Attachment 4

GNRO -2010/00056

Extended Power Uprate Environmental Assessment

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ACRONYMS AND ABBREVIATIONS

AC	alternating current
ALARA	as low as reasonably achievable
AR	Arkansas
ºC	degrees Celsius
CFFF	Condensate Full Flow Filter
CFR	Code of Federal Regulations
cfs	cubic feet per second
CLTP	current licensed thermal power
COLA	combined license application
DDT	dichlorodiphenyltrichloroethane
EHV	extra high voltage
EMF	electromagnetic fields
EOI	Entergy Operations Inc.
EPA	Environmental Protection Agency
EPRI	Electric Power Research Institute
EPU	extended power uprate
ESC	Energy Services Center
ESP	Early Site Permit
ºF	degrees Fahrenheit
FES	Final Environmental Statement
FPCC	Fuel Pool Cooling and Cleanup
FR	Federal Register
ft	feet
ft^3	cubic feet
gal	gallons
GEIS	Generic Environmental Impact Statement
GGNS	Grand Gulf Nuclear Station
gpd	gallons per day
GPI	Groundwater Protection Initiative
gpm	gallons per minute
kgal/hr	thousand gallons per hour
km	kilometer

ACRONYMS AND ABBREVIATIONS (Continued)

kV	kilovolts
LA	Louisiana
lb	pounds
lb/hr	pound per hour
lb/kgal	pounds per thousand gallons
LMR	Lower Mississippi River
LNHP	Louisiana Natural Heritage Program
LRS	Liquid Radwaste System
m^3	cubic meter
mA	milliamperes
MDAH	Mississippi Department of Archives and History
MDEQ	Mississippi Department of Environmental Quality
mgd	million gallons per day
mg/l	milligrams per liter
ml	milliliter
MNHP	Mississippi Natural Heritage Program
mrad	millirad
mrem	millirem
MS	Mississippi
MSL	mean sea level
MWd/MTU	megawatt-days per metric tonne
MWe	megawatts, electric
MWt	megawatts, thermal
MW-yr	megawatt, year
NEPA	National Environmental Policy Act
NESC	National Electrical Safety Code
NPDES	National Polluant Discharge Elimination System
NRC	Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NUREG	U.S. Nuclear Regulatory Commission Document
%	percent
PM_{10}	particulates having diameter less than 10 microns

ACRONYMS AND ABBREVIATIONS (Continued)

ppm	parts per million
PT	point
rem	roentgen equivalent man
RM	river mile
ROW	right-of-way
RWCU	Reactor Water Cleanup
SERI	System Energy Resources, Inc.
SMEPA	South Mississippi Electric Power Association
TDS	total dissolved solids
TEDE	total effective dose equivalent
tpy	tons per year
UCA	upland complex alluvium
UCOA	upland complex, old alluvium
UFSAR	Updated Final Safety Analysis Report
U.S.	United States
USACE	United States Army Corps of Engineers
VOC	volatile organic compounds

EXECUTIVE SUMMARY

This document presents an evaluation of the environmental impacts of the proposed Grand Gulf Nuclear Station (GGNS) extended power uprate (EPU) from 3,898 MWt to 4,408 MWt. As a note, the 3,898 MWt includes a 1.7% increase over the original license thermal power of 3,833 MWt as a result of the Appendix K uprate that occurred in October 2002. The intent of this document is to provide sufficient information for the Nuclear Regulatory Commission (NRC) Staff to evaluate the environmental impacts of extended power uprate in accordance with the requirements of 10 CFR Part 51.

The environmental impacts of the proposed EPU are described and compared to those previously identified by the NRC in the 1981 *Final Environmental Statement for the Operation of the Grand Gulf Nuclear Station Units 1 and 2 (NUREG-0777)*, and in certain instances to the 2006 *Environmental Impact Statement for an Early Site Permit (ESP) at the Grand Gulf ESP Site* (NUREG-1817), and the 1996 *Generic Environmental Impact Statement (GEIS) for License Renewal of Nuclear Plants* (NUREG-1437). However, it should be noted that the evaluation of environmental impacts identified in the GGNS Final Environmental Statement (NUREG-0777) was based on two units (one of which has been cancelled) producing up to 3,833 MWt each for a total of 7,666 MWt. Therefore, any EPU comparisons to the GGNS Final Environmental Statement (NUREG-0777) would be well bounded and conservative.

As previously stated, the environmental impacts identified by the NRC Staff in the GGNS Final Environmental Statement (FES) are based on conservative assumptions for source terms and other environmental parameters since impacts were evaluated for two units. Since initial operation, a variety of systematic environmental improvements have been implemented at GGNS that have further increased the margin of conservatism associated with these assumptions. By adjusting actual plant operating parameters for EPU effects, it can be demonstrated that the previous assumptions and conclusions concerning the environmental impact of GGNS operation described in the GGNS FES continue to bound plant operation at EPU conditions.

In a few cases, where the GGNS FES and its associated documentation did not contain sufficient information necessary for a detailed comparison of the EPU environmental impacts with previously evaluated impacts, comparisons and conclusions were made using other appropriate environmental criteria established by the NRC. Where other environmental regulatory authorities govern GGNS operation such as in the matter of state water quality or air quality standards, comparisons and conclusions were made using the appropriate environmental permits and regulations.

The GGNS EPU is being implemented without making extensive changes to plant systems that directly or indirectly interface with the environment. All necessary modifications are in existing buildings at GGNS with the exception of the installation of a new radial well (Section 5.1.1. and Figure 5.3-1) and additional cells being added to the auxiliary cooling tower (Section 5.1.1). Land disturbance activities associated with the new radial well would be managed under a Section 404 Permit issued by the Army Corps of Engineers (Section 5.3.3), the Mississippi Department of Environmental Quality's (MDEQ) stormwater permitting program (Permit Number MSR15), and GGNS' existing Baseline Stormwater General National Pollutant Discharge Elimination System (NPDES) Permit MSR000883 and associated Stormwater Pollution Prevention Plan. Activities associated with the auxiliary cooling tower modifications do not involve land disturbance since an existing foundation already exists. No other construction outside of established facility areas is occurring.

There would be an increase in air emissions as discussed in Section 5.2.1 due to the lube oil tanks associated with the new radial well, and changes associated with the circulating water flow rate through the cooling towers. However, this emission increase is minimal and would be regulated in accordance with GGNS Air Permit 0420-00023.

As a result of the increase in heat load from EPU which also results in an increase in water loss through evaporation, blowdown and drift, additional cooling tower make-up water is projected to be needed (~3,200 gpm). Since the existing radial wells have degraded over time and thus cannot perform at their design capacity, a new radial well is being installed north of the existing wells on the east bank of the Mississippi River to ensure that plant availability is maintained during EPU conditions. However, there is no overall increase of groundwater consumption when comparing the estimated EPU cooling tower makeup flow value of 27,860 gpm (62 cfs) to the estimated 42,636 gpm (95 cfs) value identified in the GGNS FES [Reference 26, Section 3.3.1; Reference 69, Section 4.2.3]; therefore, groundwater consumption remains bounded by the GGNS FES.

There is also no increase in the amount of waste heat discharged to the Mississippi River since the auxiliary cooling tower modifications would continue to maintain the cooling water being supplied to the main condenser at either current operating temperatures or lower as discussed in Section 5.4.5. GGNS also evaluated the compliance requirements associated with implementing the proposed EPU and determined that compliance would be maintained in accordance with MDEQ regulatory requirements, permits, licenses, and other approvals currently held by the Station (Table 5.10-1).

There is no impact on the size of the regular workforce as discussed in Section 5.6. Workforce numbers for the EPU modifications would be somewhat larger than previous outages, but would be of short duration and of such a magnitude as to not adversely affect housing availability, transportation services, or public utilities such as public water supply systems in the plant vicinity.

Generation of low-level radioactive waste would not increase significantly over the current generation rate. In addition, the change in the volume of radioactive effluents (liquid and gaseous) released to the environment and radioactive content is proportional to the size of the power uprate, and are bounded by the GGNS FES analyses. Finally, all offsite radiation doses would continue to remain small and within applicable regulatory standards.

An update of the site information and its environmental interfaces has been completed and evaluated, with emphasis on changes resulting from the EPU. Based on this evaluation, GGNS concludes that the environmental impacts of operation at 4,408 MWt are either well bounded or encompassed by previously evaluated criteria established by the NRC Staff in the GGNS FES, or well bounded by other appropriate regulatory criteria. As a result, GGNS believes that impacts to human health or the environment from EPU would be SMALL.

1.0 INTRODUCTION

Entergy Operations, Inc. (EOI) is committed to operating GGNS in an environmentally sound manner. All plant activities, including design, construction, maintenance, and operation, are conducted in a manner that involves strict compliance with environmental regulations and deliberate consideration of environmental practices and consequences. Numerous controls have been implemented to prevent and reduce impacts to the environment, and extensive environmental monitoring programs have been instituted at GGNS. In keeping with this important obligation and in accordance with regulatory requirements, EOI has conducted a comprehensive environmental evaluation of the proposed GGNS extended power uprate from 3,898 MWt to 4,408 MWt. As previously stated, the 3,898 MWt includes a 1.7% increase over the original license thermal power of 3,833 MWt as a result of the Appendix K uprate that occurred in October 2002.

In September 1981, the NRC published the *Final Environmental Statement Related to the Operation of the Grand Gulf Nuclear Station Units 1 and 2* (NUREG-0777) [Reference 69]. The NRC concluded that the issuance of the operating license for GGNS, subject to certain conditions related to monitoring, was the appropriate course of action under National Environmental Policy Act (NEPA). This decision was based on the analysis presented in the GGNS FES and the weight of environmental, economic, and technical information reviewed by the Commission. It also took into consideration the environmental costs and economic benefits of operating GGNS. The NRC subsequently issued the operating license to GGNS that authorized operation up to the maximum power level of 3,833 MWt. As a note, after GGNS had received its commercial Operating License, EOI formally requested the NRC to revoke the Construction Permit and officially cancel the second unit at the Grand Gulf Nuclear Station. The Construction Permit for Grand Gulf Nuclear Station Unit 2 was formally revoked by the NRC in August 1991 [Reference 49, Section 1.1.1].

This environmental evaluation is provided pursuant to 10 CFR 51.41 and is intended to fully support the Commission in complying with the requirements of Section 102(2) of the NEPA, as amended, for the proposed change to the GGNS operating thermal power level. The scope of the evaluation is limited to that information necessary and sufficient to determine the environmental impact of those particular changes associated with the proposed extended power uprate at GGNS from 3,898 MWt to 4,408 MWt. This evaluation is not specifically intended to re-establish the current environmental licensing basis or to justify the environmental impacts of operating at the present thermal power level.

For this evaluation, Entergy identified the significance of EPU impacts associated with each issue as SMALL, MODERATE, or LARGE consistent with the criteria that NRC established in 10 CFR Part 51, Appendix B, Table B-1, Footnote 3 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 attributes of the resource.

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

This evaluation demonstrates that the environmental impacts of extended power uprate are either well bounded or encompassed by previously evaluated criteria established by the NRC Staff in the GGNS FES or well bounded by other appropriate regulatory criteria. Therefore, Entergy concluded that EPU impacts to the human health and environment would be SMALL.

2.0 PROPOSED ACTION AND NEED

The GGNS site, consisting of approximately 2,100 acres, is located in Claiborne County, Mississippi on the east bank of the Mississippi River at River Mile (RM) 406, approximately 25 miles south of Vicksburg, Mississippi and 37 miles north-northeast of Natchez, Mississippi. [Reference 73, Section 2.0] Public transportation routes are limited within the site vicinity. The major highway in the vicinity of the GGNS site is U.S. Highway 61, which passes by on the east-southeast. U.S. Highway 61 parallels the Mississippi River from New Orleans, Louisiana, to St. Louis, Missouri, and is approximately 4.5 miles from the GGNS site at the closest point. From Port Gibson, the highway goes north to Vicksburg, Mississippi, and south-southwest to Natchez, Mississippi. A section of the Natchez Trace Parkway passes approximately 6 miles southeast of the GGNS site running southwest toward Natchez and to the northeast to Jackson. State Highway 18 runs east from Port Gibson to Jackson. A number of county and rural roads are in the vicinity of the site. [Reference 73, Section 2.1]

The GGNS site consists primarily of woodlands and former farms as well as two lakes, Hamilton Lake and Gin Lake. These lakes were once in the channel of the Mississippi River and have an average depth of 8 to 10 feet. The land in the vicinity of the GGNS site is mostly rural. The western half of the site is the Mississippi Alluvium Valley, consisting of materials deposited by the Mississippi River and extending eastward from the river about 0.8 miles. The area is generally at elevations of 55 to 75 feet above mean sea level (MSL). The eastern half of the site is rough and irregular with steep slopes and deeply cut stream valleys and drainage courses. Ground elevations in the portion of the GGNS site range from 80 feet above MSL to more than 200 feet above MSL inland. Elevations of about 400 feet above MSL occur on the hilltops east and northeast of the site. Grade elevation for the existing GGNS facility structures is 132.5 feet above MSL. [Reference 73, Section 2.1]

Figures 2.0-1 and 2.0-2 show the location of the GGNS site. Figure 2.0-3 shows the GGNS property boundary and general features of the site.

2.1 Proposed Action

GGNS utilizes a boiling water reactor and a nuclear steam supply system designed by General Electric. EOI operates GGNS pursuant to NRC Operating License NPF-29, which expires November 1, 2024.

The proposed action is to increase the licensed core thermal level of the GGNS to 4,408 MWt, which represents an increase of approximately 13.1% above the current licensed thermal power of 3,898 MWt and approximately 15% above the original licensing thermal power of 3,833 MWt. The operational goal of the proposed EPU is a corresponding increase in net electrical output, of approximately 178 MWe. GGNS intends to implement the power uprate in the 2012 refueling outage. This change in core thermal level would require an amendment to the facility's operating license. This Supplemental Environmental Report evaluates environmental impacts associated with the total increase in thermal power to 4,408 MWt.

2.2 Need for Action

The proposed action provides GGNS with the flexibility to increase the potential electrical output of the Station and to supply low cost, reliable, and efficient electrical generation to the State of Mississippi and surrounding region. The additional 178 MWe would be enough to power approximately 140,000 homes and is in the best interest of ratepayers by lowering total forecasted revenue requirements, reducing exposure to future greenhouse gas mitigation requirements, and by maintaining fuel diversity. In addition, the proposed EPU at GGNS would contribute to meeting the goals and recommendations for maintaining necessary reserve margins while providing low cost, efficient, and reliable electrical generation.

2.3 Licensee and Ownership

System Energy Resources, Inc. (SERI), a subsidiary of Entergy Corporation, and South Mississippi Electric Power Association (SMEPA) are the owners of GGNS, located in Claiborne County, Mississippi. EOI, also a subsidiary of Entergy Corporation, is the licensed operator of GGNS. SERI and SMEPA are the holders of Facility Operating License NPF-29. However for purposes of this extended power uprate, EOI is the applicant.

Figure 2.0-1: Location of GGNS, 6-Mile Radius

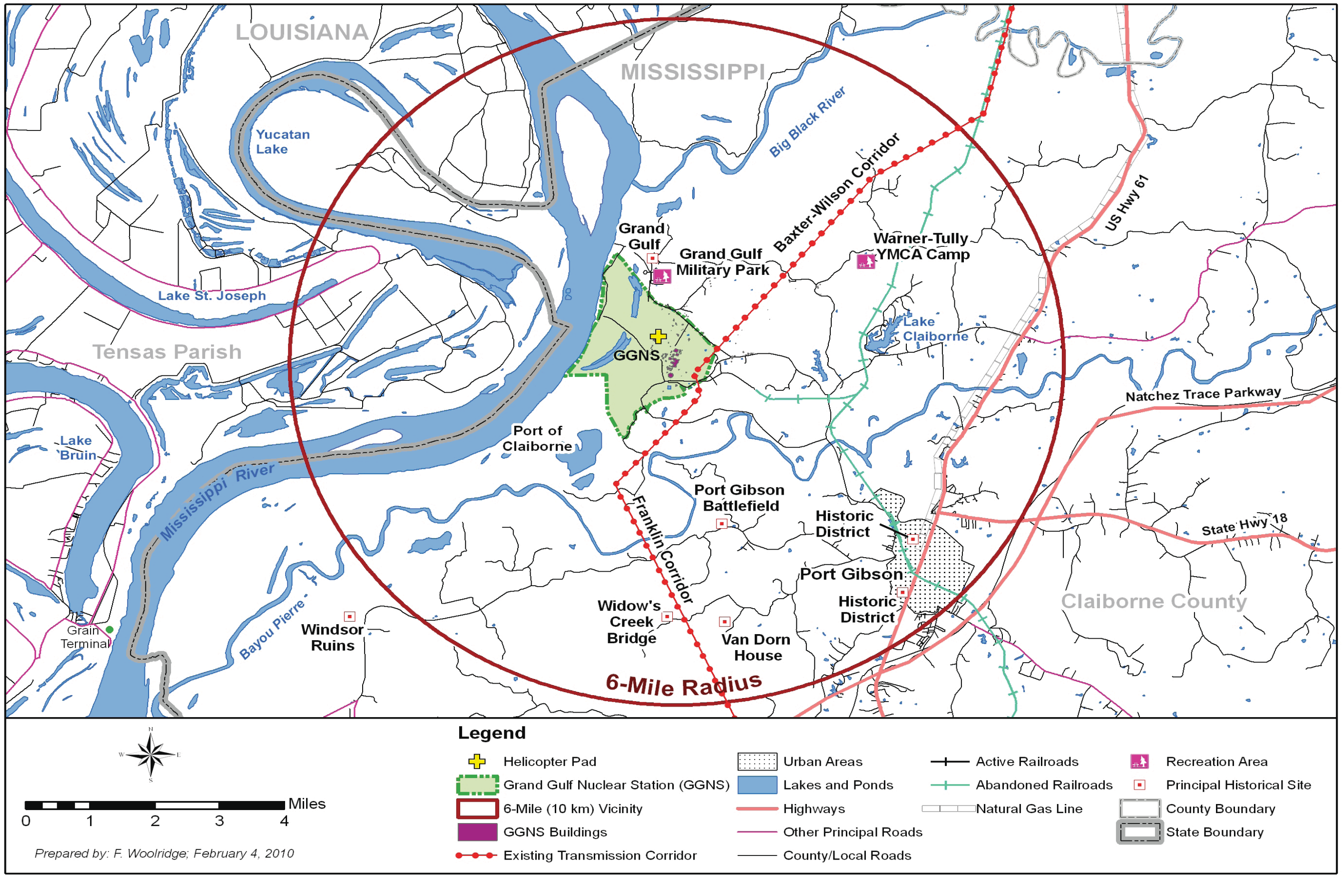


Figure 2.0-2: Location of GGNS, 50-Mile Radius

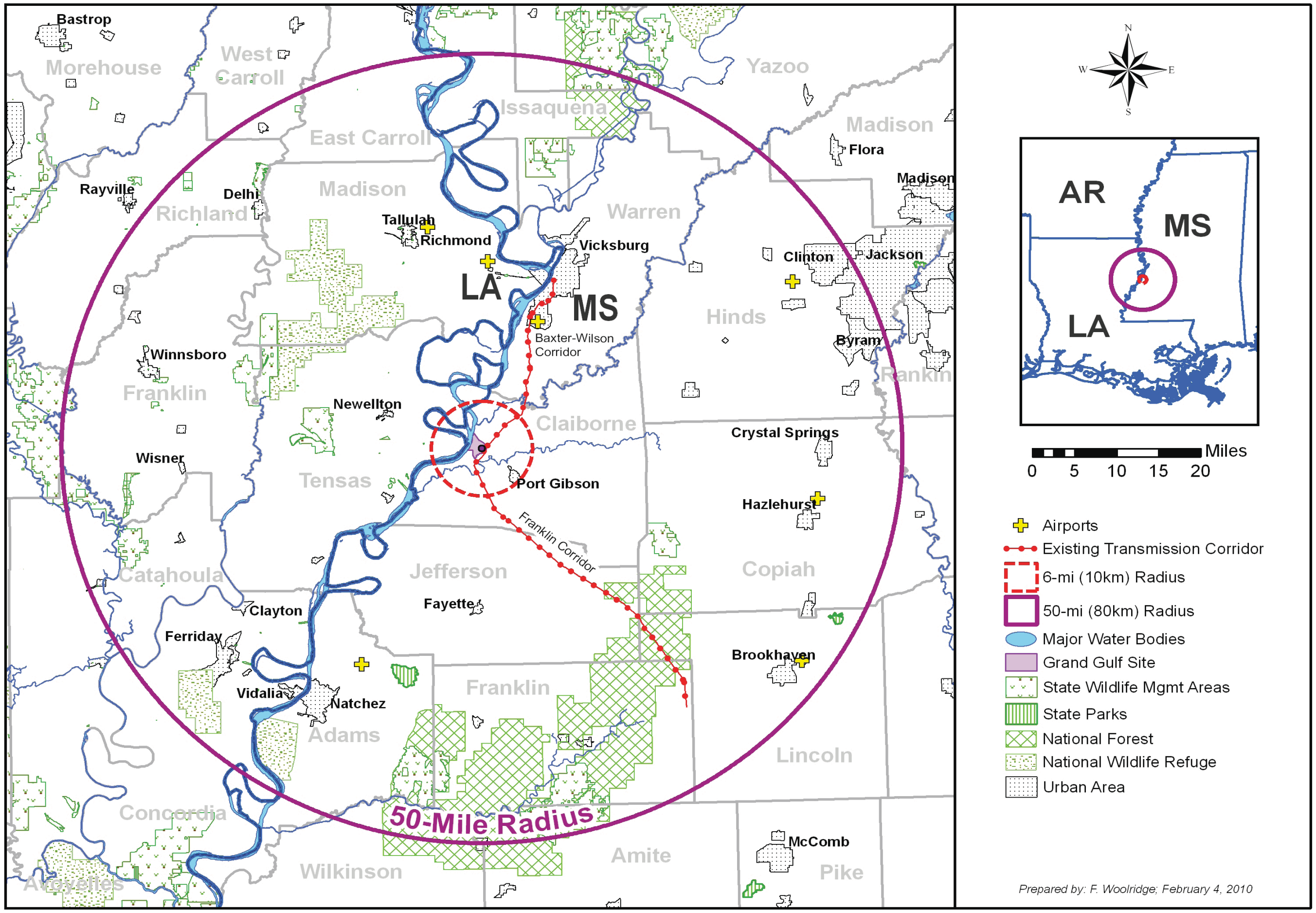
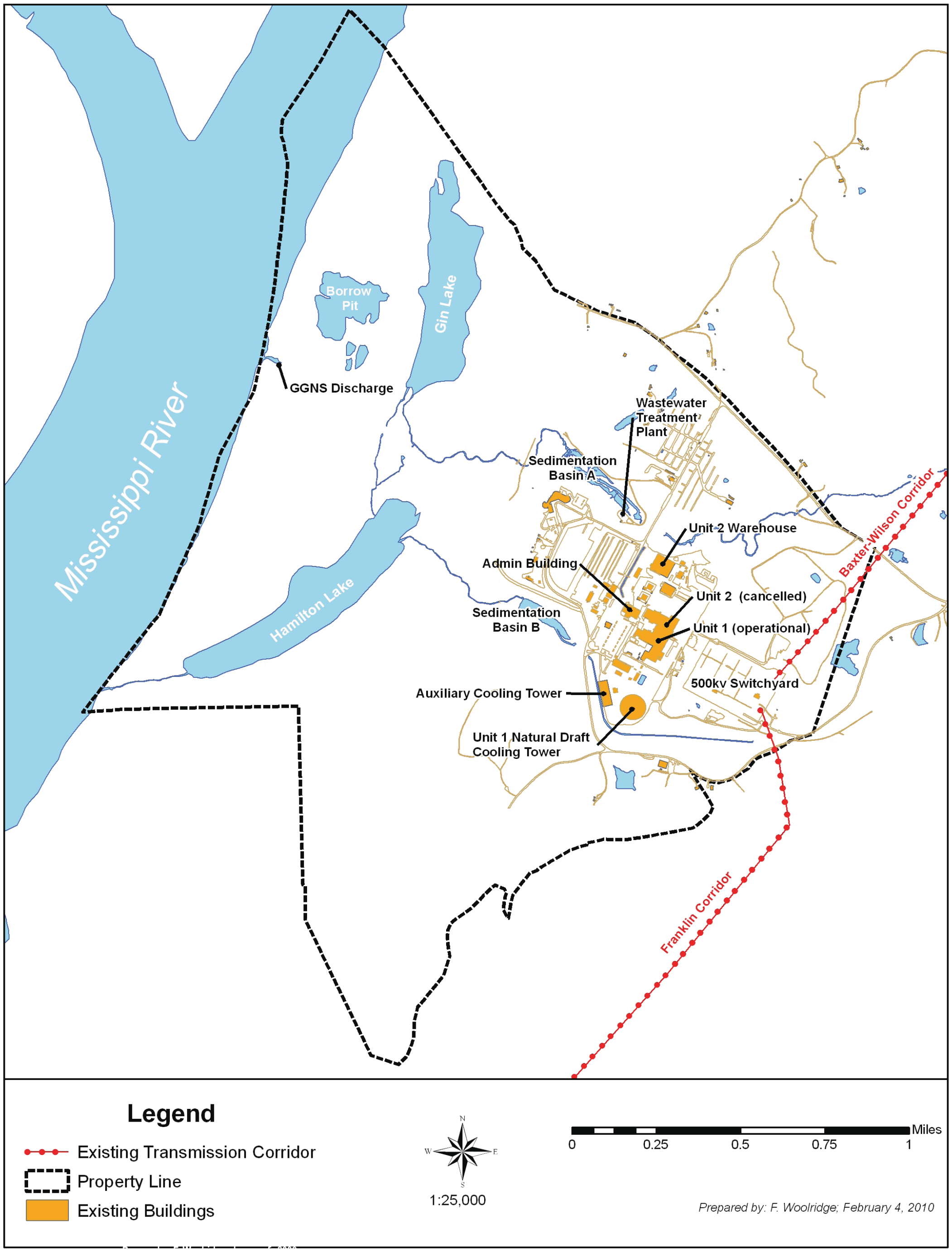


Figure 2.0-3: GGNS Site Boundary and Plant Features



3.0 OVERVIEW OF OPERATIONAL AND EQUIPMENT CHANGES

GGNS is a Boiling Water Reactor that operates in a direct thermodynamic cycle between the reactor and the turbine. At EPU conditions, thermodynamic processes are changed to extract additional work from the turbine. Simply put, EPU involves an increase in the heat output of the reactor to support increased turbine inlet steam flow requirements and an increase in the heat dissipated by the condenser to support increased turbine exhaust steam flow requirements. In order to support an EPU to 4,408 MWt, the reactor core operating range is expanded by increasing reactor power within existing rod and core flow control lines. No changes in operating pressure are necessary to support the EPU, and increases in steam flow would not result in an increase in the heat rejected to the Mississippi River since the auxiliary cooling tower modifications would continue to maintain the cooling water being supplied to the main condenser at either current operating temperatures or lower as discussed in Section 5.4.5. The environmental impacts of these operational changes are discussed herein.

