4-204.

10.4.4 REFERENCES

201 State of Mississippi, “Mississippi Code of 1972, As Amended,” Sec.27-35-309. Method for assessing said companies; taxation of nuclear generating plants generally; distribution of revenues, 1972, downloaded from http://www.mscode.com/free/statutes/27/035/0309.htm on June 20, 2007.

202 Mississippi Tax Commission, “Tax Rates,” downloaded from http://www.mstc.state.ms.us/taxareas/individ/whoshouldfile.htm, on September 5, 2007.

203 U.S. Department of Labor, Bureau of Labor Statistics, National Compensation Survey, internet-based wage calculator, <http://data.bls.gov/PDQ/servlet/NCSOutputServlet;jsessionid=f03099fe9b2a$3F$3FF$>, accessed September 18, 2007.

204 Nuclear Energy Institute (NEI), “Economic Benefits of Grand Gulf Nuclear Station,” 2006, downloaded from http://www.nei.org/documents/Economic_Benefits_Grand%20Gulf.pdf on June 20, 2007.

205 Edison Electric Institute (EEI), “Fuel Diversity,” 2006, available on EEI website at http://www.eei.org/industry_issues/energy_infrastructure/fuel_diversity/index.htm, accessed June 20, 2006.

206 Center for Energy and Economic Development (CEED, “Fuel Diversity,” 2006 available on CEED website at http://www.ceednet.org/ceed/index.cfm?cid=7500,7583, accessed June 20, 2006.

207 Plan Summary Document, Entergy Electric System Strategic Supply Resource Plan For the Planning Period 2007 – 2016, October 20, 2006

208 Nuclear Energy Institute (NEI), “Nuclear Energy's Role in Reducing Demand for Natural Gas Through Diversification of Energy Sources Used for Electricity Generation,” January 24, 2005, responding to questions posed by the Senate Energy and Natural Resource Committee for its Natural Gas Supply and Demand Conference, Quotation from Report of the President's National Energy Policy Development Group, May 2001, available on NEI website at HYPERLINK “http://www.nei.org/documents/White_Paper_Reducing_Demand_Natural_Gas_1-24-05.pdf” http://www.nei.org/

documents/White_Paper_Reducing_Demand_Natural_Gas_1-24-05.pdf, accessed June 5, 2007.

209 The Keystone Center, “Nuclear Power Joint Fact-Finding,” June 2007, downloaded from http://www.keystone.org/spp/documents/FinalReport_NJFF6_12_2007(1).pdf, September 18, 2007.

210 U.S. House of Representatives (USHR), “Securing America's Energy Future, Majority Staff Report to Committee on Government Reform and Subcommittee on Energy and Resources,” May 8, 2006, available on Committee website http://www.nei.org/documents/House_Energy_Report_5-8-06.pdf, accessed June 12, 2007.

211 Massachusetts Institute of Technology (MIT), “The Future of Nuclear Power, An Interdisciplinary MIT Study,” 2003, available on MIT website at http://web.mit.edu/nuclearpower/pdf/nuclearpower-full.pdf downloaded May 7, 2007.

212 The University of Chicago (UC), “The Economic Future of Nuclear Power,” 2004, available on the U.S. Department of Energy website at http://nuclear.energy.gov/np2010/reports/NuclIndustryStudy-Summary.pdf accessed May 3, 2007.

213 Nuclear Energy Agency, Organization for Economic Co-operation and Development (OECD), and International Energy Agency, “Projected Costs of Generating Electricity,” 2005 Update, read-only version downloaded from http://213.253.134.43/oecd/pdfs/browseit/6605011E.PDF, on September 7, 2007.

214 Energy Information Administration, “Annual Energy Outlook 2004,” 2004, DOE/EIA-0383(2004), January, available on EIA website at http://www.econstats.com/EIA/AEO2004.pdf, accessed June 12, 2007.

215 Deleted

216 U.S. Department of Energy, Nuclear Energy, Energy Policy Act of 2005 summary information, downloaded from http://www.ne.doe.gov/energyPolicyAct2005/neEPACT2a.html, on September 5, 2007.