Several plant modifications are required to support operation at the EPU power level. Attachment 8 to this license amendment request contains a listing and brief description of the planned modifications. In summary, modifications are required to some systems to generate and/or accommodate the increased feedwater and steam flow rates to achieve EPU power levels. These modifications are scheduled to occur during the 2012 refueling outage to support the EPU project schedule.

There are other modifications planned for installation in the 2010 outage. However, these other modifications also address life cycle management improvements and prepare the plant for the EPU modifications to be made in the subsequent 2012 outage.

4.0 COST BENEFIT ANALYSIS

The largest direct benefit resulting from the proposed EPU to GGNS' current capacity is the additional supply of more than 178 megawatts of reliable electrical power for residential and commercial customers. A national comparison of power-producing alternatives indicates that nuclear power generation production costs are approximately 68% of coal-fired power, and 11% of oil-fired power, and 23% of natural gas-fired power production [Reference 67]. Power production costs represent a combination of fuel, operations, and maintenance costs.

The GGNS EPU project maintains Entergy's fuel diversity goals and provides a natural hedge against fuel cost volatility in the coal, oil, and natural gas markets. Natural gas-fired plants rely on a fuel whose price is subject to change almost on a daily basis. Oil-fired generation is more expensive than either nuclear or coal-fired generation options. In addition, future increases in oil prices are expected to make oil-fired generation increasingly more expensive than coal-fired generation. 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.

The GGNS site has already been evaluated for additional new nuclear electric power generation by the NRC. The NRC granted an ESP for the GGNS site in 2006. The cost benefit of new generation versus several alternatives was evaluated during the course of the ESP review. New nuclear generation at GGNS was compared to various alternatives including, but not limited to, alternatives not requiring new generation, coal, oil, natural gas, renewable alternatives, and combinations of these. The NRC reviewed the available information on the environmental impacts of power generation alternatives compared to the construction of new nuclear units at the Grand Gulf ESP site. Based on this review, the NRC 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. [Reference 73, Section 8.2] EPU generation benefits would accrue without environmental impacts to transmission systems, significant land disturbance compared to new power generation alternatives, or most of the other potential environmental impacts related to new power generation alternatives that are discussed in Table 8-3 of NUREG-1817.

A significant environmental impact avoided by implementing an EPU at GGNS versus other options for additional capacity is that air emissions are decidedly lower in comparison to the alternatives. Unlike fossil fuel plants, an EPU would not result in significant sources of sulfur oxide, nitrogen oxide, carbon monoxide, particulate matter, carbon dioxide, or other atmospheric pollutants during normal operations; therefore, not contributing to the production of greenhouse gases or acid rain.

The radiological effects of the uranium fuel cycle are described in 10 CFR 51.51 and 51.52 and are classified as SMALL. The tables in 10 CFR 51.52 bound that associated with the GGNS EPU. While the proposed action would produce additional spent nuclear fuel, the additional amount would represent an approximate 18% increase in the number of spent fuel assemblies generated based on a 24-month refueling cycle (see Section 7.2) and would be accommodated by GGNS' current spent fuel storage strategy.

In summary, it is reasonable to conclude the proposed GGNS EPU would provide an economic advantage over other generation alternatives and is in the best interest of ratepayers by lowering total forecasted revenue requirements, reducing exposure to future greenhouse gas mitigation requirements, and by maintaining fuel diversity. The proposed EPU involves a cost-effective utilization of an existing asset, with relatively minor environmental impact, making it the preferred means of securing additional generating capacity.

5.0 NONRADIOLOGICAL ENVIRONMENTAL IMPACTS

5.1 Land Use and Visual Resources

5.1.1 Land Use

Types of land cover on the GGNS property are identified in Table 5.1-1. Any land disturbance activities, including those associated with EPU, are reviewed in accordance with Entergy procedures to ensure that necessary environmental protection measures are implemented during the project [References 13 and 14]. These measures would include provisions to protect such things as threatened and endangered species, cultural resources, wetland areas, water quality, etc.

Since additional cooling tower make-up water is projected to be needed (~3,200 gpm) due to the increase in heat load generated as a result of EPU, which also results in an increase in water loss through evaporation, blowdown and drift, a new radial well is being installed (Figure 5.3-1) to ensure that plant availability is maintained during EPU conditions, since GGNS' existing radial wells have degraded over time and thus cannot perform at their design capacity. Activities to support the well construction include clearing and grubbing of trees, construction of a working pad using engineered fill, and excavation of trenches for supply piping to the plant service water header, discharge piping into the river, and electrical equipment feeders. The proposed working pad is designed to contain all the equipment needed for construction of the well, and to provide an area for material laydown and parking. Activities conducted in wetland areas would be managed under a Section 404 issued by the United States Army Corps of Engineers (USACE) as discussed in Section 5.3.3. The remaining non-wetland areas would be managed under MDEQ's stormwater permitting program (Permit Number MSR15) and associated best management practices.

Improvements are also being made to the Heavy Haul Road to support activities associated with the installation of the new radial well, and potential delivery of heavy equipment in the event that the barge slip is utilized for this activity as discussed below. These improvements consist of refurbishing the existing road and road base in low areas or areas that have become washed out. Proposed refurbishment method in areas where some base exists is to fill in with stone and compact to a firm, level surface. In washed out areas, geofabric would be installed and covered with a stone mix and compacted to a firm, level surface. These activities would occur within the boundary of the original road with appropriate best management practices employed in accordance with GGNS' existing Baseline Stormwater General NPDES Permit MSR000883 and associated Stormwater Pollution Prevention Plan to control silt and erosion.

In the event that the Port of Claiborne is determined to be infeasible from a technical and economical standpoint for delivery of transformers and other heavy equipment associated with EPU, GGNS may conduct dredging activities in the existing barge slip area to accommodate delivery of such equipment. Activities associated with the barge slip occur in an area that would be managed under a Section 404 Permit issued by the USACE as discussed in Section 5.3.3.

The additional cooling cells being added to the auxiliary cooling tower are being installed on an existing foundation. There are no other EPU activities that would modify land use at the site since there are no plans to construct any new facilities or disturb the land around existing facilities, including buildings, parking facilities, laydown areas, onsite transmission and distribution equipment, or in-scope power line right-of-ways. In addition, the EPU would not significantly affect the storage of materials, including chemicals, fuels, and other materials stored aboveground or underground at the site. In the event that chemicals or fuels are temporarily staged in certain areas as a result of EPU activities, these materials would be subject to best management practices specified in the GGNS' Spill Prevention, Control and Countermeasures and Stormwater Pollution Prevention Plans.

In conclusion, the draft Revision 1 to NUREG-1437 concluded that impacts of continued operations and refurbishment on onsite land use are expected to be small at all nuclear plants since changes in onsite land use would be a small fraction of any nuclear power plant site and would involve only land that is controlled by the licensee [Reference 74, Section S.5]. Since the amount of area to be disturbed is only a small fraction of the GGNS site, and adequate controls are in place to manage the activities, it is concluded that impacts to land use as a result of EPU are SMALL.

Table 5.1-1

GGNS Property Land Use/Land Cover

Description	**Percentage**
Open Water	10.22
Developed, Open Space	4.44
Developed, Low Intensity	0.22
Developed, Medium Intensity	0.05
Barren Land (Rock/Sand/Clay)	4.57
Deciduous Forest	17.87
Evergreen Forest	0.86
Mixed Forest	6.06
Shrub/Scrub	10.93
Grassland/Herbaceous	1.53
Pasture/Hay	0.04
Cultivated Crops	3.30
Woody Wetlands	39.31
Emergent Herbaceous Wetlands	0.60
TOTAL	**100**
SOURCE: Reference 66	

5.1.2 Visual Resources

The NRC has reviewed and evaluated visual resource impacts of plant operations and refurbishment for all existing plants as described in NUREG-1437. Based on Table 9.1 of NUREG-1437, the NRC concluded that no significant aesthetic impacts are expected as a result of plant refurbishment activities, plant operations, or in-scope transmission lines associated with the plants [Reference 71]. The NRC also determined in NUREG-1817 that aesthetic impacts from an additional unit at the GGNS site would be minimal [Reference 73, Section 5.5.1.4]. Furthermore, the 1981 GGNS FES (NUREG-0777) determined that the socioeconomic impacts (which includes aesthetics) associated with two units would be minimal [Reference 69, Section 5.8]. Since there are no plans to modify the existing in-scope transmission lines and the aesthetic impacts from the new radial well on the banks of the Mississippi River and the addition of cooling cells to the existing auxiliary cooling tower are considered minor, EPU activities are well bounded by the conclusions determined in NUREG-1437, NUREG-1817 and NUREG-0777. Therefore, visual resources impacts would be SMALL.

5.2 Air Quality and Noise

5.2.1 Air Quality

The GGNS site is in Claiborne County, Mississippi, which is on the western edge of the Mobile, Alabama-Pensacola, Florida-Panama City, Florida-Southern Mississippi Interstate air quality control region. The area across the Mississippi River from the site is in the Monroe, Louisiana-El Dorado, Arkansas Interstate air quality control region. None of the counties in these air quality control regions have been designated as in nonattainment of the National Ambient Air Quality Standards [References 1 and 2]. There are no mandatory Class 1 Federal Areas where visibility is an important value within 100 miles of the GGNS site. [Reference 73, Section 2.3.2] The State of Mississippi is both in attainment with national primary and secondary air quality standards for all criteria air pollutants. The nearest non-attainment area to GGNS is Baton Rouge, Louisiana, approximately 115 miles south of Port Gibson. Baton Rouge is in non-attainment for the 8-hour ozone criteria [Reference 23].

GGNS is currently classified as a synthetic minor source of air emissions by the MDEQ with nonradioactive air emission effluents resulting primarily from testing of emergency generators and fire water pump diesel engines, and operation of the cooling towers. In order to be protective of Mississippi's ambient air quality standards to ensure that impacts are maintained at minimal levels, the MDEQ governs the discharge of regulated pollutants by limiting operational run times and sulfur limits in accordance with GGNS Air Permit 0420-00023.

During implementation of the EPU at the GGNS site, some minor and short duration air quality impacts may occur, with emissions from the vehicles of workers being the main sources of these air quality impacts. However since GGNS is not located near or in a non-attainment or maintenance area, and since the majority of the EPU activities would be performed inside existing buildings and would not cause additional atmospheric emissions, there would be no significant impact on air quality during and following implementation of the proposed EPU.

GGNS also evaluated the potential for an increase in particulate emissions that could occur as a result of the modification to the auxiliary cooling tower. Although the additional cooling cells by themselves would not affect particulate emissions, two factors that could affect emissions are related to changes in the circulating water flow rate or cycles of concentration (resulting in a higher TDS value). Based on GGNS' review, cycles of concentration (typically between 3 – 4) are not changing; therefore, the TDS factor utilized in calculating particulate emissions remains unchanged. However, it was determined that the circulating water flow rate through the natural draft and auxiliary cooling towers was increasing as a result of a modification to the two (2) circulating water pumps, involving changing the pump impellers, that is scheduled to occur during the 2012 refueling outage. As a result, the circulating water flow rate is increasing from 580,000 gpm to approximately 631,000 gpm; therefore, particulate emissions would increase accordingly.

Current permitted particulate emissions from Emission Point 008 (Natural Draft Cooling Tower and Auxiliary Cooling Tower) were based on a worst case total emission estimate of 48.66517 tons/year [Reference 30, Attachment IV]. As shown in Table 5.2-1, worst case total emission estimate based on the increase in circulating water flow rate is 52.94356 tons/year, which is approximately an 8.1% increase above current permitted emissions. Facility-wide particulate emissions would increase to 72.87492 tons/year which is a 5.9% increase above the current permitted emissions of 68.59653 tons/year. There also will be two 60-gallon lube oil tanks associated with the new radial well pumps that will result in some minor emissions (0.26 pounds/year) of volatile organic compounds (VOC). However, since overall site particulate and VOC emissions would remain below 100 tons/year, GGNS would continue to maintain its' synthetic minor source classification. GGNS plans to submit a modification to GGNS Air Permit 0420-00023 to the MDEQ prior to these activities occurring to reflect the increase in particulate emissions for Emission Point 008 (Natural Draft Cooling Tower and Auxiliary Cooling Tower), and the VOC emissions associated with the two (2) 60-gallon radial well pump lube oil tanks.

Since the emissions associated with the cooling towers and the two lube oil tanks are not significant and would be managed in accordance with GGNS Air Permit 0420-00023, and other air quality impacts would be minor and of short duration, it is concluded that air quality impacts associated with EPU would be SMALL.

Table 5.2-1

Cooling Tower Particulate Emissions [1]

Emission Point	Recirc Rate (kgal/hr) [2]	Total Drift Factor (lb/kgal) [3]	Total Drift (lb/hr)	TDS (ppm)	PM_{10} Emissions	
					(lb/hr)	(tpy)
AA-008 (Natural Draft Cooling Tower)	18,930	0.073	1,381.9	1,350	1.86557	8.171197
AA-008 (Auxiliary Cooling Tower)	18,930	0.4	7,572	1,350	10.222	44.77236
				Worse Case Total Emissions Estimate	**12.08777**	**52.94356**

(1) **The worse case total emissions were calculated for 50% flow (18,930 kgal/hr) to the Auxiliary Cooling Tower and to the Natural Draft Cooling Tower. As a note, 18,930 kgal/hr converts to 315,500 gpm.**

(2) **To convert kgal/hr to gpm: kgal/hr × 1,000 ÷ 60 min/hr.**

(3) **Total drift factor for the Natural Draft Cooling Tower is based on EPA's AP-42 factor (Table 13.4-1) whereas total drift factor for Auxiliary Cooling Tower is based on the derivation of manufacturer's drift factor (see below).**

Manufacturer's Drift Rate: 0.0005%

Total Drift Factor for AA-008 (Auxiliary Cooling Tower) $= 0.005\% \times 8.338 \frac{lb}{gal} \times 1000 \frac{gals}{1\ kgals} \times \frac{1}{100\%}$

$= 0.4169$ **lb/kgal (rounded to 0.4 lb/kgal)**

5.2.2 Noise

EPU would not result in any significant changes to the character, sources, or energy of noise generated at GGNS. The new equipment necessary to implement EPU would be primarily installed within existing plant buildings which would not affect ambient noise levels. The effect of the additional cells to the auxiliary cooling tower operation on ambient noise levels is not anticipated to be significant, and no other noise-generating equipment would be installed outside the plant.

The NRC has reviewed and evaluated noise impacts of plant operations for all existing plants and concluded in NUREG-1437 that noise has not been found to be a problem at operating plants [Reference 71, Table 9.1]. The NRC also concluded in NUREG-1817 that noise impacts associated with an additional nuclear unit at GGNS would be minor [Reference 73, Section 5.8.2]. Furthermore, the 1981 GGNS FES (NUREG-0777) determined that noise impacts associated with two units would be small [Reference 69, Table 6.1]. Since the 1981 GGNS FES (NUREG-0777) is based on two units and NUREG-1437 and NUREG-1817 determined that impacts would be small, noise impacts from EPU conditions are well bounded; therefore GGNS concluded that noise impacts would be SMALL.

5.3 Hydrology

5.3.1 Groundwater

There are sixteen (16) groundwater wells currently permitted for withdrawal purposes at the GGNS site as shown in Table 5.3-1 and Figure 5.3-1. As indicated in the table, there has been no need for plant dewatering activities over previous years; therefore, there has been no need to operate the eight (8) dewatering wells. The North and South Drinking Water Wells and the North Construction Well are used for domestic water, once-through cooling for plant air conditioners, and for regenerating the water softeners at the Energy Services Center.

There are currently four (4) radial wells which supply water to the Plant Service Water System. Since additional cooling tower make-up water is projected to be needed (~3,200 gpm) due to the increase in heat load generated as a result of EPU, which would also result in an increase in water loss through evaporation, blowdown and drift, a new radial well is being installed to ensure that plant availability is maintained during EPU conditions since GGNS' existing radial wells have degraded over time and thus cannot perform at their design capacity. Radial Well 6 is scheduled to be completed and operational in March 2012. Although water being utilized for cooling tower make-up is projected to increase, there is no overall increase of groundwater consumption when comparing the estimated EPU cooling tower makeup flow value of 27,860 gpm (62 cfs) to the estimated 42,636 gpm (95 cfs) value identified in the GGNS FES [Reference 26, Section 3.3.1; Reference 69, Section 4.2.3]; therefore, groundwater consumption remains bounded by the GGNS FES.

Table 5.3-1

GGNS Groundwater Well Withdrawals [1]

Permit No.	Description	Well Depth (ft)	Rated (gpm)	Total Gallons (2005) [2]	Total Gallons (2008) [3]	Total Gallons (2009) [4]
MS-GW-02970	Radial Well 3	123	10,000	2.68 E9	3.25248 E9	3.26099 E9
MS-GW-00371	Radial Well 5	128	10,000	3.76 E9	3.45403 E9	4.16753 E9
MS-GW-02971	Radial Well 1	122	10,000	1.36 E8	2.32550 E9	1.54579 E9
MS-GW-02969	Radial Well 4	125	10,000	4.29 E9	1.84822 E9	4.09741 E9
MS-GW-16714	Radial Well 6 [5]	**155**	**10,000**	**NA**	**NA**	**NA**
			Annual Average GPM	**20,674**	**20,701**	**24,870**
MS-GW-02967	North Construction Well	154.8	400	7.44 E4	4.62 E4	5.45 E4
MS-GW-14989	North Drinking Water Well	162	500	1.92 E7	1.76 E7	1.64 E7
MS-GW-15026	South Drinking Water Well	163	500	1.95 E7	1.77 E7	1.67 E7
			Annual Average GPM	**74**	**67**	**63**
MS-GW-02977	Dewatering Well 3	48.4	200	0	0	0
MS-GW-02979	Dewatering Well 1	55.2	200	0	0	0
MS-GW-02978	Dewatering Well 2	48.3	200	0	0	0
MS-GW-02976	Dewatering Well 4	42.8	200	0	0	0
MS-GW-02975	Dewatering Well 5	55.4	200	0	0	0
MS-GW-02973	Dewatering Well 7	42.5	200	0	0	0
MS-GW-02972	Dewatering Well 8	31.3	200	0	0	0
MS-GW-02974	Dewatering Well 6	59.7	200	0	0	0

(1) No water use reporting was required by MDEQ in 2006 and 2007. Data for 2008 and 2009 to be submitted in 2009 annual report.
(2) **SOURCE:** Reference 37
(3) **SOURCES:** References 50 and 52
(4) **SOURCE:** References 51 and 53
(5) Radial Well 6 scheduled to be completed and operational in March 2012.

The following provides a description of the geology of the site (Section 5.3.1.1) and local aquifers (Section 5.3.1.2), groundwater quality at the site (Section 5.3.1.3), regional groundwater usage (Section 5.3.1.4), vicinity groundwater usage (Section 5.3.1.5), and EPU impacts associated with the radial and potable water wells (Sections 5.3.1.6 and 5.3.1.7).

5.3.1.1 Geology

The important groundwater stratigraphic units encountered at the site are the Mississippi River Alluvium, Loess, Upland Complex (terrace deposits), and the Catahoula Formation. The Holocene geologic units lie in stream valleys and along the Mississippi River floodplain at the site (Figure 5.3-2). Eastward of the bluffs occurring along the eastern flanks of the floodplain, the loess is underlain by the terrace deposits of the Upland Complex, which are then underlain by the Catahoula Formation. The Catahoula Formation is part of the Southern Hills regional aquifer system, a sole-source aquifer [Reference 73, Section 5.3].

The bluffs at the site delineate a change in the upper stratigraphy. The upland plain, east of the bluffs, is a Pleistocene terrace rising to an elevation of about 150 feet above MSL. The surface of the upper plain is about 75 feet of loess overlaying about 40 feet coarse grained alluvium sand and gravel deposits of the Upland Complex. The lowland, west of the bluffs, at an elevation of about 70 feet above MSL consists of a layer of Holocene alluvium over 100 feet in thickness including backswamp areas and meander belts of the Mississippi River. The Catahoula Formation underlies both the terrace deposits in the uplands and the alluvium in the lowlands. GGNS is located in the uplands portion of the site (Figure 5.3-3). [Reference 73, Section 2. 4]

The morphology of the Mississippi River has defined much of the alluvium aquifer system near the site. The Holocene alluvium near the river has been affected by deposition and erosion. Faster-moving sections of the river are able to scour and cut down to the Catahoula Formation, whereas slower-moving sections of the river provide an opportunity for the sediment in the river to deposit. [Reference 73, Section 2.6.1.2]

The geologic units east of the bluffs on the uplands area of the site consist of Loess (Upper and Lower) underlain successively by the Upland Complex Alluvium (UCA), and Old Alluvium (UCOA), and Catahoula Formation. The loess is largely comprised of low permeability wind-deposited sediments. The UCA is a unit typically comprised of sands and clayey, silty sands. The UCOA is a unit typically comprised of coarse sands and gravels and clayey, silty sands. The Catahoula Formation is characterized as having a high percentage of fines and low permeability. Note that recent descriptions of the site have included changes in nomenclature for geologic formations to be consistent with the newer geologic references (e.g., UCA was formerly named the Pleistocene Terrace Formation). [Reference 41, Section 2.5.4.6.1]

5.3.1.2 Local Aquifers

<u>Mississippi River Alluvium</u>

The Mississippi River Alluvium is the most prolific water-bearing unit in the region. The alluvium, up to 200 feet in thickness, generally consists of a basal, coarse-sand and gravel zone grading upward into silt and clay. Recharge is derived from precipitation in areas where surficial deposits are permeable and from adjacent formations. The Mississippi River, tributary streams, and lakes also contribute recharge during high-water levels. [Reference 33, Section 2.3.1.2.1]

The Mississippi River Alluvium occupies the floodplain portion of the GGNS site (Figure 5.3-3). It consists of a surficial layer of clay and silt overlying lenses of sand, gravel, silt, and clay. In the area between Hamilton and Gin Lakes and the Mississippi River, the alluvium is predominantly fine-to-medium grained sand with varying amounts of gravel, silt, and clay. [Reference 49, Section 2.4.13.1.2]

Alluvium thickness, as determined by borings generally ranges from 95 to 182 feet at GGNS. The greatest thickness of gravel generally occurs at the base of the alluvium deposits just above the Catahoula Formation. East of the lakes and west of the bluffs, clay and silt are the principal constituents of the alluvium, with lesser amounts of sand and gravel present. [Reference 49, Section 2.4.13.1.2]

Recharge to the alluvium is derived from infiltration of precipitation, westward flow of groundwater across the terrace alluvium contact at the bluffs, and the Mississippi River during high river stages. It is unlikely that any appreciable recharge is derived from Hamilton and Gin Lakes due to a thick clay/silt layer beneath the lakes. [Reference 49, Section 2.4.13.1.2]

Beneath and adjacent to the river, the alluvium is in close hydraulic connection with the river. The fluctuation of the Mississippi River causes fluctuation in the alluvium aquifers. Generally, at the site the alluvium discharges to the river. However, during floods the direction of flow in the alluvium aquifers can reverse. [Reference 73, Section 2.6.1.2]

Upland Complex

Loess overlies the water bearing deposits of the Upland Complex at GGNS. The majority of the loess is unsaturated. The piezometric surface and first zone of saturation occur within the lower 10 feet of the loess (perched water of limited extent). The loess is not a source of groundwater supply.

The sediments of the UCA are fully saturated and contain permeable sands as well as clayey, silty sands and sandy clays. The UCOA beneath the UCA is saturated and contains highly permeable zones of coarse sands and gravels in addition to less permeable clayey and silty sands. Groundwater elevations measured on March 20, 2007 indicate groundwater elevations in the Loess and UCA are approximately 74 to 75 feet in the area west of GGNS. [Reference 41, Section 2.5.4.6.1]

While the terrace deposits have recently been called the Upland Complex in most recent site descriptions, groundwater monitoring has been consistent with the hydrogeologic characterization presented in the 1981 GGNS FES and the site characteristics presented in the GGNS Updated Final Safety Analysis Report (UFSAR). The groundwater gradient observed in the Upland Complex is generally to the west toward the Mississippi River. The GGNS UFSAR provides groundwater gradient maps for measurements in May 1973, October 1973, August 1979, November 1979, and December 1979. The May 1973 measurements were conducted when the Mississippi River was under flood conditions with 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 GGNS UFSAR maps show a groundwater gradient to the west with water level contours indicating an approximate water level of 65 – 75 feet MSL in an area that GGNS had considered locating Unit 3. The May 1973 map shows an eastward groundwater gradient in the Unit 3 area, with a water level of 84 feet MSL.

[Reference 45, Section 2.3.1.2.2; Reference 49, Figures 2.4-27, 2.4-32 to 2.4-35, 2.4-38, 2.4-39]

Catahoula Formation

Aquifers of the Miocene series underlie the entire region. The Miocene series consists of three stratigraphic units: Pascagoula, Hattiesburg, and Catahoula Formations. The Pascagoula and Hattiesburg Formations are important as aquifers only in the extreme southeastern portion of the region. Permeable zones within the Catahoula Formation are the source of water for the majority of public and private wells in Claiborne, Copiah, and Jefferson Counties, and they supply several small wells in southern Hinds and Warren Counties. The Catahoula Formation consists of lenticular deposits of sand, clayey silt, and sandy-silty clay, locally cemented. Sand layers are predominantly fine-grained and range in thickness from a few inches to more than 100 feet. The depth to Miocene aquifers varies greatly over the region from near surface in the north to about 1100 feet in southern areas. The recharge area for the Catahoula lies to the north of GGNS in Warren and Hinds Counties beneath the alluvium plain and loess bluffs. [Reference 49, Section 2.4.13.1.1]

The Catahoula Formation is continuous across the entire GGNS site and lies beneath the floodplain alluvium and terrace deposits and at a few locations directly beneath the loess. It consists of lenticular beds of locally indurated fine sand, silty clay, and clayey silt with occasional silt and fine sand seams. [Reference 49, Section 2.4.13.1.2]

The upper portion of the Catahoula Formation is impermeable and acts as a confining unit; however, thin sand lenses are encountered in the upper portion. 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. Wells installed for GGNS combined license application (COLA) site characterization indicated the water-bearing sand lens within the upper Catahoula Formation is separated from the Upland Complex by approximately 50 feet of less permeable Catahoula Formation deposits. Pump tests in the Upland Complex did not result in impacts to water level changes in the well screened within the Catahoula Formation when the well in the Upland Complex was being pumped. [Reference 41, Section 2.4.12.1.3.1]

Perched water tables were encountered at various depths in the immediate vicinity of GGNS Unit 1, where the underlying Catahoula Formation forms a ridge-like feature that rises about 20 feet above the regional water table. Groundwater migrates downward through the terrace deposits and accumulates on the terrace clay lenses above the Catahoula or at the terrace/Catahoula contact above the regional water table. [Reference 49, Section 2.4.13.1.2]

5.3.1.3 Groundwater Quality

The GGNS facility uses radial wells adjacent to and with laterals extending beneath the Mississippi River to provide cooling water. The high rate of water induced to infiltrate from the Mississippi River into the Holocene alluvium has ensured that the dissolved solids concentrations of the groundwater in the vicinity of the radial wells are nearly identical to the water quality of the Mississippi River. Suspended sediment in the river water is trapped in the stream bed, thereby reducing the suspended solids in the cooling water. The water quality of the groundwater in the Catahoula Formation does not appear to have been influenced by the construction or operation of the GGNS facility. [Reference 73, Section 2.6.3.2]

The GGNS uses wells in the Upland Complex terrace deposits as the source of water for several purposes, including potable water needs. The water is sampled as required by the Mississippi State Health Department pursuant to the Safe Drinking Water Act. The water quality of the groundwater from the Catahoula Formation, although very hard, is suitable for potable uses. Water quality generally decreases as wells go deeper below the Catahoula Formation. [Reference 73, Section 2.6.3.2] It should be noted that although an error in permitting led to an inaccurate conclusion that GGNS potable water wells were completed in the Catahoula, GGNS does not withdraw groundwater from the Catahoula Formation [References 38 and 59].

5.3.1.4 Regional Groundwater Usage

There are few population concentrations and little industry located in the region, and most water wells are used for domestic purposes. Use of alluvium aquifers is limited to several industrial wells in Warren County and shallow domestic wells along the Mississippi River and its larger tributaries. Pleistocene terrace deposits provide water for domestic wells in the upland areas of the region and one small public supply in Warren County. The Citronelle Formation supplies several shallow municipal, industrial, and domestic wells in the vicinity of Crystal Springs in Copiah County; however, use is very limited outside of this area. Aquifers of the Miocene series provide water for more than 95 percent of the public, domestic, and industrial wells in Claiborne and Jefferson Counties and about 50 percent of the wells in Copiah County. Use of Miocene aquifers in Warren and Hinds Counties is limited to a few rural domestic wells. Groundwater from the Forest Hill Formation is used primarily for domestic purposes, but this source also supplies several small public and industrial wells in Hinds and Warren Counties. [Reference 34, Section 2.4.12.2.1]

The Kosciusko and Cockfield Formations supply wells of all types in Hinds County and, to a lesser extent, in Warren County. Use of these aquifers is restricted in areas to the south because of increasing depth and salinity. [Reference 34, Section 2.4.12.2.1]

Public water supply and industrial wells in Copiah County utilize the Catahoula, Citronelle, Miocene series, and Forest Hill Sand. Public water supply and industrial wells in Hinds County utilize the Cockfield Formation, Sparta Sand, Meridian-Upper Wilcox, Forest Hill Sand, and Catahoula Formation. Public water supply and industrial wells in Jefferson County utilize the Catahoula and Miocene series formations. Public water supply and industrial wells in Warren County utilize the Mississippi River alluvium aquifer, Cockfield Formation, Forest Hill Sand, and Catahoula Formation. [Reference 34, Section 2.4.12.2.1]

5.3.1.5 Vicinity Groundwater Usage

Public water supply wells in Claiborne County (excluding GGNS) are supplied by the Catahoula Formation with well depths ranging from 166 to 960 feet. Ten active public water supply systems were located in Claiborne County as of May 2009, not including GGNS [Reference 60]. The closest area of concentrated groundwater withdrawal is the Port Gibson municipal water system about five miles southeast of the site. Water for Port Gibson is provided by five wells completed in the Catahoula Formation and withdrawals average 0.85 mgd. [Reference 34, Section 2.4.12.2.1]

According to information on water use for 1995, total groundwater withdrawals in Claiborne County were 33.9 mgd. Table 5.3-2 provides a breakdown of this usage.

Table 5.3-2 Claiborne County Water Use Data, 1995	
Sector	**Quantity (mgd)**
Public Supply	1.25
Domestic (Self-Supplied)	0.23
Irrigation	0.12
Livestock	0.08
Thermoelectric Power (GGNS Unit 1)	32.05
Commercial	0.17
SOURCE: Reference 34, Section 2.4.12.2.1	

GGNS groundwater is supplied from the Mississippi River Alluvium (radial wells) and the Upland Complex (potable wells) aquifers. Residents within the vicinity of GGNS are served by CS&I Water Association which withdraws water from the Miocene aquifer [Reference 60]. As previously discussed, the Miocene series consists of three stratigraphic units: Pascagoula, Hattiesburg, and Catahoula Formations. Since the GGNS withdraws groundwater from the Mississippi River Alluvium and Upland Complex (potable wells) aquifers, the Miocene aquifers including the Catahoula are unaffected.

5.3.1.6 Radial Well Withdrawal Impacts

Groundwater

Plant service water is supplied from radial collector wells located in the floodplain that parallels the Mississippi River (Figure 5.3-1). The collector wells, which are permitted with the MDEQ with a maximum capacity of 10,000 gpm each, are designed to derive water from the Mississippi River via induced infiltration. Collector wells were constructed by sinking a cylindrical concrete caisson into the alluvium aquifer, sealing the bottom with a concrete plug, and projecting perforated pipes horizontally near the base of the caisson into the aquifer (Figure 5.3-4). The reinforced caisson was poured in place in sections.

Sinking of the caisson was accomplished by excavating the materials inside the caisson and allowing it to sink under its own weight. When the caisson reached the desired depth, the bottom was sealed with a concrete plug. Perforated pipes (laterals) were driven horizontally into the aquifer through ports near the bottom of the caisson by a jetting and jacking process. A large part of the fine material in the aquifer in the immediate vicinity of the laterals was removed in this process, and a natural gravel pack was developed around each perforated pipe. [Reference 49, Section 2.4.13.1.3.1]

Each collector well is equipped with two pumps so that the number of pumps in operation may be varied with the plant demand. Each pump is of the vertical-turbine type with a nominal capacity of 5000 gpm. Pump motors and related equipment are housed in a protective enclosure at the top of the caisson, 25 to 30 feet above natural grade. The operating floor level of the pumps is above Elevation 96-0, which is above the 100-year flood level of the Mississippi River. [Reference 49, Section 2.4.13.1.3.1]

Since additional cooling tower make-up water is projected to be needed (~3,200 gpm) due to the increase in heat load generated as a result of EPU, which would also result in an increase in water loss through evaporation, blowdown and drift, a new radial well is being installed to ensure that plant availability is maintained during EPU conditions since GGNS' existing radial wells have degraded over time and thus cannot perform at their design capacity. Although water being utilized for cooling tower make-up is projected to increase (~3,200 gpm), there is no overall increase of groundwater consumption when comparing the estimated EPU cooling tower makeup flow value of 27,860 gpm (62 cfs) to the estimated 42,636 gpm (95 cfs) value identified in the GGNS FES, which represents less than 1 percent of the lowest one-day recorded flow of the Mississippi River [Reference 26, Section 3.3.1; Reference 69, Section 4.2.3; Summary and Conclusions]. Therefore, groundwater consumption remains bounded by the GGNS FES.

Table 5.3-1 indicates an actual total average annual withdrawal for the existing four radial wells of approximately 22,082 gpm (49 cfs). The projected 3,200 gpm required for EPU would add an additional annual average withdrawal of seven (7) cfs, for a total of 56 cfs annual average withdrawal which still remains bounded by the impact evaluated in the GGNS FES. Although the new radial well (Radial Well 6) is necessary to produce additional withdrawal capacity, the withdrawal from all five radial wells used for Unit 1 at EPU operating conditions would still be bounded by that evaluated in the GGNS FES.

The impact to offsite groundwater users from the withdrawal of the radial wells is limited by the recharge boundary created by the river, and thus is not expected to extend to the west beyond the river. Based on estimates of the radius of anticipated drawdown of the GGNS radial wells, drawdown at the GGNS property boundaries would have limited impact on potential offsite use in the Mississippi River Alluvium aquifer. This is a conservative estimate of aquifer capacity impact, since GGNS' actual withdrawal is significantly less as shown in Table 5.3-1, and aquifer recharge from sources other than the river (flooding and rainfall events) were not considered. [Reference 7] However, it should be noted GGNS's potable water wells are the closest wells withdrawing groundwater in the vicinity (although not from the Mississippi River Alluvium), and have operated to supply adequate water supply to GGNS without noticeable impact from the operation of the radial wells. The Grand Gulf Military Park is the nearest offsite water user, and obtains its source of water supply from CS&I Water Association which withdraws groundwater form the Miocene Aquifer [Reference 60]. There are no known withdrawals from the Mississippi River Alluvium aquifer other than GGNS between the Big Black River to the north, and Bayou Pierre River to the south.

Water rights and allocations of groundwater are regulated by MDEQ [Reference 58]. Therefore, all existing GGNS Unit 1 groundwater withdrawals, including those from the radial wells, are regulated by a groundwater allocation permitting program (Table 5.3-1). These permits were granted considering their identified potential impact on other uses in the area, and considering those withdrawals in the recharge area of the Mississippi River Alluvium.

Public water supply wells in Claiborne County (excluding GGNS) are supplied by the Catahoula Formation with well depths ranging from 166 to 960 feet. The closest area of concentrated groundwater withdrawal is the Port Gibson municipal water system about five miles southeast of the site. Water for Port Gibson is provided by five wells completed in the Catahoula Formation with average withdrawals of 0.85 mgd. As discussed above, the primary recharge for the Catahoula is to the north in Hinds and Warrens Counties. Limited recharge near the GGNS Unit 1 power block occurs due to low permeability strata in the uppermost portions of the Catahoula. While some recharge to the Catahoula may occur due to its contact with the Mississippi River in some locations along the river valley, GGNS radial well withdrawal impact on the Catahoula is believed to be non-existent since the radial well withdrawal rate is less than 1 percent of the low flow conditions of the river.

It is also important to note that none of Claiborne County's public water systems sources are from the Mississippi River Alluvium [Reference 60]; therefore, there are no groundwater use conflicts and GGNS radial well withdrawal impacts are SMALL.

Wetlands

Plant service water is supplied from radial wells located in the floodplain parallel to the Mississippi River. The radial wells are designed to derive water via induced infiltration from the Mississippi River. The creation of a depression cone in the well field area results in induced infiltration from the river to the wells, with most of the groundwater withdrawn being from the infiltration rather from groundwater within the floodplain. [Reference 49, 2.4.13.1.3.1]

Groundwater levels resulting from radial well pumping were developed at GGNS based on the long-term pumping tests of Radial Wells 3 and 5 conducted from August 7, 1979 to December 19, 1979 (134 days). Measured groundwater levels allowed the development of groundwater contours during periods of various river stages. [Reference 49, 2.4.13.2.5] Contours were developed from these measurements for November 17, 1979 when the river stage was at 39.0 feet MSL, and on December 10, 1979 when the river stage was at 66.2 feet MSL [Reference 49, Figures 2.4-40 and 2.4-43]. These results show the significant influence of the river stage on groundwater levels in the immediate vicinity of the radial wells. Predicted groundwater levels were developed for radial well pumping rates for Radial Wells 1, 3, 4, and 5 at "normal" river stage of 61.7 feet MSL [Reference 49, Figure 2.4-44]. Operation of the radial wells does not alter the groundwater regime in the site vicinity, other than in the immediate area of the well field. This is not expected to significantly change, even with the addition of Radial Well 6 [Reference 7].

Table 5.1-1 indicates that approximately 40 percent of the GGNS site is bottomland, including forested, shrub, and emergent marsh wetlands. As stated in Section 5.3.1.2 the groundwater in the alluvium in the floodplain is in close hydraulic communication with the river. The groundwater contour figures reveal that the impact of the cone of depression surrounding the radial wells is dependent upon river stage. This impact is limited also by recharge to the alluvium derived from infiltration of precipitation, westward flow of groundwater across the terrace alluvium contact at the bluffs, and the flooding of the Mississippi River during high river stages. Thus, based on the localized influence of the drawdown zone surrounding the wells, the groundwater's hydraulic connection with the river, recharge from seasonal flooding and additional recharge from the Upland Terrace aquifer east of the bluffs, the impact of radial well groundwater withdrawal in the floodplain is of limited extent. Even though there is potentially greater impact to groundwater levels at the lowest river stages than at higher river stages, the low river stages are generally temporary. Thus, the impact of the radial wells on nearby wetlands is SMALL.

5.3.1.7 Potable Water Well Withdrawal Impacts

Groundwater

Three wells completed within the Upland Complex are currently used to supply water for general site purposes including potable, sanitary, air conditioning and landscape maintenance. Two of the wells are in routine use and have electric pumps, and the third well is a backup well with a diesel pump. The backup well (North Construction Well) was installed in 1976 to supply water for construction purposes, and the remaining two wells (North Drinking Water Well and South Drinking Water Well) were installed in 1995 and 1996 to replace a well that had become inoperable. During GGNS Unit 1 refueling outages, the two wells operate at near full capacity. [Reference 33, Section 2.3.2.2] Groundwater use from these three wells is provided in Table 5.3-1. As shown, annual average groundwater withdrawal from the Upland Complex has been less than 100 gpm based on water usage reported to the MDEQ.

A review of existing information, site geology, and groundwater was performed from February 2006 through July 2007 during the site hydrogeologic investigations. An extensive database of groundwater characterization information supports the evaluation of impacts. The wells providing potable water for Unit 1 operations are completed in the Pleistocene sand and gravel deposits of the Upland Complex. No GGNS withdrawals occur from the Catahoula Formation. [Reference 45, 4.2.2.2]

Aside from GGNS Unit 1, the primary use of groundwater in Claiborne County is for public supply purposes with a small percentage used for domestic water, irrigation, and livestock. Within a two-mile radius of the plant site, essentially all groundwater is used for domestic purposes. [Reference 34, 2.4.12.2.2]

Since there are no plans to construct any new facilities or modify the existing facilities, or change operational practices associated with the wells, EPU activities are not expected to require additional withdrawals of groundwater from these wells. Therefore, there are no groundwater use conflicts and impacts associated with EPU are SMALL.

5.3.1.8 Conclusion

As previously discussed groundwater withdrawals would continue to be bounded by the GGNS FES as a result of EPU and continued operational activities. The installation of an additional radial well is expected to reduce the per-well withdrawal rates without an increase in overall groundwater impacts. No major construction is planned (no concrete batch plant required) so additional withdrawals is not required. Therefore, EPU does not have any significant impact on the quality or quantity of groundwater in the underlying aquifers, and operation under EPU conditions would not cause a water use conflict with other groundwater users in the GGNS area. Therefore, impacts are SMALL.