TABLE 10.4-201 (SHEET 1 OF 2)
MONETARY AND NON-MONETARY BENEFITS OF UNIT 3

Benefit Category	Unit 3 Project as Proposed
State Tax Payments	$20,000,000 annually (Subsection 10.4.1.1.1).
Construction workers	An influx of 3150 workers (Subsection 10.4.1.1.2) creates an incremental increase in indirect jobs, permanent or temporary within the region.
Operational workers	An influx of 400 direct jobs (Subsection 10.4.1.1.2) will result in an incremental increase in indirect jobs in the region.
Net Generating Capacity	1520 MWe (Subsection 10.4.1.2.1).
Annual Electricity Generated (operating at 90% cap.)	~12,000,000 MWh (Subsection 10.4.1.2.1).
Fuel Diversity	Increases fuel mix diversity that reduces potential energy disruptions and other adverse consequences (Subsection 10.4.1.2.2).
Emissions Reduction	Avoidance of sulfur oxides, nitrogen oxides, carbon monoxide, and particulates associated with fossil fuel-powered generating plants (Subsection 10.4.1.2.4).
Electrical Reliability	Enhances electrical reliability (Subsection 10.4.1.2.2).
Price Volatility	Dampens potential for price volatility (Subsection 10.4.1.2.2).
Air Pollution	Significant beneficial impact in terms of avoidance of air emissions (Subsection 10.4.1.2.4).
Global Warming and Climate Change	Significant beneficial impact in terms of avoidance of greenhouse gases (Subsection 10.4.1.2.5).

TABLE 10.4-201 (SHEET 2 OF 2)
MONETARY AND NON-MONETARY BENEFITS OF UNIT 3

Benefit Category	Unit 3 Project as Proposed
Aesthetics	Nuclear plants do not produce smog that is associated with fossil-fueled plants (Subsection 10.4.1.2.4).
Socioeconomics	Increased tax revenue supports improvements to public infrastructure and social services. The increased revenue spurs future growth and development (Subsection 10.4.1.1.1).
Dependence on Foreign Energy	Reduces dependence on foreign energy and vulnerability to energy disruptions (Subsection 10.4.1.3).
Foreign Trade Deficit	Reduced Foreign Trade Deficit (Subsection 10.4.1.3).
Fossil Fuel Supplies	Offsets usage of finite fossil fuel supplies (Subsection 10.4.1.2.2).

TABLE 10.4-202
AVOIDED AIR POLLUTANT EMISSIONS[5]

	Emissions from Proposed Project Unit 3[1,3]	Emissions from a Natural Gas-Fired Plant(s)[1, 2]	Emissions Reduced by Selecting Proposed Project over Natural Gas-Fired Plant(s)	Emissions from a Coal-Fired Plant(s)[1, 2]	Emissions Reduced by Selecting Proposed Project over Coal-Fired Plant(s)
Pollutant					
SO_x	60	120	60	13,340	13,280
NO_x	50	460	410	12,800	12,750
CO	10	610	600	1650	1640
PM[(4)]	20	70[(4)]	50	390	370

Notes:

1. See ESP ER Table 9.2-1.
2. Computations for coal and natural gas-fired plants based on a generating capacity of 2032 MWe.
3. Computations for the proposed nuclear plant based on a generating capacity of 2000 MWe.
4. PM – particulate matter. As discussed in ESP ER Table 9.2-1 (Footnote 9), the value listed for natural gas emissions is given as PM_{10} (particulates of a size less than 10 micrometers).
5. Emissions measured in tons per year (Tpy).