Figure 5.3-1: GGNS Permitted Groundwater Well Locations

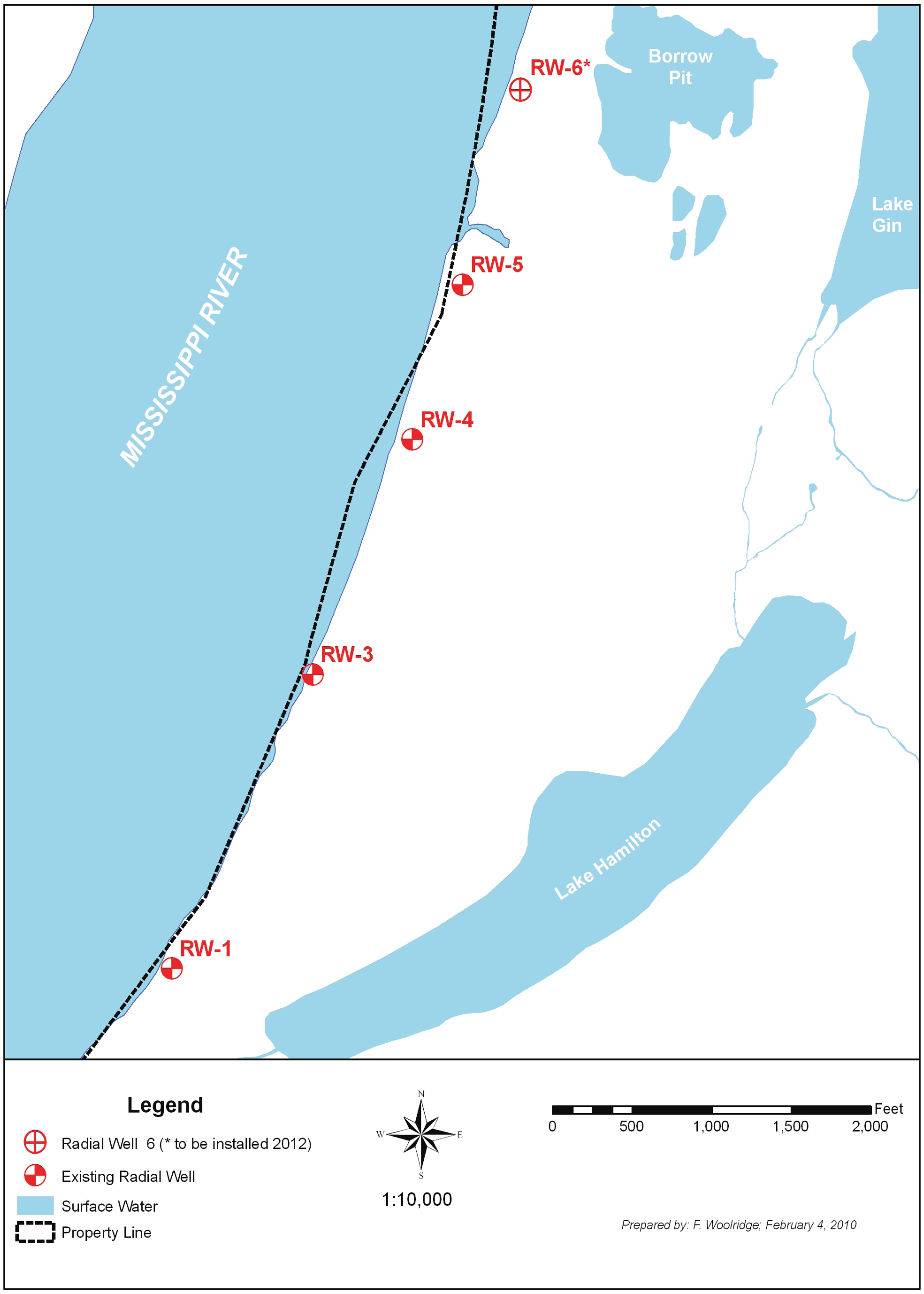


Figure 5.3-1: GGNS Permitted Groundwater Well Locations (Continued)

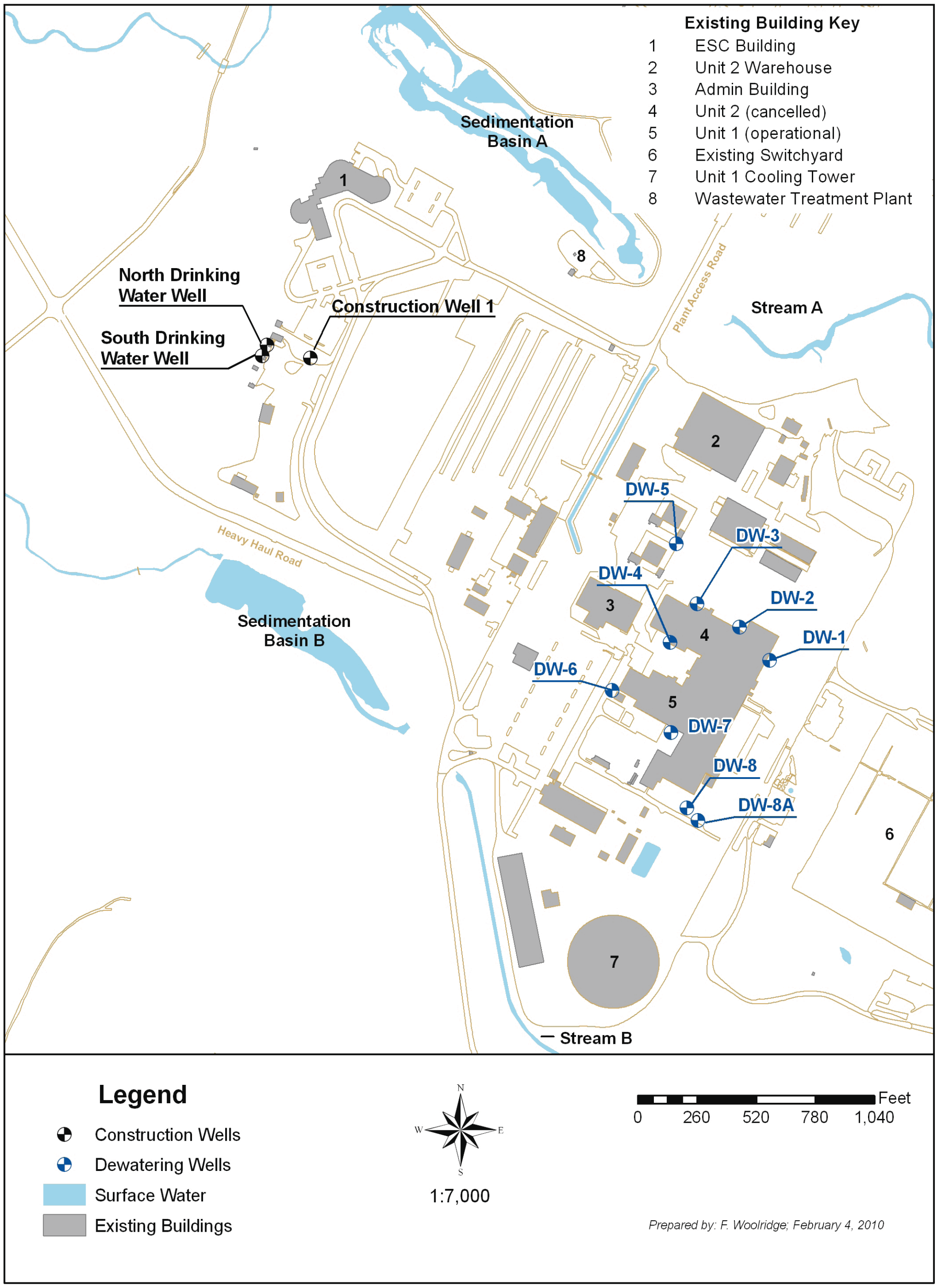
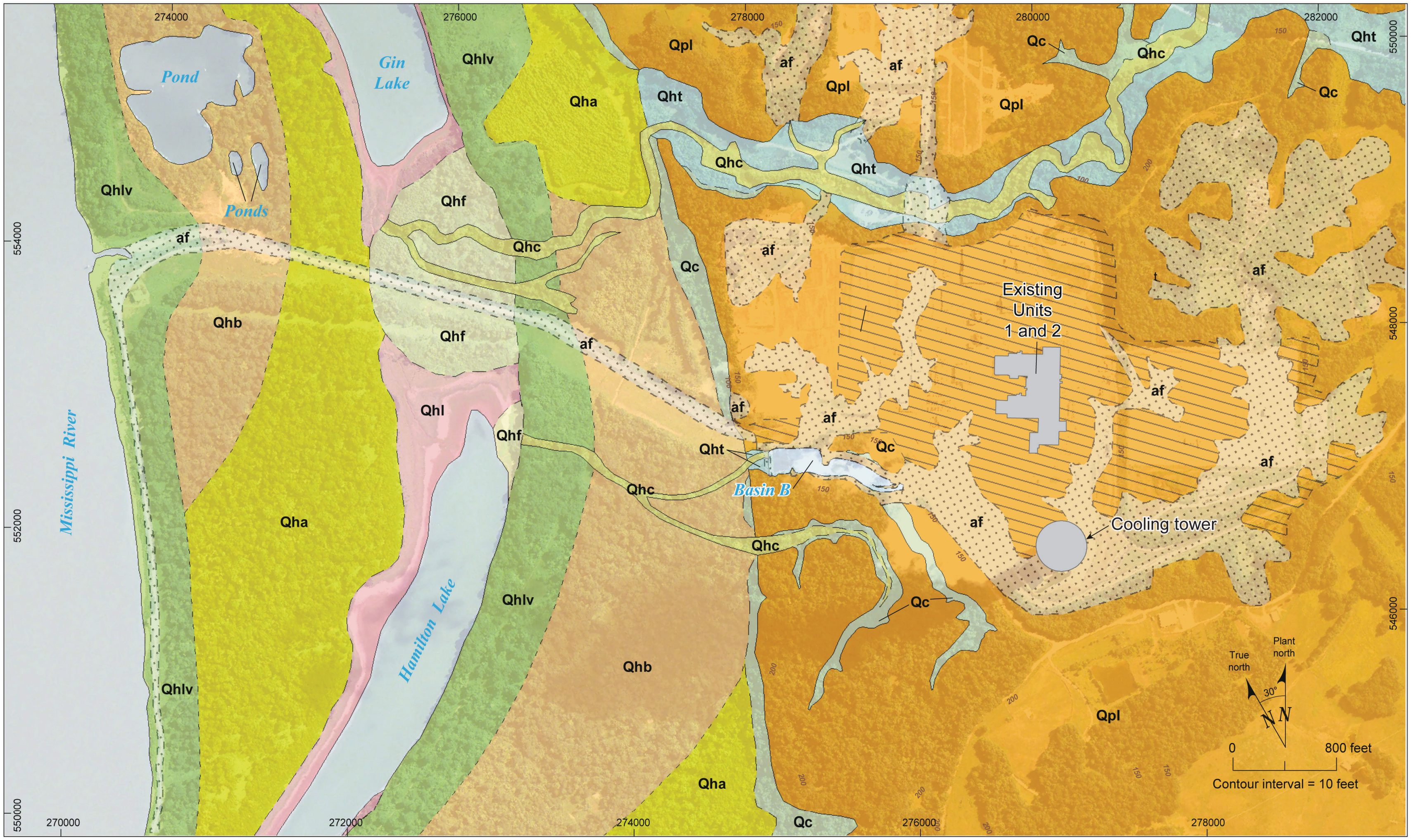


Figure 5.3-2: GGNS
Site Geologic Map



Notes: 1. Projection NAD 27 State Plane Mississippi West FIPS.
2. Vertical datum NAVD 88.
3. See Sheet 2 for Explanation.

Figure 5.3-2: GGNS Site Geologic Map (Continued)

Legend

Explanation

Unit Descriptions

Holocene	af	Undocumented fill - may be engineered and/or non-engineered
Holocene	Qhc	Stream channel deposits - gravel, sand, silt and clay deposited in active natural stream channels
Holocene	Qht	Stream terrace deposits - gravel, silt, sand and clay deposits associated with stream channel point bar and overbank deposits adjacent to fluvial channels
Holocene	Qha	Mississippi River alluvium, undifferentiated - unconsolidated gravel, sand, silt and clay deposited by the Mississippi River
Holocene	Qhf	Alluvial fan deposits - gravel, sand, and silt associated with streams emanating from confined drainages onto alluvial valleys
Holocene	Qhl	Lacustrine deposits - clay, silt, and sand deposits associated with lake deposition
Holocene	Qhb	Backswamp deposits - sand, silt and clay deposited in the floodbasin behind a natural levee
Holocene	Qhlv	Levee deposits - gravel, sand and silt deposited in a low ridge adjacent to present or former river channels
Holocene	Qc	Colluvium - unconsolidated sand, silt and clay accumulated on or at the base of slopes
Pleistocene	Qpl	Loess (upper) - silt, trace clay, massive, weak blocky structure, very thinly laminated, and occasional gastropod shells

Symbols

- - - — — ——— Contacts between map units; solid where accurately located; long dashed line where approximately located; short dashed line where inferred

Cut

Figure 5.3-3: Cross Section of Local Aquifers

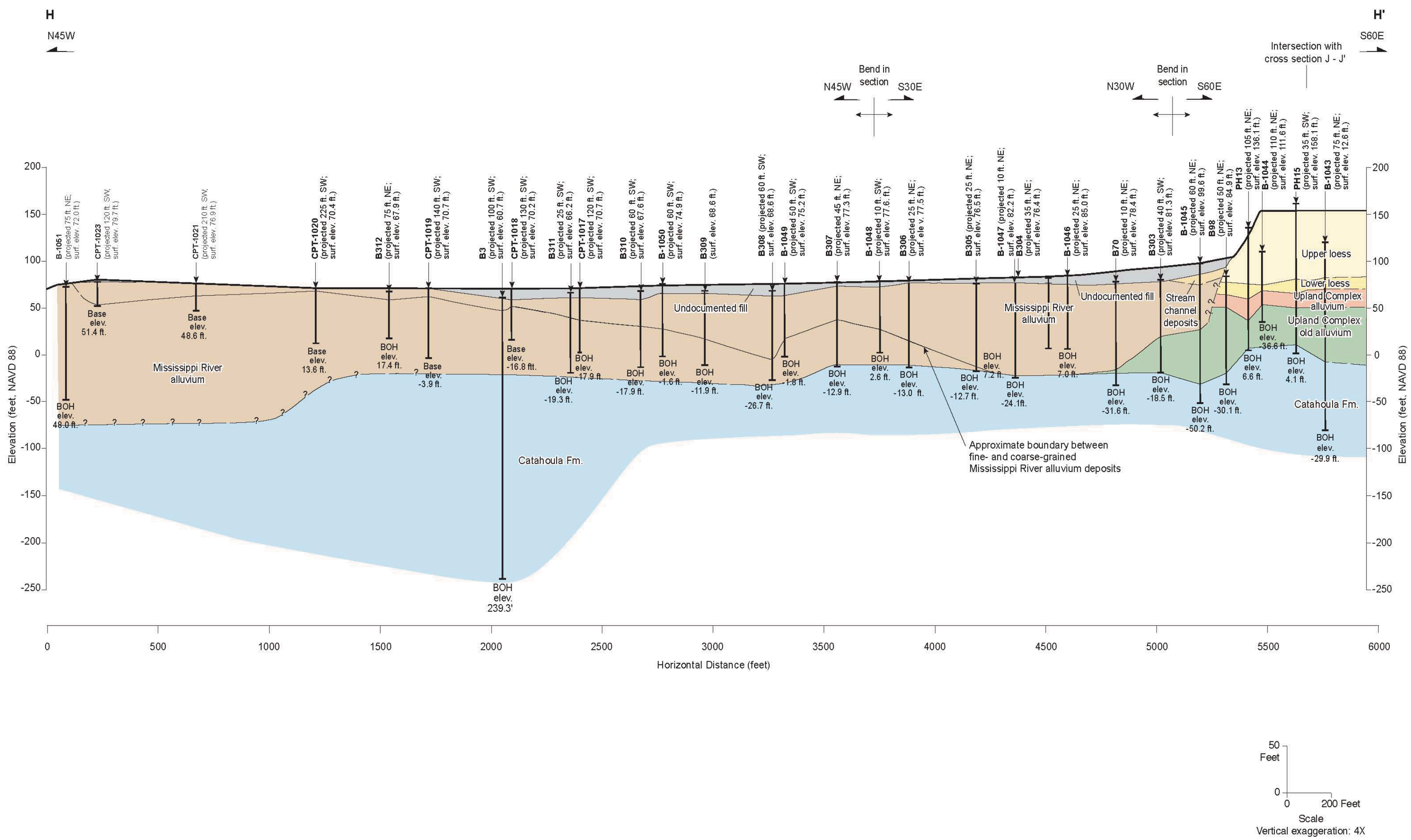
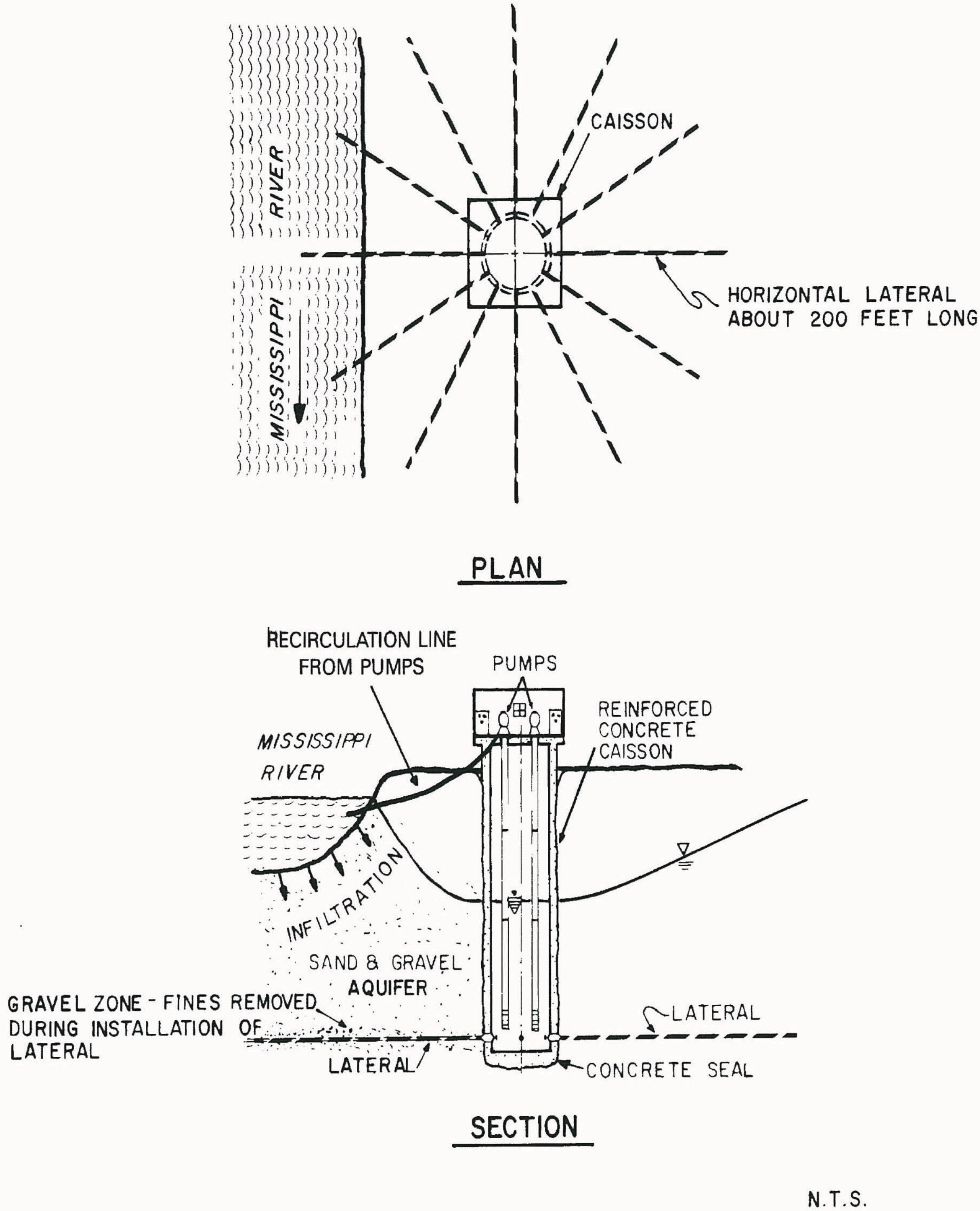


Figure 5.3-4: Radial Collector Well



5.3.2 Surface Water

5.3.2.1 Water Quality

With an average discharge of 593,000 cfs draining 1,150,000 square miles, the Mississippi River is the largest river in the United States. The western boundary of the GGNS site is defined by the Mississippi River's eastern bank (Figure 2.0-3). At the site, the Mississippi River is about 0.5 miles wide at low flow and about 1.4 miles during a typical annual high flow period. The depth of the thalweg of the Mississippi River at the site is about 16 feet below MSL. Historically, the Mississippi River near the site has been very active with frequent changes in the channel alignment and thalweg. [Reference 73, Section 2.6.1.1]

However, the Mississippi River is now subject to the management and control of the USACE. Through an aggressive and ongoing program of dredging, installation of river bank revetments and armor, levee construction and maintenance, and upstream reservoir regulation, the USACE has stabilized the historical movement of the river into a relatively stable channel alignment. The bluffs at the GGNS site represent a natural levee and have confined the river, even during pre-channelization times, to stay to the west of the GGNS site. [Reference 73, Section 2.6.1.1]

The Mississippi River flow varies considerably throughout the year and between years. Based on stream flow data from Vicksburg, Mississippi, from 1929 through 1983, the 7-day, 10-year low flow and 100-year flood have been estimated at 120,000 cfs and 2,203,000 cfs, respectively. February, March, April, and May are the months with the highest mean monthly discharges and as such are the periods that the river would most likely rise over its normal banks inundating the adjacent lowland floodplain. [Reference 73, Section 2.6.1.1]

The Mississippi River is classified for Fish and Wildlife use. As such, the river is to be suitable for the propagation of fish, aquatic life and wildlife; and for fishing, fish consumption, and secondary contact recreation. Secondary contact recreation is defined as incidental contact with the water during activities such as wading, fishing, and boating, that are not likely to result in full body immersion. Based on MDEQ's 2008 Section 303(d) list of impaired waterbodies, the segment of the Mississippi River located within Claiborne County is not listed as impaired.

The massive nature of the Mississippi River makes the discharges from the GGNS facility undetectable within the overall flow regime, and any changes in the quality are small and localized compared to the overall width of the river. [Reference 73, Section 2.6.3.1] Effluent limitations and monitoring requirements for plant discharges are an integral part of the NPDES Permit. Flow rate associated with NPDES Outfall 001, which receives effluents from Outfalls 002, 004, 005, 006 and 011 and discharges directly to the Mississippi River, is required to be monitored continuously as specified in the GGNS NPDES Permit. Modifications of the non-radiological drain systems or other systems conveying wastewaters are not required due to EPU, and biocide/chemical discharges would be consistent with existing permit limits. Although it is estimated that blowdown (NPDES Outfall 002) would increase slightly (~825 gpm) based on evaporation, EPU is not introducing any new contaminants or pollutants and is not increasing the amount of those potential contaminants presently allowed for release by GGNS.

Due to the additional cells being added to the auxiliary cooling tower and the associated fill material, additional sodium hypochlorite injection is needed for effective biological fouling control. However, blowdown (NPDES Outfall 002) is dechlorinated with sodium bisulfite prior to being discharged to the Mississippi River. Therefore, effluent concentrations would continue to be below the NPDES Permit limits specified in Table 5.3-3. Consequently, water quality impacts would be SMALL.

5.3.2.2 Wastewater Discharges

Some amount of chemical and biocide wastes are produced from processes used to control the pH in the coolant, to control scale, to control corrosion and to clean and defoul the condenser. These waste liquids are typically combined with cooling water discharges in accordance with the site's NPDES Permit MS0029521. Sanitary wastewater from all plant locations, which are also regulated by GGNS NPDES Permit MS0029521, flows to an onsite sewage treatment plant prior to discharging to Basin A via NPDES Outfall 010. Solids associated with treatment of the sanitary wastewater are placed in drying beds and then managed appropriately for eventual offsite disposal.

Surface water and wastewater discharges are regulated by the MDEQ via the NPDES permit which is reviewed and re-issued by the MDEQ on a five year basis. The current GGNS NPDES permit, which has been administratively continued by the MDEQ based on the timely December 28, 2007 submittal of the permit renewal application, authorizes discharges from eleven outfalls (3 external and 8 internal). The outfalls and their associated effluent limits are listed in Table 5.3-3 [Reference 29, Part I]. None of the limits listed in Table 5.3-3 would require a modification to support or implement EPU. Therefore impacts associated with wastewater discharges would be SMALL.

Table 5.3-3
NPDES Permitted Outfalls

Outfall	Description	Parameter	Limit
001	Discharge Basin	Flow Temperature Free Available Chlorine * Chlorination * pH	Report only Report only 0.2 mg/l daily average 0.5 mg/l daily maximum 120 minutes/day (6.5 – 9.0)
002	Cooling Tower Blowdown	Flow Free Available Chlorine Chlorination Zinc	Report only 0.2 mg/l monthly average 0.5 mg/l daily maximum 120 minutes/day 1.0 mg/l monthly average 1.0 mg/l daily maximum
004	Standby Service Water A	Flow Free Available Chlorine Chlorination Zinc	Report only 0.2 mg/l monthly average 0.5 mg/l daily maximum 120 minutes/day 1.0 mg/l monthly average 1.0 mg/l daily maximum
005	Standby Service Water B	Flow Free Available Chlorine Chlorination Zinc	Report only 0.2 mg/l monthly average 0.5 mg/l daily maximum 120 minutes/day 1.0 mg/l monthly average 1.0 mg/l daily maximum
006	Low Volume Waste Basin	Flow Oil and Grease Total Suspended Solids	Report only 15 mg/l monthly average 20 mg/l daily maximum 30 mg/l monthly average 100 mg/l daily maximum
007	Stormwater	Flow Total Suspended Solids Oil and Grease Total Residual Chlorine pH	Report only 30 mg/l monthly average 100 mg/l daily maximum 15 mg/l monthly average 20 mg/l daily maximum Report only (6.5 – 9.0)
010	Sewage Treatment Plant	Flow Biological Oxygen Demand Total Suspended Solids Fecal Coliform Total Residual Chlorine pH	Report only 30 mg/l monthly average 45 mg/l daily maximum 30 mg/l monthly average 45 mg/l daily maximum 2000/100 ml 4000/100 ml 0.5 mg/l daily maximum (6.5 – 9.0)
011	Liquid Radwaste	Flow Total Suspended Solids	Report only 30 mg/l daily maximum
013	Sedimentation Basin A	Flow Total Suspended Solids pH	Report only Report only (6.5 – 9.0)
014	Sedimentation Basin B	Flow Total Suspended Solids pH	Report only Report only (6.5 – 9.0)
016	Energy Services Center	Flow Total Residual Chlorine pH	Report only 0.5 mg/l yearly maximum (6.5 – 9.0)

* Required when Plant Service Water bypasses cooling towers and discharges directly to Discharge Basin.

5.3.2.3 Water Use Conflicts

Water in the vicinity satisfies a variety of purposes including domestic, industrial, and agricultural uses with groundwater withdrawn from the various aquifers and surface water withdrawn from the Mississippi River. In NUREG-1817, the NRC staff used 2000 data from the United States Geological Services and found that the total estimated water use in Claiborne County was 34.3 mgd. Groundwater comprises that entire total except 0.4 mgd of surface water. [Reference 73, Section 2.6.2]

Total surface water withdrawals in Claiborne County are predominantly for agricultural use (livestock and irrigation), with no surface water usage reported for public supply, domestic self-supplied systems, mining, hydroelectric power, thermoelectric power, industrial or commercial uses. [Reference 73, Section 2.6.2.1]

The nearest downstream user of Mississippi River water is Southeast Wood Fiber located at the Claiborne County Port facility, 0.8 miles downstream of the GGNS site. The maximum intake requirement for this facility is less than 0.9 mgd for industrial purposes; however, none of this intake is used as potable water. There are only three public water supply systems in the State of Mississippi that use surface water as a source, and none of these are located within 50 miles of the GGNS site. There are also no downstream or upstream intakes in Mississippi within 100 miles of the GGNS site that use the Mississippi River as a potable water supply. [Reference 73, Section 2.6.2.1]

Although GGNS withdraws groundwater that is hydraulically connected to the river as discussed in Section 5.3.1.2, the plant is located on a large river (Section 5.8.1), and surface water usage in Claiborne County is minimal as discussed above. Therefore, impacts to surface water usage associated current operations and EPU are SMALL.

5.3.3 Wetlands

As discussed in Section 5.1.1 above, an additional radial well is being constructed approximately 1700 feet north of Radial Well #5 (Figure 5.3-1) that would impact wetland areas. Activities that would occur in these wetland areas include the following:

- Clearing and grubbing of trees and vegetation.
- Construction of a working pad (150 feet x 225 feet).
- Excavating for the well caisson.
- Excavation of trenches for piping and electrical equipment

In addition, dredging activities may potentially occur in the existing barge slip area to accommodate delivery of transformers and other heavy equipment associated with EPU in the event that the Claiborne County Port facility is determined to be infeasible from an economical and technological standpoint.

All activities listed above would be conducted in accordance with the USACE's Section 404 permitting process. In general, these activities only affect localized areas for a brief period of time and therefore are short-lived. In addition, the USACE permitting process involves a site-specific evaluation of potential environmental impacts and appropriate mitigation measures associated with these activities. Therefore the impact to wetlands, as a result of EPU, is considered minimal and is consistent with the NRC's conclusion in the draft Revision 1 to NUREG-1437, which states that impacts of dredging has not been found to be a problem at operating nuclear power plants [Reference 74, Section S.5]. Therefore wetland impacts as a result of EPU would be SMALL.

5.4 Ecology

5.4.1 Terrestrial Biota

Types of land cover on the GGNS property are identified in Table 5.1-1. The site is bisected by a prominent bluff line that runs parallel to the Mississippi River. Areas below the bluff line are seasonally flooded, except for two oxbow lakes which are permanently inundated, and are considered wetland areas. The predominant bottomland canopy vegetation consists of black willow (*Salix nigra*), box elder (*Acer negundo*), green ash (*Fraxinus pennsylvanica*), and sugarberry (*Celtis laevigata*). [Reference 73, Section 2.7.1.1]

Above the bluff line, the two prominent habitat types are upland field and upland forest with the vast majority upland forest. One small area of wetland has been defined on the north side of the plant as upland, palustrine, emergent, permanently flooded. Most of the previous developed areas are in upland habitat; however, approximately 400 acres of upland forest remains on-site. Dominant canopy cover in upland forested areas consists of American elm (*Ulmus americana*), hickory trees (*Carya* spp.), southern red oak (*Quercus falcate*), sweetgum (*Liquidambar styraciflua*), water oak (*Quercus nigra*), and winged elm (*Ulmus alata*). [Reference 73, Section 2.7.1.1]

Habitat located on the GGNS site is home to many animals including mammals, forest community birds, water dependant birds, upland game birds and birds of prey. Although not inclusive, Table 5.4-1 lists many of these species that may be near or on the GGNS site.

As discussed in Section 5.1.1 above, activities associated with installation of the new radial well would be managed in accordance with the Section 404 Permit and MDEQ's stormwater permitting program (Permit Number MSR15) as appropriate. Although there is no habitat present on the Heavy Haul Road, refurbishment activities associated with the road would be managed in accordance with GGNS' existing Baseline Stormwater General NPDES Permit MSR000883. There are no other EPU activities that would involve land disturbance or any changes to right-of-way maintenance practices associated with in-scope transmission lines. In addition, as discussed in Section 5.1.2 above, noise impacts associated with EPU activities are minimal. Because only a small percentage of habitat is anticipated to be disturbed, affects to wildlife species (including threatened or endangered species as discussed in Section 5.4.7) are not expected. Therefore terrestrial biota impacts would be SMALL.

Table 5.4-1

Mammals and Birds On or Near the GGNS Site

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

SOURCE: Reference 73, Section 2.7.1.1

Table 5.4-1 (Continued)

Mammals and Birds On or Near the GGNS Site

Scientific Name	Common Name
Forest Community Birds	
Cyanocitta cristata	blue jay
Cardinalis cardinalis	northern cardinal
Empidonax virescens	Acadian flycatcher
Coccyzus americanus	yellow-billed cuckoo
Turdus migratorius	American robin
Regulus calendula	ruby-crowned kinglet
Zenaida macroura	mourning dove
Agelaius phoeniceus	red-winged blackbird
Icterus spurius	orchard oriole
Stelgidopteryx serripennis	northern rough-winged swallow
Spizella pusilla	field sparrow
Chondestes grammacus	lark sparrow
Water Dependent Birds	
Ardea herodias	great blue heron
Egretta tricolor	tricolored (Louisiana) heron
Bubulcus ibis	cattle egret
Ardea alba	great (common) egret
Eudocimus albus	white ibis
Mycteria americana	wood stork or wood ibis
Ceryle alcyon	belted kingfisher
Fulica americana	American coot
Podilymbus podiceps	pied-billed grebe
Anas platyrhynchos	mallard
Anas acuta	northern pintail
Aix sponsa	wood duck
Birds of Prey	
Coragyps atratus	black vulture
Cathartes aura	turkey vulture
Buteo platypterus	Broadwinged hawk
Circus cyaneus	northern harrier
Buteo lineatus	red-shouldered hawk
Buteo jamaicensis	red-tailed hawk
Accipiter striatus	sharp-shinned hawk
Falco sparverius	American kestrel
Ictinia mississippiensis	Mississippi kite
Bubo virginianus	great horned owl
Otus asio	eastern screech-owl

SOURCE: Reference 73, Section 2.7.1.1

5.4.2 Aquatic Biota

5.4.2.1 Mississippi River

The Mississippi River and its tributaries drain a total of 1,245,000 square miles, which is 41 percent of the 48 contiguous states of the United States. The river basin spans 31 states and two Canadian provinces and is bounded on the west by the Rocky Mountains and on the east by the Appalachian Mountain Chain. Waters from New York as well as Montana contribute flows into the Mississippi. [Reference 77]

Beginning in Minnesota, the headwaters of the Mississippi flow southward for about 2,470 miles into the Gulf of Mexico [Reference 77]. Because the river is so vast, it has been broken into three segments, which contain a variety of habitat conditions and fisheries. The upper 512 miles from Lake Itasca to St. Anthony Falls, Minnesota is considered the headwaters of the Mississippi. This portion of the Mississippi flows alternately through forests and wetlands. Dams have been built to form 11 small reservoirs and modify the elevation and discharge of several natural river lakes. These dams variously function for flood control, electric generation, water supply, or recreation. [Reference 84]

The Upper Mississippi River reach stretches 668 miles from St. Anthony Falls to Alton, Illinois, a few miles above the confluence with the Missouri River. The Upper Mississippi River is impounded by 28 locks and dams built for commercial navigation and one dam (Keokuk, Iowa) built for navigation and hydropower generation. These dams are operated to maintain minimum navigation channel depth (9 feet); thus, the dams have little effect on the river stage and discharge during spring floods. [Reference 84]

Downstream from the confluence of the Missouri River, the Mississippi flows un-dammed to Head of Passes where it branches into several distributaries that carry water to the Gulf of Mexico [Reference 81]. The 195 miles reach from the mouth of the Missouri River to the mouth of the Ohio River is referred to as the Middle Mississippi River by management agencies. At the Missouri River confluence, water volumes in the Mississippi River almost double. The 976 miles reach from the Ohio River to Head of Passes is referred to as the Lower Mississippi River (LMR). Water from the Ohio River increases Mississippi River discharge 150 percent. Although discharge and channel size differ between the two reaches, they share similar hydrologic conditions, methods and levels of channelization and loss of connectivity with the historic floodplain. [Reference 76]

The LMR habitat near the GGNS site has the following features: backwater, river bank, and main channel. The main channel is deep with strong, turbulent currents and coarse grained substrate. Backwater habitat is associated with the large bend in the river at the site, which creates slow moving, relatively shallow, quiet water. The substrate in the backwaters is loosely consolidated, silty clay sediment of low plasticity. The river bank habitat is steep with swift current, consolidated, high-plastic clay substrate, and eroding slopes. [Reference 73, Section 2.7.2]

In the LMR, biological productivity is low due primarily to poor water quality. Heavy river traffic, high water velocity, floods, non-point source pollution and municipal and industrial water effluents contribute to poor water quality in the area [Reference 12, Section 3.4.1.1]. In addition, productivity of the system is limited by light penetration and high suspended solids concentrations, as well as stability and habitability of the available substrate. As a result, the

Mississippi River food chain is considered to be detrital-based because phytoplankton occurs in low densities and are not the primary energy source. This is typical of larger southeastern and Midwestern river systems. [Reference 12, Section 2.0]

Although primary productivity in the LMR is low, it is distinguished by extraordinary species richness with regard to fish. Plentiful habitat exist for fishes that thrive in swiftly flowing water but few species can tolerate the high current velocities of the upper and middle water column of the channel. The LMR is noted for its assemblages of large river fish, which include lamprey species (F. Petromyzontidae), sturgeon (F. Acipenseridae), the only North American paddlefish (*Polyodon spathula*), gar (*Lepisosteus* spp.), and the bowfin (*Amia calva*). [Reference 24] Many of these large river fish exhibit adaptations for the constantly turbid character of the Mississippi River. Species less tolerant of high current velocities likely inhabit areas near the banks and channel bottom where the current is less severe. [Reference 54, Section 2.2.2.5.2]

Only four percent of fish species are endemic to the LMR, and these are found in tributary drainages rather than in the Mississippi mainstem. These endemics include a shiner (*Notropis rafinesquei*), catfish (*Noturus hildebrandi*), killifish (*Fundulus euryzonus*), and a number of darters (*Percina aurora*, *Etheostoma chienense*, *E. pyrrhogaster*, *E. raneyi*, *E. rubrum, E. cervus* and *E. lynceum*). [Reference 24]

The dominant species in the Mississippi River based on numbers and weight are gizzard shad (*Dorosoma cepedianum*), freshwater drum (*Aplodinotus grunniens*), blue catfish (*Ictalurus furcatus*), and flathead catfish (*Pylodictis olivaris*). The numbers vary within the particular habitats of the river. In the backwater habitat, the dominant species are gizzard shad, blue catfish, river carpsucker (*Carpiodes carpio*), freshwater drum, and shovelnose sturgeon (*Scaphirhynchus platorynchus*). In the river bank, the dominant fish are gizzard shad, freshwater drum, silver chub (*Macrhybopsis storeriana*), flathead catfish, and blue catfish. [Reference 73, Section 2.7.2.1]

Benthic macroinvertebrate populations are most common in the backwaters of the riverine environment. Dipteran larvae (aquatic true fly larvae), tube-forming worms, and bivalves (mussels and clams) represent the dominant groups of macroinvertebrates. Where the river banks are stable (consolidated silt and clay), mayflies are the most common macroinvertebrate. The majority of the drifting macroinvertebrates are composed of dipteran pupae and larvae, predominantly of the genus *Chaoborus*. Another predominant invertebrate is the river shrimp (*Macrobrachium ohione*), located mainly along the river banks. [Reference 73, Section 2.7.2.1]

5.4.2.2 Hamilton and Gin Lakes

Hamilton and Gin are oxbow lakes on the GGNS site. These lakes are what remain of the former river channel after the Mississippi River moved to the west. Hamilton and Gin lakes are relatively small and shallow with characteristics similar to the backwater habitat. The surface area of these lakes has decreased since 1973, and the last estimates made in 2001 indicate the surface area of Hamilton Lake is 64 acres and Gin Lake is 55 acres. The average depth of these lakes is approximately 8 to 10 feet. However, during high-water events, the Mississippi River submerges these lakes. Hamilton Lake receives water from Streams A and B. Gin Lake is connected to Hamilton Lake via a culvert beneath Heavy Haul Road. [Reference 73, Section 2.7.2]

Based on preconstruction studies (1972 – 1973), Hamilton Lake had 46 fish species, and Gin Lake had 36 species. Several of the fish species in Hamilton and Gin lakes are thought to be from the Mississippi River. When the river floods the lakes, fish are brought into the area and then are trapped in the lakes when the flood waters recede. The difference in fish diversity between the two lakes was attributed to the connection of Hamilton to the river during periods when the river is not at flood stage. While more species were present in Hamilton Lake based on the study, the dominant fish were the same in both lakes. The top 80 percent of the population was made up of gizzard shad, bluegill (*Lepomis macrochirus*), threadfin shad (*Dorosoma petenense*), and largemouth bass (*Micropterus salmoides*). Several stragglers, fish that normally inhabit the river, were found in Hamilton and Gin lakes. [Reference 73, Section 2.7.2.1]

Benthic macroinvertebrates in Hamilton and Gin lakes more closely resemble the populations collected in the backwaters of the river. Chironomids, tubificid worms, and bivalves were the most dominant taxa. The composition and abundance of plankton in Hamilton and Gin lakes varied based on the frequency and duration of flooding by the river. When the lakes were not flooded, they developed distinct plankton populations. However, during flood events, the populations more closely resemble those characterized in the river. [Reference 73, Section 2.7.2.1]

5.4.2.3 Commercially and Recreationally Important Species

Commercial harvest of fishes in the LMR is difficult to assess because of inconsistencies in methods of gathering and reporting data. Limited information indicates commercial harvest is increasing. [Reference 12, Section 3.3.1.1] Valuable commercial catches from the LMR include buffalo fish (*Ictiobus* spp.), freshwater catfish (*Ictalurus* spp.), gar (*Lepisosteus* spp.) and freshwater drum (*Aplodinotus gunniens*) [Reference 54, Section 2.2.2.4.1]. Commercial fishing is limited in the area with most occurring on the Mississippi River near the GGNS site and on the Big Black and Bayou Pierre Rivers. Approximately twelve commercial fishing operations are in the area. They catch predominately catfish but also harvest bigmouth (*Ictiobus cyprinellus*) and smallmouth buffalo fish (*Ictiobus bubalus*). [Reference 73, Section 2.7.2.1]

Recreational species targeted most often in freshwater portions of the LMR include black bass (*Micropterus* spp.), catfish, crappie (*Pomoxi* spp.), gar, and carp (*Cyprinus* spp.). [Reference 11, Section 3.3]

5.4.2.4 Conclusion

The only anticipated activity that would affect the aquatic ecology of the site is the potential dredging of the barge slip to accommodate delivery of transformers and other heavy equipment associated with EPU in the event that the Port of Claiborne is determined to be infeasible. This activity would be conducted in accordance with the Section 404 Permit issued by the USACE. In general, this activity only affects a localized area for a brief period of time and therefore is short-lived. In addition, the USACE permitting process involves a site-specific evaluation of potential environmental impacts and appropriate mitigation measures associated with these type activities. Therefore the impact to aquatic communities, as a result of EPU, is considered minimal and is consistent with the NRC's conclusion in Revision 1 to NUREG-1437, which states that impacts of dredging has not been found to be a problem at operating nuclear power plants [Reference 74, Section S.5]. Therefore impacts to the aquatic community would be SMALL.

5.4.3 Cooling Tower Drift, Icing, and Fog

There are no nearby major transportation corridors (air, water or ground) or commercial facilities that would be affected by icing or fogging from GGNS' cooling tower operations. Any icing that may occur during sub-freezing temperatures would be restricted to the site property and the only area that could potentially be affected by fogging is a portion of a county road (Bald Hill Road) that parallels the GGNS facility.

Based on operational monitoring that was conducted in accordance with a previous Environmental Protection Plan (Appendix B to the GGNS Operating License) requirement, it was determined that there were no discernible impacts on vegetation as a result of drift from the natural draft cooling tower. NRC also concluded in the 1981 GGNS FES (NUREG-0777) that the effects of drift on terrestrial ecosystems from a two-unit, two cooling tower site would be insignificant [Reference 69, Summary and Conclusions]. Therefore, even though evaporation and drift would increase somewhat due to the additional cells being installed in the auxiliary cooling tower to accommodate EPU, impacts from drift would still be bounded by the GGNS FES.

In conclusion, the NRC has reviewed and evaluated impacts from drift, icing, and fogging with cooling tower operation in NUREG-1437 and determined that it was not a problem at operating nuclear power plants [Reference 71, Table 9.1]. Based on the discussion above, NRC's conclusion are valid for EPU. Therefore, impacts would be SMALL.

5.4.4 Impingement and Entrainment

Since GGNS does not have an intake structure that withdraws surface water directly from the Mississippi River, no entrainment and impingement of organisms would occur. Therefore, this issue is not applicable and thus there are no associated impacts.

5.4.5 Thermal Discharges

The circulating water system, which provides the main condenser with a continuous supply of cooling water to remove the heat rejected from the condensation cycle, is a closed system utilizing a natural draft cooling tower and a mechanical draft auxiliary cooling tower. Two vertical motor-driven pumps circulate the cooling water from the cooling tower basin through the main condenser and then back to the cooling towers. Makeup water, to compensate for drift, blowdown, and evaporation losses, is supplied from the plant service water system by means of the radial wells. [Reference 49, Section 1.2.2.5.7]

The natural draft cooling tower is designed to operate alone or in conjunction with the auxiliary cooling tower to dissipate all excess heat removed from the main condensers, while the auxiliary cooling tower is designed to operate in conjunction with the natural draft cooling tower only. [Reference 49, Section 1.2.2.2]

The circulating water system is designed to supply the main condenser with cooling water at temperatures ranging from 37°F to 97°F when the mechanical draft auxiliary cooling tower is not in service. With the natural draft and auxiliary cooling towers both in service, the maximum cooling water temperature to the main condenser is expected to be less than 90°F. [Reference 49, Section 10.4.5.2] As a note, the auxiliary cooling towers remain in service year round, with the exception of a short period (i.e., hours) when they are taken out of service for cleaning.

Therefore, water being supplied to the condenser is anticipated to be less than 90°F year round. The main condenser is designed for the following conditions at normal full load: Flow (572,000 gpm), inlet temperature (85°F), and outlet temperature (115°F) [Reference 49, Section 10.4.1.1]

As previously discussed in Section 5.3.2.1, the massive nature of the Mississippi River makes the discharges from the GGNS facility undetectable within the overall flow regime, and any changes in the quality are small and localized compared to the overall width of the river. [Reference 73, Section 2.6.3.1] Thermal effluents associated with cooling tower blowdown (NPDES Outfall 002) are combined with other plant effluents from NPDES Outfalls 004, 005, 006 and 011, and conveyed via a 54-inch diameter outlet pipe (NPDES Outfall 001) to a discharge structure on the Mississippi River (~0.75 mile), which is located on the south bank of the GGNS barge slip, about 300 feet from the mouth of the barge slip. The velocity of the plant discharge flow at the exit of the barge slip varies with the river stage since the discharge pipe exit is under water during certain periods of the year. [Reference 69, Section 4.2.4]

The conditions associated with thermal discharges as outlined in Part II, Section D.3 of GGNS NPDES Permit MS0029521 are as follows:

> *The receiving water shall not exceed a maximum water temperature change of 2.8°C (5.0°F) relative to the upriver temperature, outside a mixing zone not exceeding a maximum width of 60 feet from the river edge and a maximum length of 6,000 feet downstream from the point of discharge, as measured at depth of 5 feet The river edge shall be determined as being no further east than the mouth of the barge slip. The maximum water temperature shall not exceed 32.2°C (90°F) outside the same mixing zone, except when ambient temperatures approach or exceed this value. Thermal monitoring shall be performed any time the river stage is less than 0.5 feet (Vicksburg gauge) during winter months (November - April) or, is less than minus 1.2 feet (Vicksburg gauge) during summer months (May - October). If these conditions occur and the plant is generating power, monitoring shall be performed upriver at PT. I (surface/5 feet subsurface), Discharge Outlet, Barge Slip Outlet, and down river at PT. 7. However, once monitoring has been performed at river stages less than those cited (0.5 feet during the winter months and minus 1.2 feet during the summer), the river stage which existed at the time of thermal monitoring, will then become the standard river stage during which a subsequent monitoring exercise must be performed if the river falls below that stage. Thorough documentation shall be maintained on file of the river stage during each period of the thermal monitoring. This policy is subject to modification if any data collected during a particular river stage indicates temperature variations not previously measured…*

GGNS is also required by the NPDES Permit to conduct thermal monitoring during the winter and summer months preceding the submittal year of the permit renewal application and include those results in the submittal [Reference 29, Part III, Section D.3]. Based on previous years of operational experience, GGNS has not violated the thermal conditions outlined in the permit.

As a result of the technical reviews and analyses conducted, it was determined that although the heat load would increase as a result of EPU, the thermal discharge associated with GGNS operations would continue to remain at current operating temperatures, and most likely decrease approximately 3ºF due to the additional cooling cells being installed in the auxiliary cooling tower. As previously stated above, the auxiliary cooling towers operate in conjunction with the natural draft cooling tower year round. Therefore, the temperature of the cooling water being supplied to the condenser is not increasing, which ensures that the thermal conditions outlined in the GGNS NPDES Permit continue to be met.

Therefore, there would be no impacts on aquatic biota that are different in kind or greater in magnitude than those identified in the GGNS FES and no changes would be necessary to the thermal conditions outlined in the NPDES Permit. In addition, the NRC determined in NUREG-1437 that potential effects from closed-cycle cooling systems have not been shown to cause reductions in the aquatic populations near any existing nuclear power plants [Reference 71, Section 4.3.3]. Therefore, thermal impacts would be SMALL.

5.4.6 Cold Shock

Cold shock occurs when organisms that have been acclimated to warm water (e.g., in a discharge canal in winter) are exposed to sudden temperature decreases when artificial heating ceases. Such situations may occur when a single-unit power plant suddenly shuts down in winter or when winds or currents shift a thermal plume that was occupied by fish or benthic invertebrates seeking warm water. [Reference 71, Section 4.2.2.1.5]

At GGNS, the potential for a cold shock fish kill during the winter is minor, and the potential for this kill having a detrimental effect on the fish community is insignificant, because of (1) the low volume of blowdown discharge in relationship to the flow rate of the Mississippi River, and (2) the depauperate fauna and flora inhabiting the stabilized shoreline downstream of the discharge structure and barge slip. [Reference 69, Section 5.6.2] The NRC also concluded in the GEIS (NUREG-1437) that impacts from cold shock events are of small significance. [Reference 71, Section 4.2.2.1.5].