TABLE 10.4-203 (SHEET 1 OF 2)
INTERNAL AND EXTERNAL COSTS OF UNIT 3

Cost Category	Cost
Internal Costs	
Overnight Capital Costs	An overnight capital cost of $3250 to $4000 per KWe selected as a reasonable estimate. (Subsection 10.4.2.1.1)
Construction Costs	$5.2 billion to $6.5 billion. (Subsection 10.4.2.1.1)
Levelized Cost of Operation	Literature range of $50 to $60 per MWe hour selected as a reasonable estimate. (Subsection 10.4.2.1.2)
External Costs	
Land and Land Use	Unit 3 would occupy approximately 234 ac. of the approximately 2100-ac. existing GGNS site. SMALL impact. (Subsection 10.4.2.2.1)
	Destruction of geological resources during uranium mining and fuel cycle. SMALL impact. (Subsection 10.4.2.2.7)
Hydrological and Water Use	There are some costs associated with providing water for various needs during construction and operation. Cooling water is taken from the Mississippi River after treatment. SMALL impact. (Subsection 10.4.2.2.2)
	Relatively small levels of hazardous and/or radioactive effluents introduced into the Mississippi River. SMALL impact. (Subsection 10.4.2.2.6)
	Thermal plume resulting from cooling water blowdown discharged to the Mississippi River. The effect of this thermal plume is SMALL and localized. (Subsection 10.4.2.2.2)
Terrestrial and Aquatic Species	Some cost to wildlife due to mortality during construction and operations is anticipated. However, these costs do not affect long term wildlife populations. Wildlife mortality, including aquatic biota, during operation is expected to be SMALL. (Subsection 10.4.2.2.4)
Radioactive Effluents and Emissions	Radioactive waste is generated. The plant produces radioactive air emissions. Relatively small levels of radioactive effluents are introduced into the Mississippi River after treatment. SMALL impact. (Subsection 10.4.2.2.6)

TABLE 10.4-203 (SHEET 2 OF 2)
INTERNAL AND EXTERNAL COSTS OF UNIT 3

Cost Category	Cost
External Costs (cont.)	
Hazardous and Radioactive Waste	Storage, treatment, and disposal of low-level radioactive spent nuclear fuel. SMALL impact. (Subsection 10.4.2.2.6) Commitment of geological resources for disposal of radioactive spent fuel. SMALL impact. (Subsection 10.4.2.2.6)
Air Emissions	Air emissions from diesel generators, auxiliary boilers and equipment, and vehicles that have a SMALL impact on workers and local residents. (Subsection 10.4.2.2.3) Cooling tower drift that deposits some salt on the surrounding vicinity, but the level is unlikely to result in any measurable impact on plants and vegetation. Cooling tower atmospheric plume discharge. SMALL impact. (Subsection 10.4.2.2.3)
Materials, Energy, and Uranium	Irreversible and irretrievable commitments of materials and energy, including depletion of uranium. SMALL impact. (Subsection 10.4.2.2.7)
Postulated Accident	The costs of postulated accidents would be large. However, the probability of such accidents is very small. Therefore, the overall probability-weighted costs of postulated accidents are SMALL. (Subsection 10.4.2.2.8)
Socioeconomic	Construction of Unit 3 may pose additional costs to public and social services in the area. However, these costs likely would be more than offset by increased tax revenues generated directly and indirectly by plant construction and operation. MODERATE adverse to LARGE beneficial impact. (Subsection 10.4.2.2.9)

**TABLE 10.4-204 (SHEET 1 OF 4)
SUMMARY OF PRINCIPAL BENEFITS AND COSTS FOR CONSTRUCTING AND OPERATING UNIT 3**

Attribute	Benefits
Net Electrical Generation	Obtain a relatively clean and abundant form of base load electricity that is relatively cost-competitive with fossil fuels. (Subsection 10.4.1.2.2) Electrical generation: ~12,000,000 MWh. (Subsection 10.4.1.2.1)
State Tax Payments	Construction contractor's taxes estimated at approximately $68 million. (Subsection 10.4.1.1.1) It is assumed that Unit 3 will pay $20,000,000 in taxes annually during operation. (Subsection 10.4.1.1.1)
Regional Productivity	An influx of 3150 construction workers will also create indirect jobs; permanent or temporary. (Subsection 10.4.1.1.2) An influx of 400 direct operational jobs also results in an increase in indirect jobs. (Subsection 10.4.1.1.2) Provides relatively clean, reliable, price competitive source of energy. Creates jobs and stimulates local economy. (Subsection 10.4.1)
Fuel Diversity	Increases fuel mix diversity that reduces potential energy disruptions and other adverse consequences. (Subsection 10.4.1.2.2)
Electrical Reliability	Enhances electrical reliability. (Subsection 10.4.1.2.2)
Price Volatility	Dampens potential for price volatility. (Subsection 10.4.1.2.2)