Since there have been no cold shock fish kill events observed at the discharge structure and barge slip area, the conclusions reached by the NRC staff in the GGNS FES (NUREG-0777) and GEIS (NUREG-1437) continue to remain valid for EPU conditions. Therefore, impacts would be SMALL.

5.4.7 Threatened and Endangered Species

5.4.7.1 Federally-Listed Species

Species currently protected under the Endangered Species Act, including candidate species, that may potentially be present in the vicinity of the site include three (3) mammals, four (4) birds, one (1) reptile, four (4) fish, and one (1) plant. These are the Florida panther *(Puma concolor coryi)*, Louisiana black bear *(Ursus americanus luteolus)*, American black bear (*Ursus americanus*), interior least tern (*Sterna antillarum athalassos*), red-cockaded woodpecker (*Picoides borealis*), peregrine falcon (*Falco peregrinus*), wood stork (*Mycteria americana),* american alligator (*Alligator mississippiensis*), pallid sturgeon (*Scaphirhynchus albus*), bayou darter (*Etheostoma rubrum*), fat pocketbook mussel (*Potamilus capax*), rabbitsfoot mussel *(Quadrula cylindrical),* and the pondberry (*Lindera melissifolia*).

Since EPU activities are limited to the GGNS property and no changes to in-scope transmission lines are occurring including right-of-way management practices, the discussion below focuses only on species that have the potential to be present on the GGNS site (Table 5.4-2).

- There are currently no viable populations of the Florida panther that occur outside of Florida [Reference 73, Section 5.4.3.1]. Therefore, potential impacts on Florida panthers associated with EPU activities would be SMALL.

- It is likely that the Louisiana black bear occurs on and in the vicinity of the GGNS site and potentially could be initially affected by noise from cooling tower operation. However, if present, the bear likely has become accustomed to noise produced by the existing GGNS cooling tower. [Reference 73, Section 5.4.3.1] In addition, habitat typically associated with this species would not be disturbed as a result of EPU activities. Thus, potential impacts on this species would be SMALL.

- The American black bear is listed as threatened in the historic range of the Louisiana black bear (southern Mississippi, Louisiana, and east Texas) due to its similarity of appearance [Reference 3]. Similar to the Louisiana black bear, it is possible that the American black bear occurs on and in the vicinity of the GGNS site and potentially could be initially affected by noise from cooling tower operation. However, if present, the bear likely has become accustomed to noise produced by the existing GGNS cooling tower. In addition, habitat typically associated with this species would not be disturbed as a result of EPU activities. Thus, potential impacts on this species would be SMALL.

- Non-breeding wood storks have been known to occur on and in the near vicinity of the GGNS site. Wood storks were observed in summer on Gin and/or Hamilton lakes during 18 years prior to construction of GGNS. The wood stork should currently be considered a possible non-breeding transient to the GGNS and vicinity. [Reference 73, Section 2.7.1.1] The only EPU activity involving land disturbance is the installation of a new radial well, improvements to Heavy Haul Road, and potential dredging activities in the barge slip in the event that the Port of Claiborne is determined to be infeasible. Procedures are in place at GGNS to ensure that threatened and endangered species are adequately protected, if present, during operations and project planning [Reference 13]. Therefore, impacts are anticipated to be SMALL.

- The nearest areas occupied by least terns upstream and downstream from the GGNS site (RM 405) were at Yucatan Dikes (RM 409.8), Togo Island Dikes (RM 413.6), and Below Bondurant Towhead Dikes (RM 393.0) [Reference 73, Section 5.4.3.1]. Therefore, potential impacts on interior least terns associated with EPU activities would be SMALL.

- The red-cockaded woodpecker is not known to exist in Claiborne County and would thus not be affected by activities associated with the EPU. [Reference 73, Section 5.4.3.1] Therefore, potential impacts associated with EPU activities on this species would be SMALL.

- The peregrine falcon is a crow-sized bird 16 – 20 inches in length with a wing spread of approximately 36 – 44 inches. The peregrine falcon formerly bred from Alaska and Greenland south to Georgia and Baja California, southern South America, Eurasia, Africa, and Australia. It was at one time absent from much of the eastern United States and Europe, although populations in eastern North American have rebounded. There are no breeding records of the peregrine falcon from Mississippi. Chemical pesticides (chlorinated hydrocarbons – specifically DDT) caused eggshell thinning which reduced the breeding success of this species. Since activities associated with EPU would not impact falcon habitat, nor involve the use of pesticides, impacts to this species would be SMALL. [Reference 61]

- The only Federally listed animal species actually known to inhabit the GGNS site is the threatened American alligator. However, the alligator is listed only because of its similarity of appearance to the American crocodile (*Crocodylus acutus*). American alligator populations are considered disjunct, limited to available habitat but stable. [Reference 73, Section 5.4.3.1] Although the alligator is present onsite, potential impacts as a result of EPU activities would be SMALL since areas typically inhabited by this species would not be disturbed.
- Pallid sturgeon have been collected in the region of the GGNS site. Adult pallid sturgeon have been caught in regions with moderate to strong currents and a sand or sand/gravel substrate, similar to the main channel of the Mississippi River as it passes by the GGNS site. Little is known about the use of the Mississippi River in the area of the GGNS site for spawning by the pallid sturgeon. Spawning habitat may exist within 10 miles of the site. There also is little information about the use of the reach by larvae or juvenile pallid sturgeon. [Reference 73, Section 5.4.3.1] Since GGNS does not have an intake structure, and activities associated with EPU do not affect areas where this species may potentially be present, impacts would be SMALL.
- The bayou darter is endemic to Bayou Pierre and its tributaries, which flow as close as 1.9 miles east of the GGNS site [Reference 73, Section 5.4.3.1]. Since GGNS does not have an intake structure, and activities associated with EPU do not affect areas where this species may potentially be present, impacts would be SMALL.
- The fat pocketbook mussel was historically found throughout the Mississippi River drainage from Minnesota to Louisiana. In 2003, the mussel was found near Vicksburg in the Mississippi River, as well as south of the GGNS Site. The adult mussels are found in sand and mud as well as in stable substrates of fast flowing rivers. Little information is available on the reproduction of the fat pocketbook mussel; however, they are thought to be similar to other freshwater mussels. [Reference 73, Section 5.4.3.1] Since GGNS does not have an intake structure, and activities associated with EPU do not affect areas where this species may potentially be present, impacts would be SMALL.
- The rabbitsfoot mussel *(Quadrula cylindrical),* a Candidate Species, is an historical resident of the Bear Creek, Big Sunflower River and Big Black River watersheds. Population declines can be attributed to water-quality degradation, loss of stable substrates, sedimentation, channelization, gravel milling, dredging, impoundments, and competition of exotic mussel species. [Reference 82] Since GGNS does not have an intake structure, and activities associated with EPU do not affect areas where this species may potentially be present, impacts would be SMALL.
- The pondberry is associated with wetland habitats such as bottomland hardwoods in the interior areas, and the margins of sinks, ponds and other depressions in the more coastal sites. The plants generally grow in shaded areas. The most significant threats are drainage and subsequent conversion of its habitat to other uses. Pondberry is known to occur in six states in the southeast, including Arkansas, Georgia, Missouri, Mississippi, North Carolina, and South Carolina. This species' historical range also included Alabama, Louisiana, and Florida. In Mississippi, four populations are known to occur in the Yazoo Delta Region in Bolivar, Sharkey, Sunflower, and Tallahatchie counties. [Reference 61] None have been identified in Claiborne County; therefore, impacts from EPU would be SMALL.

5.4.7.2 State-Listed Species

The Mississippi Natural Heritage Program (MNHP) has designated twelve (12) species as threatened while the Louisiana Natural Heritage Program (LNHP) has designated five (5) species as either threatened or endangered that could potentially be present in the vicinity of GGNS. These species collectively include the Florida panther, Louisiana black bear, American Black Bear, bald eagle *(Haliaeetus leucocephalus),* wood stork (*Mycteria americana),* interior least tern, red-cockaded woodpecker, pallid sturgeon, bayou darter, crystal darter (*Crystallaria asprella*), fat pocketbook mussel, and the pondberry. An additional three (3) species have been designated by the MNHP as species of special concern: white ibis (*Eudocimus albus*), sicklefin chub (*Macrhybopsis meeki*), and robust baskettail (*Epitheca spinosa*).

Since EPU activities are limited to the GGNS property and no changes to in-scope transmission lines are occurring including right-of-way management practices, the discussion below focuses only on species that have the potential to be present on the GGNS site and species not already discussed above (Table 5.4-2).

- Bald eagle occurrences have not been reported within 10 miles of the GGNS site [Reference 73, Section 5.4.3.1]. Since activities associated with EPU are occurring on the GGNS site only, potential impacts on bald eagles would be SMALL.

- The White Ibis breeds coastally from Louisiana east along the Gulf Coast. They occur inland across Florida, and along the Atlantic coast as far north as the Carolinas. The non-breeding range extends further inland, north to Virginia, and west to eastern Texas. The main threats to the White Ibis are human disturbance and habitat loss. Nesting adults are particularly sensitive to disturbance, and eggs and chicks left alone due to human intrusion are susceptible to predation. Since the species nests in large groups, nest disturbance, even by well-meaning researchers, can have devastating effects on a colony. [Reference 6] The only EPU activity involving land disturbance is the installation of a new radial well, improvements to Heavy Haul Road, and potential dredging activities in the barge slip in the event that the Port of Claiborne is determined to be infeasible. Procedures are in place at GGNS to ensure that threatened and endangered species are adequately protected, if present, during operations and project planning [Reference 13]. Therefore, impacts are anticipated to be SMALL.

- The crystal darter has a historical range throughout the Mississippi, Missouri, and Ohio Rivers. The crystal darter is a large, cigar-shaped fish, which is bi-colored with the lower half being white or silvery. These fish live in swift areas of sand and gravel raceways of large rivers. Crystal darters are found in the Bayou Pierre River and tributaries, which flow as close as 1.9 miles east of the GGNS site [Reference 73, Section 2.7.2.1] Since GGNS does not have an intake structure, and activities associated with EPU do not affect areas where this species may potentially be present, impacts would be SMALL.

- The sicklefin chub is listed by MNHP as a species of special concern, critically imperiled in Mississippi because of extreme rarity or some factors making it vulnerable to extirpation. It is not federally listed as either threatened or endangered. Based on current understanding of this species, it is believe that the sicklefin chub historically occurred in approximately 85 miles of the Lower Yellowstone River, approximately 1,950 miles of the main stem Missouri River, and about 1,150 miles of the Mississippi River, below the mouth of the Missouri River [Reference 4]. Since GGNS does not have an intake structure, and activities associated with EPU do not affect areas where this species may potentially be present, impacts would be SMALL.

- The robust baskettail has a robust abdomen with a mild constriction at the base; the cerci are distinct with a protuberance dorsally (visible in the lateral view) and the cerci appear more or less parallel in dorsal view. Habitat information on the baskettail in Mississippi is limited. The only EPU activity involving land disturbance is the installation of a new radial well, improvements to Heavy Haul Road, and potential dredging activities in the barge slip in the event that the Port of Claiborne is determined to be infeasible. These activities would be temporary and of limited aerial extent, and thus any impact to this species would be SMALL.

5.4.7.3 Conclusion

Based on the information above, there would no adverse impact on any federally or state listed species that may exist on or pass through the GGNS facilities as a result of EPU. As discussed in Section 5.1.1 above, the only EPU activity involving land disturbance is the installation of a new radial well, improvements to Heavy Haul Road, and potential dredging activities in the barge slip in the event that the Port of Claiborne is determined to be infeasible. These activities would be managed in accordance with the USACE's Section 404 permitting process, MDEQ's stormwater permitting program (Permit Number MSR15), and GGNS' existing Baseline Stormwater General NPDES Permit MSR000883, as appropriate. There would also be no changes in the characteristics of discharges associated with GGNS NPDES Permit MS0029521 that would affect any federally or state listed species as a result of EPU.

The U. S. Fish and Wildlife Services and the MNHP were contacted for input on listed threatened or endangered species in the vicinity of GGNS [References 8, 9 and 85]. Based on responses received from these agencies, no issues were identified that would impact federally or state-listed species as a result of EPU [References 64, 82, and 83]. In addition as previously stated, Entergy has procedural controls in place to ensure that threatened and endangered terrestrial species are adequately protected, if present, during operations and project planning [Reference 13]. Therefore, impacts from EPU activities would be SMALL.

Table 5.4-2

Federal and State-Listed Species in Vicinity of GGNS

Scientific Name	Common Name	Federal Status	MS Status	LA Status	On-Site	Vicinity (6-mile)	Transmission ROW
Mammals							
Puma concolor coryi	Florida Panther	E	E	E	No	No	No
Ursus americanus luteolus	Louisiana Black Bear	T	E	T	Yes[3,4,5,6]	Yes[3,4,5,6]	Yes[5]
Ursus americanus	American Black Bear	T	E	_	Yes[7]	Yes[7]	Yes[7]
Birds							
Haliaeetus leucocephalus	Bald Eagle	_	E	E	Yes	Yes[6]	Yes
Mycteria americana	Wood Stork	E	E	_	Yes[7]	Yes[7]	Yes[7]
Sterna antillarum athalassos	Interior Least Tern	E*	E*	E	No[3]	Yes[6]	Yes[6]
Picoides borealis	Red-Cockaded Woodpecker	E	E	_	No[3]	No[5,6]	Yes[5]
Falco peregrinus	Peregrine Falcon	E	_	_	No[3]	No[5]	Yes[5]
Eudocimus albus	White Ibis	_	S2, S3	_	Yes[7]	Yes[7]	Yes[7]
Reptiles							
Alligator mississippiensis	American Alligator	T (S/A)	_	_	Yes[3]	Yes	Yes
Fish							
Scaphirhynchus albus	Pallid Sturgeon	E	E	E	Yes[3]	Yes[6]	No
Etheostoma rubrum	Bayou Darter	T	E	_	No[3]	Yes[5]	No
Crystallaria asprella	Crystal Darter	_	E	_	Yes[3]	Yes[3,5]	No
Potamilus capax	Fat Pocketbook Mussel	E	E	_	No[1]	No[5,6]	Yes[5]
Quadrula cylindrical	Rabbitsfoot Mussel	CS	_	_	No	Yes[8]	Yes[8]
Macrhybopsis meeki	Sicklefin Chub	_	S1	_	Yes[7]	Yes[7]	_

Table 5.4-2 (Continued)

Federal and State-Listed Species in Vicinity of GGNS

Scientific Name	Common Name	Federal Status	MS Status	LA Status	On-Site	Vicinity (6-mile)	Transmission ROW
Insects							
Epitheca spinosa	Robust Baskettail	_	S1	_	Yes[7]	Yes[7]	_
Plants							
Lindera melissifolia	Pondberry	E	E	_	No[3]	No[5,6]	Yes[2]

T = Threatened
E = Endangered
CS = Candidate Species
S1 = Critically Imperiled in Mississippi
S2 = Imperiled in Mississippi
S3 = Rare or uncommon in Mississippi
T (S/A) = Threatened by similarity of appearance.

* Interior least terns belong to a subspecies of least terns and are protected Federally, and by the state of Mississippi under the species name. *Sterna antillarum athalassos* is the subspecies endemic to the project region and is therefore specified above.

SOURCES:
1 - Reference 5
2 - Reference 79
3 - Reference 63
4 - Reference 80
5 - Reference 62
6 - Reference 55
7 - Reference 64
8 - Reference 82

5.5 Historic and Cultural Resources

During the GGNS Unit 3 COLA process and at the recommendation of the Mississippi Department of Archives and History (MDAH), a Phase I archaeological survey was conducted in 2007 in conjunction with the GGNS Unit 3 COLA effort, on two onsite study areas totaling approximately 115 acres of a well dissected upland landform using a combination of shovel testing and pedestrian surveys. Eleven archaeological sites and eight isolated finds/small artifact scatters were identified during this survey. One historic site within the study area and located south of the plant in a wooded 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. [Reference 45, Section 2.5.3] The MDAH required no further actions from GGNS provided that no construction activities occurred in this specific area.

Other areas discussed in NUREG-1817 in conjunction with the GGNS ESP process included the Grand Gulf Mound, the Callendar House and the Grand Gulf and Port Gibson Railroad. The Grand Gulf Mound located on a terrace on the bluffs overlooking the Mississippi River has been excavated by the MDAH; therefore little remains of the mound. The Callendar House site was considered an unrecorded archaeological resource, as subsurface archaeological deposits probably exist. However, the site likely would not be considered eligible for listing on the NRHP because of a lack of integrity. Finally, a 300-feet segment of an important 19th century historic railroad, known as the Grand Gulf and Port Gibson Railroad, still exists within the site boundary. The steel rails are gone, but the railroad bed exists in good condition. [Reference 73, Section 2.9.2]

As discussed in Section 5.1.1 above, the only EPU activity involving land disturbance is the installation of a new radial well, Heavy Haul Road improvements, and potential dredging activities in the barge slip which would be evaluated and managed in accordance with the USACE's Section 404 permitting process, MDEQ's stormwater permitting program (Permit Number MSR15), and GGNS' existing Baseline Stormwater General NPDES Permit MSR000883, as appropriate.

EOI also has a fleet procedure in place for management of cultural resources ahead of any future ground-disturbing activities at the plant. This procedure, which requires reviews, investigations and consultations as needed, ensures that existing or potentially existing cultural resources are adequately protected and assists EOI in meeting state and federal expectations. [Reference 14] Based on EOI's review of the activities associated with EPU, it was determined that cultural resources would be unaffected. EOI also consulted with the MDAH regarding land disturbance activities associated with the EPU project [References 10 and 86]. The MDAH determined that no historic properties would be affected as a result of EPU activities [References 56 and 57]. Therefore, impacts would be SMALL.

5.6 Socioeconomics

GGNS is one of the largest, stable employers in a four-county region (Claiborne, Copiah and Franklin Counties in Mississippi and Tensas Parish in Louisiana), and the largest single contributor, by far, to the local tax base. In addition, GGNS personnel have higher incomes than the area on average and contribute significantly to the local tax base by payment of sales taxes and property taxes. Many GGNS personnel are actively involved in volunteer work within the local community and contribute to local service agencies. All these activities have a positive impact on the local and regional economies.

5.6.1 Current Economic Structure

GGNS currently employs approximately 690 people on a full-time basis (see Table 5.6-1 for employee distribution by county, state and city). This workforce is typically augmented by an additional 700 - 900 persons on average during regularly scheduled refueling outages. Employment at GGNS benefits local and regional economies as employee salaries flow through the communities purchasing good and services and contributing income, sales, and personal property taxes.

In addition, taxes paid by GGNS are significant. Mississippi Code Title 27 addresses taxation of nuclear generating plants and the distribution of tax revenues from nuclear plants (Mississippi Tax Code 2003). This code states that any nuclear generating plant located in the State, which is owned or operated by a public utility rendering electric service within the State, is exempt from county, municipal, and district ad valorem taxes. In lieu of the payment of county, municipal, and district ad valorem taxes, the nuclear power plant owner pays the State Tax Commission a sum based on the assessed value of the nuclear generating plant. [Reference 73, Section 2.8.2.3]

GGNS is taxed by the State for a sum equal to 2 percent of the assessed value but not less than $20 million annually. At least $7.8 million goes to Claiborne County. Of this amount, $3 million is allocated contingent upon Claiborne County upholding its commitment to the GGNS offsite emergency plan. The $7.8 million represents roughly 83 percent of all Claiborne County revenues. [Reference 73, Section 2.8.2.3]

The Mississippi State Tax Commission transfers $160,000 annually to the town of Port Gibson provided that the city maintains its commitment to the GGNS offsite emergency plan. Ten percent of the remainder of the payments is transferred from the Mississippi State Tax Commission to the General Fund of the State. The balance of the tax revenue from the GGNS site is transferred to the counties and municipalities in the state of Mississippi where electric service is provided. The tax revenues are distributed in proportion to the amount of electric energy consumed by the retail customers in each county, with no county receiving an excess of 20 percent of the funds. This distribution, based on energy consumed, also includes Claiborne County. [Reference 73, Section 2.8.2.3]

Based on the taxes paid by GGNS in the sum of $20 million dollars annually, communities in the vicinity of GGNS would continue to benefit from tax payments that are distributed to the local areas. In addition, public services such as public education, police and fire protection, roads maintenance, and other municipal services are funded in part through tax revenues.

5.6.2 Extended Power Uprate Impacts to Socioeconomics

The proposed EPU is not anticipated to affect the size of the regular workforce. Workforce numbers for the 2012 outage, when the EPU modifications would be completed, would be somewhat larger than previous outages, but would be of short duration and of such a magnitude as to not adversely affect housing availability, transportation services, or public utilities such as public water supply systems in the plant vicinity. Employee incomes and the purchases of goods and services afforded by those incomes along with the personal property taxes paid would continue to contribute positively to the communities in the vicinity of GGNS. Increasing GGNS' licensed power level would not affect taxes paid by the site. Payments made to engineering and consulting firms, equipment suppliers, and service industries for implementation of the proposed

EPU would have a positive, though unsustained impact on local and regional economies. Additionally, there would be the economic benefit to both the regional and local economies of the enhanced viability of GGNS' long-term operation resulting from the additional electrical generation.

5.6.3 Conclusion

The socioeconomic impacts of implementing the proposed EPU at GGNS include the positive contribution to the local and regional economies of payments for goods and services associated with the proposed action. Additionally, the continuation of employment of the local population with the associated expenditures for goods and services and contributions to income, sales, and property taxes along with the continuation of tax payments by GGNS would both positively impact local and regional economies. Therefore, any negative socioeconomic impacts associated with EPU would be SMALL.

Table 5.6-1

GGNS Employee Residence Information (November 2009)

County, State, and City	Employees (Entergy and Baseline Contractors)
Adams (Mississippi)	**30**
Natchez	29
Washington	1
Attala (Mississippi)	**1**
Patterson	1
Claiborne (Mississippi)	**142**
Hermanville	11
Pattison	9
Port Gibson	122
Copiah (Mississippi)	**31**
Crystal Springs	5
Hazelhurst	11
Wesson	15
Franklin (Mississippi)	**10**
Meadville	7
Roxie	3
Hinds (Mississippi)	**94**
Bolton	1
Byram	5
Clinton	44
Edwards	7
Jackson	8
Raymond	13
Terry	7
Utica	9
Jefferson (Mississippi)	**82**
Fayette	50
Lorman	32
Lawrence (Mississippi)	**1**
Silver Creek	1
SOURCE: Reference 46	

Table 5.6-1 (Continued) GGNS Employee Residence Information (November 2009)	
County, State, and City	**Employees (Entergy and Baseline Contractors)**
Lee (Mississippi)	**1**
Belden	1
Lincoln (Mississippi)	**23**
Brookhaven	23
Madison (Mississippi)	**11**
Canton	1
Madison	6
Ridgeland	4
Neshoba (Mississippi)	**1**
Philadelphia	1
Newton (Mississippi)	**1**
Chunky	1
Pike (Mississippi)	**2**
McComb	1
Summit	1
Rankin (Mississippi)	**8**
Brandon	4
Florence	2
Pearl	1
Star	1
Warren (Mississippi)	**240**
Vicksburg	240
Wilkinson (Mississippi)	**2**
Centerville	1
Woodville	1
Houston (Alabama)	**1**
Dothan	1
Pope (Arkansas)	**1**
Hector	1
SOURCE: Reference 46	

Table 5.6-1 (Continued)

GGNS Employee Residence Information (November 2009)

County, State, and City	Employees (Entergy and Baseline Contractors)
Cobb (Georgia)	**1**
Marietta	1
Claiborne (Louisiana) *	**1**
Homer	1
Concordia (Louisiana) *	**3**
Ferriday	1
Ridgecrest	1
Vidalia	1
Madison (Louisiana) *	**2**
Tallulah	2
Richland (Louisiana) *	**1**
Delhi	1
TOTAL	**690**

SOURCE: Reference 46

* **Based on Parish, State and City.**

5.7 Environmental Justice

5.7.1 Regional Population

The Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS) presents a population characterization method that is based on two factors: "sparseness" and "proximity" [Reference 71, Section C.1.4]. "Sparseness" measures population density and city size within 20 miles of a site and categorizes the demographic information as follows.

Demographic Categories Based on Sparseness

Category		
Most sparse	1.	Less than 40 persons per square mile and no community with 25,000 or more persons within 20 miles
	2.	40 to 60 persons per square mile and no community with 25,000 or more persons within 20 miles
	3.	60 to 120 persons per square mile or less than 60 persons per square mile with at least one community with 25,000 or more persons within 20 miles
Least sparse	4.	Greater than or equal to 120 persons per square mile within 20 miles

Reference: Reference 71

"Proximity" measures population density and city size within 50 miles and categorizes the demographic information as follows.

Demographic Categories Based on Proximity

Category		
Not in close proximity	1.	No city with 100,000 or more persons and less than 50 persons per square mile within 50 miles
	2.	No city with 100,000 or more persons and between 50 and 190 persons per square mile within 50 miles
	3.	One or more cities with 100,000 or more persons and less than 190 persons per square mile within 50 miles
In close proximity	4.	Greater than or equal to 190 persons per square mile within 50 miles

SOURCE: Reference 71

The GEIS then uses the following matrix to rank the population in the vicinity of the plant as low, medium, or high.

GEIS Sparseness and Proximity Matrix					
		Proximity			
		1	2	3	4
Sparseness	1	1.1	1.2	1.3	1.4
	2	2.1	2.2	2.3	2.4
	3	3.1	3.2	3.3	3.4
	4	4.1	4.2	4.3	4.4

Low Population Area	Medium Population Area	High Population Area

SOURCE: Reference 71

Port Gibson, located approximately 6 miles to the southeast, is the closest town to the GGNS site with a 2000 Census population of 1,840. The U.S. Census Bureau indicates that Port Gibson's population declined by 9.3 percent to an estimated 2008 population of 1,668. The majority of the population in this area is African American. Four towns with higher population densities are located within the 50-mile radius of the GGNS site. Vicksburg, Mississippi, located 25 miles to the north-northeast, had a 2000 Census population of 26,407 and declined by 5.4 percent to a 2008 estimated population of 24,974. Clinton, Mississippi located to the northeast and Natchez, Mississippi, located to the southwest had 2000 U.S. Census populations of 23,347 and 18,464, respectively. Clinton's population rose by 12.7 percent and had a 2008 estimated population of 26,313. The population of Natchez declined by 11.3 percent with a 2008 estimated population of 16,413. Jackson, Mississippi, the largest nearby metropolitan area, located about 55 miles northeast of the site, had a 2000 Census population of 184,256. Jackson's population has declined by 5.6 percent with an estimated 2008 population of 173,861. Except for Clinton, MS, the population of the listed cities has decreased since 2000. However, the overall population in the state of Mississippi has risen by 3.2 percent, from 2,844,658 in 2000 to an estimated population of 2,938,618 in 2008. [Reference 33, Section 2.5.2.3; Reference 78]

The 2000 census data indicates that approximately 26,225 people live within a 20-mile radius of the site, which equates to a population density of 21 persons per square mile [Reference 53]. According to the GEIS sparseness index, the site is classified as Category 1 sparseness (having less than 40 persons per square mile within 20 miles). The 2000 census data indicates that approximately 323,096 people live within a 50-mile radius of the site, which equates to a population density of 41 persons per square mile [Reference 53]. According to the GEIS proximity index, the site is classified as Category 1 proximity (less than 50 persons per square mile within 50 miles). According to the GEIS sparseness and proximity matrix, the combination of sparseness Category 1 and proximity Category 1 results in the conclusion that the site is located in a "low" population area.

Population data for the areas surrounding GGNS indicate low population densities and a rural setting. The larger population centers to the north, northeast, and southwest provide employment, services, and entertainment for the region. Rural communities, similar to Port Gibson are located throughout the outlying areas, and provide limited services. [Reference 33, Section 2.5.2.4]

5.7.2 Minority and Low-Income Populations

5.7.2.1 Background

Environmental justice refers to a Federal policy under which each executive agency identifies and addresses, as appropriate, disproportionately high and adverse impacts on human health or environmental effects of its programs, policies, and activities on minority or low-income populations. Executive Order 12898 (59 FR 7629) directs Federal executive agencies to consider environmental justice under the National Environmental Policy Act of 1969. [Reference 73, Section 2.10]

The geographic distribution of minority and low-income populations within 50 miles of the GGNS site was examined employing the 2000 census block group data for low-income and minority populations. The populations within 50 miles of the GGNS site encompass parts of sixteen counties in Mississippi and nine parishes in Louisiana. [Reference 73, Section 2.10]

A minority population is defined to exist if the percentage of each minority, or aggregated minority category within the census block groups located within 50 miles of the GGNS site, exceeds the corresponding percentage of minorities in the entire state of Mississippi or Louisiana by 20 percent, or if the corresponding percentage of minorities within the census block group is at least 50 percent. A low-income population is defined to exist if the percentage of low-income population within a census block group exceeds the corresponding percentage of low-income population in the entire state of Mississippi or Louisiana (as applicable) by 20 percent, or if the corresponding percentage of low-income population within a census block group is at least 50 percent. [Reference 73, Section 2.10]

Based on 2000 census block group data for the identification of minority and low-income block groups within the 50-mile radius of the GGNS site, the 50-mile radius includes 129 census block groups for minority populations and 34 census block groups for low-income populations. Both Mississippi and Louisiana have relatively large percentages of low-income and minority persons. [Reference 73, Section 2.10]

5.7.2.2 Minority Populations

Minority populations are present in all of the counties and parishes within the 50-mile radius of the GGNS site. Minority populations are primarily concentrated on the Mississippi side of the river in Claiborne and Jefferson counties, and Hinds County has the largest number of minorities. Claiborne County is entirely composed of minority block groups and contains 10 of the 129 block groups containing exceptionally significant minority populations. [Reference 73, Section 2.10]

5.7.2.3 Low-Income Populations

Data from the 2000 census characterize low-income populations within the 50-mile radius of the GGNS site. The United States' percentage of low-income population was 12.4 percent in the 2000 Census, while in Louisiana it was 19.2 percent and in Mississippi 19.9 percent. Applying the NRC criterion of "more than 20 percent greater than the state" yields the census block groups containing exceptionally high percentages of low-income households. In fact, most of the area near the proposed site, especially Claiborne and Jefferson counties, has percentages of low-income populations in the range of 20 to 30 percent of the population. Nine out of 10 census block groups in Claiborne County, 17 out of 24 in Copiah County, 5 out of 6 in Jefferson County, 12 out of 18 in Concordia Parish, and 6 out of 7 in Tensas Parish have low-income persons making up more than 20 percent of the population. The heaviest concentrations of low-income populations are in southern Claiborne County, central Jefferson County, and eastern Tensas and Concordia parishes. [Reference 73, Section 2.10]

5.7.3 Conclusion

For the purpose of this environmental justice assessment, the environmental impacts considered include potential impacts to socioeconomic conditions due to increased GGNS personnel that may be associated with the proposed EPU. Also considered were potential impacts to air quality, noise conditions, land use, and area ecology in the 50-mile radius of GGNS.

The proposed EPU is not expected to affect the size of the regular workforce as discussed in Section 5.6.2. No significant site construction is anticipated with the proposed EPU and any plant modifications would take place during the scheduled 2012 outage. Workforce numbers associated with the outage would be somewhat larger than normal, but would be temporary in nature. No adverse impacts to socioeconomic conditions in the 50-mile region are anticipated to occur as a result of EPU.

As described in Sections 5.1, 5.2 and 5.4, no adverse impacts to land use, air quality, noise or terrestrial and aquatic biota is anticipated. Therefore, no adverse impacts due to the proposed EPU have been identified that would disproportionately affect minority or low-income populations. In conclusion, environmental justice impacts would be SMALL.

5.8 Human Health

5.8.1 Microbiological Organisms

Based on evaluations presented by the NRC in NUREG-1437, if the applicant's plant uses a cooling pond, lake, or canal or discharges into a river having an annual average flow rate of less than 3.15×10^{12} ft^3/year (9×10^{10} m^3/year), an assessment of the impact of the proposed action on public health from thermophilic organisms in the affected water must be provided. [Reference 71, Section 4.3.6]

The Mississippi River flow varies considerably throughout the year and between years. Based on stream flow data from Vicksburg, Mississippi, from 1929 through 1983, the 7-day, 10-year low flow and 100-year flood have been estimated at 120,000 cfs and 2,203,000 cfs, respectively. These equate to 3.78×10^{12} ft^3/year for the 7-day, 10-year low flow, and 6.95×10^{13} ft^3/year for the 100-year flood. [Reference 73, Section 2.6.1.1] Thus, even the low flow stage of the Mississippi River is greater than the annual average flow standard for a small river. Therefore, microbiological organism impacts as a result of EPU would be considered SMALL and a non-issue since GGNS is located on a large river.

5.8.2 Power Transmission Facilities

5.8.2.1 In-Scope Transmission Lines

The transmission lines which were constructed to connect GGNS to the grid for purposes of power distribution and that are within the scope of this evaluation (see Figure 2.0-1) include the following:

- The Baxter-Wilson transmission line is a 22-mile single-circuit 500 kV line that spans from the 500 kV switchyard located at GGNS to the Baxter Wilson Steam Electric Station and its Extra High Voltage (EHV) switchyard. [Reference 65, Section 3.9.1.1] This line traverses a rural, sparsely populated area with agriculture and forestry as the predominating land uses. The northern portion of the line runs parallel to an existing 115 kV line for 6.9 miles. Approximately 3 miles of this section of the route is located 1/4 to 1/2 mile west of U. S. Highway 61 and the adjacent Illinois Central Gulf Railroad tracks. This line also runs parallel to and approximately 100 feet east of an existing 13 kV distribution circuit right-of-way for 2.2 miles in Warren County. [Reference 65, Section 3.9.3.1] The line does not cross any major highways.

- The Franklin transmission line is a 43.6-mile single-circuit 500 kV line that spans from the 500 kV switchyard located at GGNS to the Franklin EHV Switching Station. [Reference 65, Section 3.9.1.3] Major highways crossed by this line are U. S. Highway 61, the Natchez Trace Parkway, Mississippi Highway 28, and Mississippi Highway 550. This line also crosses Bayou Pierre and the Homochitto River and traverses portions of the Homochitto National Forest. Other than U. S. Highway 61, this route does not cross any heavily traveled roads or approach any populous areas. [Reference 65, Section 3.9.3.3]

- One 500 kV line (approximately 300 feet) that spans from the GGNS Unit 1 Turbine Building to the 500 kV switchyard located entirely within the Station's property.

Entergy Mississippi, Inc. a subsidiary of Entergy Corporation, owns and operates the in-scope transmission lines identified above. Entergy's Transmission Group is responsible for maintenance associated with the lines such as maintaining clearances and vegetation management.

5.8.2.2 Out-of-Scope Transmission Lines

The Port Gibson transmission line is a 5.5-mile single-circuit 115 kV transmission line that spans from the Port Gibson Substation to the GGNS 115 kV switchyard. This line provides construction power and is an alternate source of emergency startup power for GGNS, and is not used for distributing power from the Station to the electrical grid. Therefore, it is not within the scope of this evaluation.

There are also two 500 kV lines that span from the GGNS 500 kV switchyard to the GGNS power block that are utilized as offsite power sources only. Therefore, these lines are also not within the scope of this evaluation.

5.8.2.3 Acute Shock Hazard Analysis

Objects near transmission lines can become electrically charged due to their immersion in the lines' electric field. This charge results in a current that flows through the object to the ground. The current is called "induced" because there is no direct connection between the line and the object. The induced current can also flow to the ground through the body of a person who touches the object. An object that is insulated from the ground can actually store an electrical charge, becoming what is called "capacitively charged." A person standing on the ground and touching a vehicle or a fence receives an electrical shock due to the discharge of the capacitive charge through the person's body to the ground. After the initial discharge, a steady-state current can develop, the magnitude of which depends on several factors, including the following:

- strength of the electric field which, in turn, depends on the voltage of the transmission line as well as its height and geometry;
- size of the object on the ground; and
- extent to which the object is grounded.

In 1977, the National Electrical Safety Code (NESC) adopted a provision that describes an additional criterion to establish minimum vertical clearances to the ground for electric lines having voltages exceeding 98-kV alternating current to ground. The clearance must limit the steady-state induced current to 5 milliamperes (mA) if the largest anticipated truck, vehicle, or equipment were short-circuited to ground. By way of comparison, the setting of ground fault circuit interrupters used in residential wiring (special breakers for outside circuits or those with outlets around water pipes) is 4 to 6 milliamperes.

Baxter-Wilson and Franklin 500 kV Transmission Lines

Entergy's Transmission Line Design group completed an acute shock analysis for the Baxter-Wilson and Franklin 500 kV transmission lines to determine if the overhead clearances for the existing lines comply with current NESC requirements for what is commonly referred to as the 5 mA rule (Rule 232.C.1.c). [Reference 19] As a note, there would be no changes in the configuration or operation of these lines as a result of EPU.

Using sags corresponding to the final unloaded conductor temperature of 50°C (120°F), the clearances over major roads, railroads, field roads, and woods were determined. The minimum clearance on the Franklin line above any of the travel ways mentioned was found to be 35.4 feet. The minimum clearance above any of the travel ways mentioned on the Baxter-Wilson line was found to be 44.5 feet. These two minimum clearance situations were used as the basis for the analysis. [Reference 19]

Electric Power Research Institute's (EPRI) "Applet Gallery", part of EPRI's EPRI AC Transmission Line Reference Book 200 kV and Above, Third Edition, is a collection of software used to calculate many different aspects of overhead electrical facilities (e.g. audible noise, corona loss, ozone concentrations near transmission lines, etc.) The Applet, EMF-10 Electric Field Induction on Objects, was used to model and directly calculate the short circuit current for the (2) minimum clearance locations. [Reference 19]

The vehicle modeled in EPRI's Applet is based off dimensions given for the "Large tractor - trailer" described in Table 7.8-2, Induced Current Coefficient and Spark Discharge Capacitance of Different Objects found on page 7-40 of EPRI AC Transmission Line Reference Book 200 kV and Above, Third Edition. The midpoint of the long axis of the tractor - trailer was positioned at the center of the right-of-way (ROW) corridor perpendicular to the 500 kV line in question. One model each was created for each of the minimum clearance locations for the 500 kV lines and the induced current calculated for each of the identified locations. [Reference 19]

Based on these calculations, it was determined that no location resulted in an induced current of greater than 5 mA. Therefore, the Baxter-Wilson and Franklin 500 kV transmission lines satisfy the NESC requirements for Rule 232.C.1.c. [Reference 19]

In addition, Entergy's current maintenance practices associated with maintaining transmission line clearances would continue. All transmission lines 230 kV and above are aerially inspected at least three times each year (Spring, Summer and Fall). Any anomalies or hazardous conditions related to vegetation are recorded, entered into an electronic database by priority, and assigned to crews for mitigation. Also, lines 230 kV and above are presently scheduled on a two year herbicide cycle to maintain vertical and horizontal clearances from conductors. [Reference 19]

Potential encroachments identified in aerial patrols are referred to the Entergy's Right-of-Way group for identification, investigation and resolution. The ROW group also works with internal and external customers to investigate and resolve potential encroachments (e.g. building or roadway construction projects, pipeline installation or maintenance) to the right-of-way. [Reference 19]

GGNS 500 kV Switchyard Transmission Line

Based on the analysis conducted by Entergy's Transmission Line Design group, the lowest point of sag for the 500 kV intertie transmission line occurs at the 5M-70 Tower, approximately 70 feet above the perimeter road. Because the clearance at this crossing is almost twice the clearance used in acute shock analyses for the Baxter-Wilson and Franklin transmission lines, by inspection this span of line meets the applicable vertical clearance requirement and associated NESC 5 mA rule (Rule 232.C.1.c). [References 21 and 22]

5.8.2.4 Conclusion

Transmission lines that connect GGNS to the transmission grid meet the applicable vertical clearance requirements specified by the NESC. In addition, Entergy's current maintenance practices associated with maintaining transmission line clearances would continue to occur. Therefore, Entergy concludes that electrical shock impacts associated with these lines as a result of EPU is SMALL.

5.8.3 Electromagnetic Fields (EMF)

The NRC has concluded that the chronic effects of EMF on humans are unquantified at this time, and no significant impacts to terrestrial biota have been identified [Reference 71, Sections 4.5.4.2.3 and 4.5.6.3.4]. In addition, the National Institute of Environmental Health Sciences has concluded that the overall scientific evidence for human health risk from EMF exposure is weak and that there is no consistent pattern of biological effects [Reference 68, page 3]. Therefore, the potential for chronic effects from these electromagnetic fields continues to be studied and consensus results are still outstanding. Therefore, impacts are considered to be SMALL.

5.9 Miscellaneous Waste

5.9.1 Resource Conservation and Recovery Act Wastes

GGNS, which operates under a hazardous waste generator's identification number assigned by the MDEQ Hazardous Waste Division, generates nonradioactive waste as a result of plant maintenance, cleaning, and operational processes. With the exception of periodic waste that may be generated from sandblasting, construction or spill remediation activities, the majority of the routine wastes generated consists of nonhazardous used oil and oily wastes as a result of the operation and maintenance of oil-filled equipment. Universal wastes, such as spent fluorescent lamps and batteries common to any industrial facility, also comprise a majority of the remaining waste volumes generated. Since GGNS is classified as a small quantity generator by the MDEQ, hazardous wastes routinely make up only a small percentage of the total wastes generated, and include and consist of spent and off-specification (e.g., shelf-life expired) chemicals, laboratory chemical wastes, and occasional project-specific wastes. Nonradioactive wastes generated at GGNS are managed in accordance with the appropriate state and federal regulations that are implemented at the site level through fleet administrative procedures.

EPU would not have any significant impact on the quality or quantity of nonradioactive wastes generated, and operation under EPU conditions would not significantly reduce the margin to the limits or controls established by the appropriate permits or regulations. Programs that have been implemented at the facility to reduce, to the extent feasible, waste generated, treated, accumulated or disposed are described in Entergy Nuclear's Waste Minimization Plan. This Plan, which also identifies waste streams (current and potential) generated at the facility, is used in conjunction with nuclear fleet administrative procedures associated with waste minimization (EN-EV-104, Waste Minimization), waste management (EN-EV-106, Waste Management Program), chemical control (EN-EV-112, Chemical Control Program), and other site-specific procedures to minimize waste generation to the maximum extent practicable [References 15, 16, and 17]. Therefore, impacts would be SMALL.

5.10 GGNS Authorizations

Table 5.10-1 provides a summary of authorizations held by GGNS for current plant operations. Authorizations in this context include any permits, licenses, approvals, or other entitlements. These authorizations would continue to be in place as appropriate post EPU given their respective renewal schedules.

Table 5.10-1

GGNS Authorizations – Current Operations

Agency	Authority	Requirement	Number	Expiration Date	Renewal Frequency
DOT	49 CFR 107, Subpart G	Hazardous Materials Certificate of Registration	051110552067S	June 30, 2011	Yearly renewal
MAWPCC	Federal Water Pollution Control Act Section 401	401 Water Quality Certification	None	None	Does not expire
MDEQ	Federal Water Pollution Control Act Section 402	NPDES Permit	MS0029521	June 30, 2008 *	5-year renewal
MDEQ	Federal Water Pollution Control Act Section 402	Baseline Stormwater General NPDES Permit	MSR000883	September 30, 2010	5-year renewal
MDEQ	Federal Water Pollution Control Act Section 402	Small Construction General Permit	MSR15	December 31, 2012	5-year renewal (typical)
MDEQ	Federal Clean Air Act	Air Permit	0420-00023	May 31, 2009 *	5-year renewal
MDEQ	HW-1 Hazardous Waste Management Regulations, Part 262	Hazardous Waste Generator Identification	MSD000644617	None	Does not expire
MDEQ	Mississippi Water Laws, Mississippi Code Sections 5 1-3-1, et seq.	Well Permit (Radial Well 1)	MS-GW-02971	September 25, 2016	10-year renewal (typical)
MDEQ	Mississippi Water Laws, Mississippi Code Sections 5 1-3-1, et seq.	Well Permit (Radial Well 3)	MS-GW-02970	September 25, 2016	10-year renewal (typical)
MDEQ	Mississippi Water Laws, Mississippi Code Sections 5 1-3-1, et seq.	Well Permit (Radial Well 4)	MS-GW-02969	September 25, 2016	10-year renewal (typical)

Table 5.10-1 (Continued)

GGNS Authorizations – Current Operations

Agency	Authority	Requirement	Number	Expiration Date	Renewal Frequency
MDEQ	Mississippi Water Laws, Mississippi Code Sections 5 1-3-1, et seq.	Well Permit (Radial Well 5)	MS-GW-00371	September 25, 2016	10-year renewal (typical)
MDEQ	Mississippi Water Laws, Mississippi Code Sections 5 1-3-1, et seq.	Well Permit (Radial Well 6)	MS-GW-16714	March 10, 2020	10-year renewal (typical)
MDEQ	Mississippi Water Laws, Mississippi Code Sections 5 1-3-1, et seq.	Well Permit (Construction Well 1)	MS-GW-02967	September 25, 2016	10-year renewal (typical)
MDEQ	Mississippi Water Laws, Mississippi Code Sections 5 1-3-1, et seq.	Well Permit (Construction Well 3)	MS-GW-14989	September 26, 2015	10-year renewal (typical)
MDEQ	Mississippi Water Laws, Mississippi Code Sections 5 1-3-1, et seq.	Well Permit (Construction Well 4)	MS-GW-15026	September 26, 2015	10-year renewal (typical)
MDEQ	Mississippi Water Laws, Mississippi Code Sections 5 1-3-1, et seq.	Well Permit (Dewatering Well 1)	MS-GW-02979	September 25, 2016	10-year renewal (typical)
MDEQ	Mississippi Water Laws, Mississippi Code Sections 5 1-3-1, et seq.	Well Permit (Dewatering Well 2)	MS-GW-02978	September 25, 2016	10-year renewal (typical)

Table 5.10-1 (Continued)

GGNS Authorizations – Current Operations

Agency	Authority	Requirement	Number	Expiration Date	Renewal Frequency
MDEQ	Mississippi Water Laws, Mississippi Code Sections 5 1-3-1, et seq.	Well Permit (Dewatering Well 3)	MS-GW-02977	September 25, 2016	10-year renewal (typical)
MDEQ	Mississippi Water Laws, Mississippi Code Sections 5 1-3-1, et seq.	Well Permit (Dewatering Well 4)	MS-GW-02976	September 25, 2016	10-year renewal (typical)
MDEQ	Mississippi Water Laws, Mississippi Code Sections 5 1-3-1, et seq.	Well Permit (Dewatering Well 5)	MS-GW-02975	September 25, 2016	10-year renewal (typical)
MDEQ	Mississippi Water Laws, Mississippi Code Sections 5 1-3-1, et seq.	Well Permit (Dewatering Well 6)	MS-GW-02974	September 25, 2016	10-year renewal (typical)
MDEQ	Mississippi Water Laws, Mississippi Code Sections 5 1-3-1, et seq.	Well Permit (Dewatering Well 7)	MS-GW-02973	September 25, 2016	10-year renewal (typical)
MDEQ	Mississippi Water Laws, Mississippi Code Sections 5 1-3-1, et seq.	Well Permit (Dewatering Well 8)	MS-GW-02972	September 25, 2016	10-year renewal (typical)
MDEQ	Mississippi Underground Storage Tank Regulations, Part 280	Underground Storage Tanks Registration	5913	June 30, 2010	Yearly renewal

Table 5.10-1 (Continued)

GGNS Authorizations – Current Operations

Agency	Authority	Requirement	Number	Expiration Date	Renewal Frequency
NRC	Atomic Energy Act, 10 CFR 50	GGNS License to Operate	NPF-29	November 1, 2024	Forty-year original term.
NRC	Atomic Energy Act, 10 CFR 72	Independent Spent Fuel Storage Installation Certificate	1014	June 1, 2020	20-year renewal (typical)
USACE	Clean Water Act Section 404	Nationwide Permit	12	March 18, 2012	5-Year renewal
USFWS	16 USC 703-712	Depredation Permit	MB798276-O	March 31, 2011	Yearly renewal
TDEC	Tennessee Department of Environment and Conservation Regulations	GGNS Radioactive Waste License for Delivery	T-MS002-L10	December 31, 2010	Yearly renewal
MEMA	Chapter 432, Laws of 1982, Mississippi Radioactive Waste Transportation Act	GGNS Radioactive Waste Transport Permit	4578	June 30, 2011	Yearly renewal
UDEQ	Utah Radiation Control Rule R313-26	GGNS Generator Access Permit	0204001347	April 28, 2011	Yearly renewal

DOT: U.S. Department of Transportation
MAWPCC: Mississippi Air & Water Pollution Control Commission
MDEQ: Mississippi Department of Environmental Quality
MEMA: Mississippi Emergency Management Agency
NRC: U.S. Nuclear Regulatory Commission
TDEC: Tennessee Department of Environment and Conservation (Division of Radiological Health)
UDEQ: Utah Department of Environmental Quality
USACE: United States Army of Corps Engineers
USFWS: United States Fish and Wildlife Service

* Timely renewal application was submitted; therefore, permit has been administratively continued.