TABLE 10.4-204 (SHEET 2 OF 4)
SUMMARY OF PRINCIPAL BENEFITS AND COSTS FOR CONSTRUCTING AND OPERATING UNIT 3

Attribute	Benefits
Air Pollution	Major beneficial impact in terms of avoidance of power plant air emissions. (Subsection 10.4.1.2.4)
Aesthetics	As opposed to fossil-fueled plants, nuclear plants do not contribute to viewscape-obscuring smog. (Subsection 10.4.1.2.4)
Global Warming and Climate Change	Significant beneficial impact in terms of avoidance of greenhouse gases. (Subsection 10.4.1.2.5)
Dependence on Foreign Energy	Reduces dependence on foreign energy and vulnerability to energy disruptions. (Subsection 10.4.1.3)
Foreign Trade Deficit	Reduced foreign trade deficit. (Subsection 10.4.1.3)
Fossil Fuel Supplies	Offsets usage of finite fossil fuel supplies. (Subsection 10.4.1.3)
Land and Land Use	Consumes about the same amount of land as a comparable gas-fired plant and less land than a comparable sized coal-fired plant. (Subsection 10.4.2.2.1)
Hydrological and Water Use	Produces a cleaner form of energy (lower air emissions) than either coal- or gas-fired plants, benefiting water quality. (Subsection 10.4.1.2.4)
Terrestrial and Aquatic Species	Produces a relatively clean form of energy with smaller level of impacts on terrestrial and aquatic species as is expected from either a comparable coal- or gas-fired plant. (Subsection 10.4.2.2.4)
Materials, Energy and Uranium	Reduces the amount of finite fossil fuels used if a comparable coal- or gas-fired plant were built instead. (Subsection 10.4.1.3)

TABLE 10.4-204 (SHEET 3 OF 4)
SUMMARY OF PRINCIPAL BENEFITS AND COSTS FOR CONSTRUCTING AND OPERATING UNIT 3

Attribute	Benefits
Socioeconomic	Increased tax revenues generated directly and indirectly by plant construction and operation more than offset socioeconomic costs. Increased tax revenue supports improvements to public infrastructure and social services. Increased taxes and revenue spurs future growth and development. (Subsection 10.4.1.1.1)

Attribute	Costs
Capital and Operating Costs	Overnight Capital Costs are estimated at $3250 to $4000 per KWe as a reasonable estimate. Construction costs have been estimated at $5.2 billion to $6.5 billion. (Subsection 10.4.2.1.1) Levelized operational costs are estimated at $50 to $60 per MWh. (Subsection 10.4.2.1.2)
Aesthetics	Produces a relatively small vapor plume that can obscure the viewscape. (Subsection 10.4.2.2.3)
Fossil Fuel Supplies	Consumes finite supplies of uranium. (Subsection 10.4.2.2.7)
Land and Land use	Unit 3 would occupy approximately 234 acres of the approximately 2100-acre existing GGNS site. (Subsection 10.4.2.2.1)
Hydrological and Water Use	Consumes some water. Produces a thermal plume and small amounts of hazardous/ radioactive waste are discharged into the Mississippi River after treatment. (Subsection 10.4.2.2.2)
Terrestrial and Aquatic Species	Some cost to wildlife due to mortality as a result of construction and operation of the plant. (Subsection 10.4.2.2.4)

TABLE 10.4-204 (SHEET 4 OF 4)
SUMMARY OF PRINCIPAL BENEFITS AND COSTS FOR CONSTRUCTING AND OPERATING UNIT 3

Attribute	Benefits
Hazardous and Radioactive Waste	Relatively small quantities of hazardous and low-level and high-level radioactive waste are generated that require storage, treatment, and disposal. (Subsections 10.4.2.2.5 and 10.4.2.2.6)
	Storage, treatment, and disposal of high-level radioactive spent nuclear fuel. (Subsection 10.4.2.2.6)
	Commitment of underground geological resources for disposal of radioactive spent fuel. (Subsection 10.4.2.2.6)
Materials, Energy and Uranium	Irreversible and irretrievable commitments of materials and energy, including depletion of uranium. (Subsection 10.4.2.2.7)
Postulated Accident	The costs of postulated accidents would be large. However, the probability of such accidents is very small. Therefore, the overall probability-weighted costs of postulated accidents are SMALL. (Subsection 10.4.2.2.8)
Socioeconomic	Construction of Unit 3 places additional burdens on public infrastructure and social services. The growth and development changes the local character of surrounding community. (Subsection 10.4.2.2.9)