5.11 Nonradiological Impacts Summary

As discussed in the sections above, the proposed EPU would not result in any significant nonradiological impacts. GGNS also anticipates that there would be no significant nonradiological cumulative impacts related to the proposed EPU. Table 5.11-1 summarizes the nonradiological environmental impacts of the proposed EPU at GGNS.

Table 5.11-1

Summary of Nonradiological Environmental Impacts

Land Use	**SMALL Impact:** Installation of the new radial well involves areas to be managed under a Section 404 Permit, MDEQ's stormwater permitting program (Permit Number MSR15), and GGNS' existing Baseline Stormwater NPDES Permit MSR000883 and associated Stormwater Pollution Prevention Plan. There are no plans to modify in-scope transmission lines, or increase noise levels above that evaluated in the GGNS FES.
Air Quality	**SMALL Impact:** GGNS is not located near or in a non-attainment or maintenance area, increase of emissions associated with cooling towers and lube oil tanks would be managed in accordance with air permit, and other impacts would be minor and of short duration
Water Use	**SMALL Impact:** There is no surface water usage. Current groundwater usage does not affect offsite users and there would be no increase in usage due to EPU.
Aquatic Resources	**SMALL Impact:** There is no increase in thermal discharges and no significant increase in water treatment usage. All discharges are regulated by the NPDES Permit.
Terrestrial Resources	**SMALL Impact:** Installation of new radial well involves areas to be managed under a Section 404 Permit, MDEQ's stormwater permitting program (Permit Number MSR15), and GGNS' existing Baseline Stormwater NPDES Permit MSR000883 and associated Stormwater Pollution Prevention Plan. EPU activities do not involve a measurable increase in noise levels outside the plant, or any changes to right-of-way maintenance practices associated with in-scope transmission.
Threatened and Endangered Species	**SMALL Impact:** Installation of the new radial well involves areas to be managed under a Section 404 Permit, MDEQ's stormwater permitting program (Permit Number MSR15), and GGNS' existing Baseline Stormwater NPDES Permit MSR000883 and associated Stormwater Pollution Prevention Plan. EPU activities do not involve a measurable increase in noise levels outside the plant, or any changes to right-of-way maintenance practices associated with in-scope transmission.
Historic and Archaeological Resources	**SMALL Impact:** Installation of new radial well involves areas to be managed under a Section 404 Permit, MDEQ's stormwater permitting program (Permit Number MSR15), and GGNS' existing Baseline Stormwater NPDES Permit MSR000883 and associated Stormwater Pollution Prevention Plan. EPU activities do not involve changes to right-of-way maintenance practices associated with in-scope transmission.
Socioeconomics	**SMALL Impact:** The increase in the workforce would be temporary.
Environmental Justice	**SMALL Impact:** No disproportionately high and adverse human health and environmental effects on minority and low-income populations in the vicinity of GGNS.

6.0 RADIOLOGICAL ENVIRONMENTAL IMPACTS

6.1 Radioactive Waste Treatment Processes

The radioactive waste treatment systems at GGNS are designed to collect, process, and dispose of radioactive wastes in a controlled and safe manner. The design bases for these systems during normal operation are to limit discharges in accordance with 10 CFR 20 and to satisfy the design objectives of Appendix I to 10 CFR 50.

These limits and objectives would continue to be adhered to under EPU since there are no changes in the operation or design of equipment in the liquid, gaseous or solid waste systems. In addition, the safety and reliability of these systems is unaffected. EPU does not affect the environmental monitoring of any of these waste streams, and the GGNS Technical Specifications radiological monitoring requirements would be unaffected. There are also no new or different radiological release pathways introduced and the probability of an operator error or equipment malfunction that would result in an uncontrolled radioactive release has not been increased. The specific effects of EPU on each of the radioactive waste systems are evaluated below.

6.1.1 Liquid Radwaste

The Liquid Radwaste System (LRS) is designed to collect, process, monitor and recycle or dispose of radioactive liquid wastes on a batch basis to permit optimum control and disposal of radioactive waste. The LRS consists of the following: equipment drains subsystem, floor drains subsystem, chemical wastes subsystem, and miscellaneous supporting subsystems (oil separation, Reactor Water Cleanup (RWCU) phase separation and decay, spent resin, condensate phase separation, removal of resin fines, particulates, and other impurities, and alternative liquid radioactive waste processing equipment). [Reference 27, Section 3.3.1.1]

A Condensate Full Flow Filter (CFFF) – Iron Control modification is being installed upstream of the condensate demineralizers to reduce the corrosion product loading on the demineralizer resins. The effect of EPU on the liquid waste management system is primarily a result of the increased load on RWCU filter/demineralizers. Other increases in the liquid waste management system load, such as increased leakage due to system conditions changes, are minimal. The RWCU filer/demineralizers require more frequent backwashes due to slightly higher levels of activation and fission products. [Reference 27, Attachment A, Section 2.5.5.2.1]

Liquid radwastes from the floor drains (dirty radwaste), chemical radwaste, oil separation, and condensate phase separation subsystems are independent of power and therefore unaffected by EPU. [Reference 27, Section 3.3.1.1] The power-dependent radwaste sources are all processed by the equipment drain subsystem. The liquid waste flow rate of the condensate demineralizer backwash is unchanged at EPU. However, the iron control addition to the CFFF would result in iron not being deposited on the demineralization resin at EPU conditions, and the amount of liquid waste generated by the condensate demineralizer backwashes would remain unchanged or decrease at EPU. [Reference 27, Section 3.3.1.1]

The RWCU and Fuel Pool Cooling and Cleanup (FPCC) filter/demineralizer backwash frequency would increase approximately 15% each, due to additional buildup of solids, crud and corrosion products. An additional 15% increase of liquid wastes results in RWCU radwaste increasing from 67 gpd to 77 gpd, or 10 gpd. The FPCC liquid radwaste is estimated to increase from 107 gpd to 123 gpd, or 16 gpd. [Reference 27, Section 3.3.1.1]

Tables 6.1-1 and 6.1-2 provide the liquid release and dose information from 2004 - 2008. The annual liquid volume processed by the LRS is estimated to increase less than 0.1%, from approximately 32,135 gpd to 32,161 gpd, partially due to the increased frequency of RWCU filter/demineralizer and FPCC filter/demineralizer backwash as a result of EPU [Reference 27, Section 3.3.1.1; Table 3.3-1]. This change in frequency is estimated to add approximately 9,490 gallons/year or about 26 gpd [Reference 27, Section 3.3.1.1]. However, the increase is insignificant and within the capacity of the system, and would have a small impact on the total effluent release volume and resulting dose when discharged.

In conclusion, with the current low waste generation rate at GGNS and the insignificant effect of EPU on liquid radwaste generation, EPU would not increase liquid radwaste above system handling capacities. In addition, EPU would not affect compliance with the 10 CFR 20 limits or the guidelines of Appendix I to 10 CFR 50 for liquid effluents at GGNS. Therefore, it is concluded that impacts would be SMALL.

Table 6.1-1

GGNS Liquid Effluent Releases, 2004 – 2008

Year (Curies and % of Limit)		Fission & Activation Products	Tritium	Dissolved & Entrained Gases
2004	Curies	2.64E-02	4.55E+01	3.44E-02
	% of Limit	6.43E-01	9.01E-01	3.41E-02
2005	Curies	8.01E-02	4.37E+01	2.03E-03
	% of Limit	2.40E+00	8.15E-01	1.90E-03
2006	Curies	6.74E-02	6.60E+01	2.16E-02
	% of Limit	1.85E+00	8.08E-01	1.32E-02
2007	Curies	4.20E-01	1.04E+02	2.14E-02
	% of Limit	5.22E+00	5.30E-01	5.45E-03
2008	Curies	3.71E-01	9.90E+01	1.74E-02
	% of Limit	7.30E+00	3.83E-01	3.36E-03

SOURCES: References 31, 35, 39, 42, and 47

Table 6.1-2

GGNS Liquid Effluent Dose (mrem), 2004 – 2008

	2004	2005	2006	2007	2008
Bone	1.40E-02	5.10E-02	3.53E-02	1.32E-01	2.15E-01
Liver	4.15E-02	1.53E-01	1.05E-01	3.44E-01	4.57E-01
Thyroid	3.27E-03	4.95E-03	7.79E-03	1.99E-02	1.60E-02
Kidney	2.54E-02	9.24E-02	5.95E-02	2.14E-01	2.88E-01
Lung	4.87E-03	5.79E-03	8.83E-03	1.73E-02	1.67E-02
GI-LLI	3.97E-02	1.42E-01	1.22E-01	4.72E-01	4.15E-01
Whole Body	1.93E-02	7.21E-02	5.55E-02	1.57E-01	2.19E-01

SOURCES: References 31, 35, 42, and 47

6.1.2 Gaseous Waste

Tables 6.1-3 and 6.1-4 provide the gaseous release and dose information from 2004 – 2008. The GGNS gaseous waste management systems include all systems that have the potential to release airborne radioactive materials into the environment during normal operation and anticipated operational occurrences. Included are the vent systems of normally and potentially radioactive components, building ventilation systems, the off-gas system and the mechanical vacuum pump system. The waste gases originating in the reactor coolant consist mainly of hydrogen and nitrogen with trace amounts of radioactive gases. The function of the off-gas system is to collect and isolate these radioactive noble gases, airborne halogens, and particulates, and to reduce their activity through decay. [Reference 49, Section 11.3]

The dose to individuals from normal gaseous effluent releases at GGNS at the current licensed thermal power level are well within the guidelines of Appendix I to 10 CFR 50 and the limits of 10 CFR 20 for all airborne radioactive nuclides [Reference 25, Section 1.3.1]. Under EPU conditions, off-gas system functions, other than the recombiner and related components, are not significantly affected by power uprate [Reference 25, Attachment A, Section 2.5.5.1.1]. Radiolytic gas production increases proportionally with reactor power; EPU is expected to increase the production and activity of gaseous effluents approximately 13%. However, the increase would continue to be below the design basis value. [Reference 25, Attachment A, Section 2.5.5.1.1] As non-condensable flow rates do not change, and noble gas holdup times do not change, there is no impact to dose limits as delineated in 10 CFR 20 and Appendix I to 10 CFR 50 [Reference 25, Section 1.3.1].

Therefore, it is concluded that impacts would be SMALL.

Table 6.1-3

GGNS Gaseous Effluent Releases, 2004 – 2008

Year (Curies and % of Limit)		Fission & Activation Gases	Iodine-131	Particulates Half Life >= 8 days	Tritium
2004	Curies	9.89E+01	2.34E-03	3.33E-04	3.18E+01
	% of Limit	5.67E-01	2.43E-01	2.54E-02	1.52E-01
2005	Curies	2.24E+02	2.13E-03	4.23E-04	3.76E+01
	% of Limit	1.66E+00	2.57E-01	3.74E-02	1.79E-01
2006	Curies	2.42E+02	1.96E-02	2.03E-04	1.92E+01
	% of Limit	1.90E+00	1.38+00	9.90E-02	6.32E-02
2007	Curies	6.23E+02	4.28E-02	1.81E-03	1.56E+01
	% of Limit	7.52E+00	4.71E+00	1.17E-01	1.22E-01
2008	Curies	4.43E+02	1.18E-02	1.51E-04	1.03E+01
	% of Limit	3.21E+00	1.29E+00	1.00E-01	6.32E-02

SOURCES: References 31, 35, 39, 41, and 47

Table 6.1-4

GGNS Gaseous Effluent Dose (mrem), 2004 – 2008

Year (Dose and % of Limit)		Organ	Gamma *	Beta *	Direct Radiation
2004	Dose	6.31E-02	5.67E-02	3.04E-02	2.30
	% of Limit	4.20E-01	5.67E-01	1.52E-01	NA
2005	Dose	7.10E-02	1.66E-01	7.40E-02	4.20
	% of Limit	4.73E-01	1.66 E+00	3.70E-01	NA
2006	Dose	2.32E-01	1.90E-01	8.26E-02	0.00
	% of Limit	1.55E+00	1.90E+00	4.13E-01	NA
2007	Dose	7.39E-01	7.52E-01	3.60E-01	2.70
	% of Limit	4.93E+00	7.52E+00	1.80E+00	NA
2008	Dose	2.18E-01	3.21E-01	2.39E-01	3.80
	% of Limit	1.45E+00	3.21+00	1.20+00	NA

* Measurement units are mrad.

SOURCES: References 31, 35, 39, 42, and 47

6.1.3 Solid Waste (Process Waste & Reactor System Wastes)

The Solid Radwaste System is designed to provide solidification and packaging for radioactive wastes that are produced during shutdown, startup and normal operation, and to store these wastes until they are shipped offsite for burial. Processing and packaging is provided for resins, pre-coat material, and particulate waste collected from the RWCU, FPCC, condensate cleanup system, and the LRS. [Reference 27, Section 3.3.1.2]

The quantities of low-level compressible radioactive wastes are not expected to increase as a result of EPU. The production of dry active waste is not directly related to core power, and drastic changes in system maintenance are not anticipated at EPU. Operation of the solid radwaste system at EPU conditions does not require changes to the configuration of the waste handling areas or the area radiation monitoring system. [Reference 27, Section 3.3.1.2]

Solid radwaste is processed on a batch basis, and would increase slightly at EPU, resulting in an increase in batch processing. Due to a slight increase in reactor water conductivity and other impurities, the usable life of the RWCU demineralizer resin would be reduced at EPU. This would result in an increase in backwash frequency approximately proportional to the 15% increase in feedwater flow at EPU. The batch volume of effluent discharged to the radwaste system created during each backwash cycle would not change, but batch frequency would increase, and solid waste generation would increase at approximately 0.004 m^3 per day. [Reference 27, Section 3.3.1.2]

FPCC flowrates are independent of power uprate, but crud activity and corrosion products associated with spent fuel can increase slightly due to power uprate. Additional crud activity and corrosion products are expected to result in an increase in backwash frequency of the FPCC filter/demineralizer of approximately 15% at EPU. Batch frequency would increase, resulting in solid waste generation increase from 0.012 m^3 of resin per day to 0.014 m^3 of resin per day. [Reference 27, Section 3.3.1.2]

GGNS continually tracks the volume of solid radwaste generated, stored, and shipped from the plant. Significant volume reductions have occurred over the years. Table 6.1-5 indicates that for calendar years 2004 through 2008, the average volume of solid radwaste (spent resin, filter sludge, evaporator bottoms, etc.) shipped per year was approximately 63 cubic meters.

The annual volume of solid waste is expected to increase from 152.83 m^3 at current licensed thermal power to 153.65 m^3 per year, or 0.82 m^3 per year. This increased volume of solid waste is due to increased backwashes of the RWCU and FPCC filter/demineralizers. [Reference 27, Section 3.3.1.2; Table 3.3-2] Although EPU implementation increases the amount of solid waste produced from RWCU and FPCC, the design capability of the solid radwaste system and the total volume capacity for handling solid waste are unaffected. The amount of solid waste packaged for final disposal offsite is increasing for EPU; however, the requirements for packaging, shielding, handling, and shipping of the radioactive solid waste are not changing. Therefore, the existing equipment, instrumentation, and procedures that control waste shipments and releases to the environment would continue to meet GDC-60, 63, and 64, and 10 CFR 71 requirements. [Reference 27, Section 3.3.1.2]

The annual environmental impact of low-level and high-level solid wastes has been generically evaluated by the NRC Staff for a 1000 MWe reference reactor. The estimated activity content of these wastes is given in Table S-4 of 10 CFR 51.52. The evaluation with respect to this table is included in Section 7.0 of this report. Therefore based on the information above, the environmental impact due to generation of solid radwaste from EPU conditions would be SMALL.

Table 6.1-5

GGNS Solid Radioactive Waste Generation (m^3), 2004 - 2008

Waste Stream	2004	2005	2006	2007	2008
Spent resins, filter sludges, evaporator bottoms, etc.	59.8	56.8	0	121.74	76.5
Dry compressible waste, contaminated equipment, etc.	154.598	0.234	0	827.0861	744
Irradiated components, control rods, etc.	0	0.846	0	0.3575	0
Other: Dry compressible waste, contaminated equipment, spent resins for volume reduction	0	740.75	886.75	60.4	0

SOURCES: References 31, 35, 39, 42 and 47

6.2 Radiation Levels and Offsite Dose

6.2.1 Operating and Shutdown In-Plant Radiation

EPU would involve an increase in radiation levels but the increase would be small and would have a negligible effect on occupational and onsite radiation exposure. The normal operation radiation levels in most areas of the plant are expected to increase by approximately the percentage of power uprate, or 13%. However, in some areas, the radiation levels would increase by greater percentages:

- The radiation level adjacent to components carrying main steam upstream of the Main Condenser is expected to increase up to a maximum of 12%.
- The radiation level adjacent to the Main Condenser is expected to increase up to a maximum of 27%.
- The radiation level adjacent to portions of the Offgas System, including steam jet air ejectors, recombiners, Offgas System condensers, water separators, the hold-up pipe, etc. is expected to increase up to a maximum of 43%.
- The radiation level adjacent to the condensate demineralizer is estimated to increase up to a maximum of 32%.
- The radiation level adjacent to components of the Liquid and Solid Radwaste System is expected to increase up to a maximum of 32%.
- The radiation level adjacent to the Turbine Building charcoal and high efficiency particulate air filters is expected to increase up to a maximum of 17% and 212%, respectively. [Reference 28, Section 1.3]

Although some increase in radiation levels are expected, there is sufficient margin in the GGNS design to ensure that shielding is adequate to maintain occupational and onsite doses as low as reasonably achievable (ALARA) [Reference 28, Section 3.3.1.1.2]. The normal operation dose rates and available shielding continue to meet the requirements of 10 CFR 20 related to allowable operator exposure and access control. [Reference 28, Section 1.3]

GGNS has been designed using an extremely conservative basis for water and steam radionuclide concentrations such that changes in actual concentrations as a result of EPU are well bounded by the original design. Inside containment, the radiation levels near the reactor vessel are assumed to increase by 13%. However, the reactor vessel is inaccessible during operation, and because of the margin in the shielding around the reactor vessel, an increase of 13% would not measurably increase occupational doses during power operation. The radiation levels due to spent fuel are anticipated to increase by 13%. Expected increases in these values would occur primarily in fuel handling operations during refueling outages. However, a review of existing radiation zoning design concluded that no changes in the radiation zone designations or shielding requirements would need to be made as a result of EPU, and operation under EPU conditions would have a negligible effect on occupational and onsite radiation exposure. [Reference 28, Attachment A, Section 2.10.1.2.1]

Post-accident radiation levels have also been evaluated. The review concluded that because very conservative analyses were used for the Current Licensed Thermal Power (CLTP) conditions, the post-accident levels specified by the CLTP conditions are bounding for the EPU conditions. [Reference 28, Attachment A, Section 2.10.1.2.3]

Post-operation radiation levels in most areas of the plant would increase by no more than the percentage increase in power level. In some areas near the reactor water piping and liquid radwaste equipment, the increase could be slightly higher. However, individual worker exposures can be maintained within acceptable limits by controlling access to radiation areas using the site ALARA program. Procedural controls compensate for increased radiation levels. [Reference 28, Attachment A, Section 2.10.1.2.2]

Table 6.2-1 below summarizes the exposure history for GGNS from 2000 - 2008. In general, radiation levels and dose rates are estimated to increase in proportion to the increase in power level (i.e., approximately 13%), although in some areas the increase may be slightly higher. ALARA dose reduction programs would continue to address the increases in individual doses due to EPU. The plant radiation protection program would be used to maintain individual doses consistent with ALARA policies and well below the established limits of 10 CFR 20. Routine plant radiation surveys required by the radiation protection program would identify increased radiation levels in accessible areas of the plant, but there is no change of radiation zone design anticipated. Time within radiation areas is controlled under the radiation protection program. Administrative dose control limits are established well below regulatory criteria and provide significant margin to that allowed by regulatory dose limits, and are not routinely exceeded under present power conditions. Therefore, impacts are anticipated to be SMALL.

Table 6.2-1

Exposure History for GGNS Workers, 2000 – 2008

Year	Collective Dose (rem)	Average Measured Dose (rem) *
2000	35	0.12
2001	185	0.17
2002	176	0.17
2003	31	0.11
2004	158	0.13
2005	168	0.13
2006	60	0.06
2007	178	0.10
2008	168	0.09

* NRC used the number of MW-yr of electricity generated in determining the ratio of the average value of the annual collective dose (TEDE) to the number of MW-yr of net electricity generated. Ratio was then calculated by dividing total collective dose in person-rem by electric energy generated in MW-yr and is a measure of dose incurred by workers at power plants in relation to electric energy produced. [Reference 75, Section 4.2.3]

SOURCE: Reference 75, Appendix C

6.2.2 Offsite Doses at Extended Power Uprate Conditions

For EPU, normal operational gaseous activity levels may increase slightly. The increase in activity levels is generally proportional to the percentage increase in core thermal power. However, this slight increase does not affect the large margin to the offsite dose limits established by 10 CFR 20. Doses from liquid effluents for the years 2004 – 2008 are provided in Table 6.1-2 and are expected to increase proportional to the percentage of power uprate which allows the doses to remain well below the regulatory limits under the EPU conditions.

The GGNS Technical Specifications implement the guidelines of 10 CFR 50 Appendix I which are well within the 10 CFR 20 limits. Tables 6.1-2 and 6.1-4 contain the results of the liquid and gaseous dose assessment for 2004 - 2008. An increase of approximately 13% for EPU operation remains a very small fraction of the reporting limits.

Table 6.2-2 presents the ambient gamma radiation data as measured by thermoluminescent dosimetry for GGNS for the years 2004 – 2008. The conclusion from that data is that no plant effect on ambient gamma radiation is expected from the EPU. Therefore, impacts are anticipated to be SMALL.

Table 6.2-2

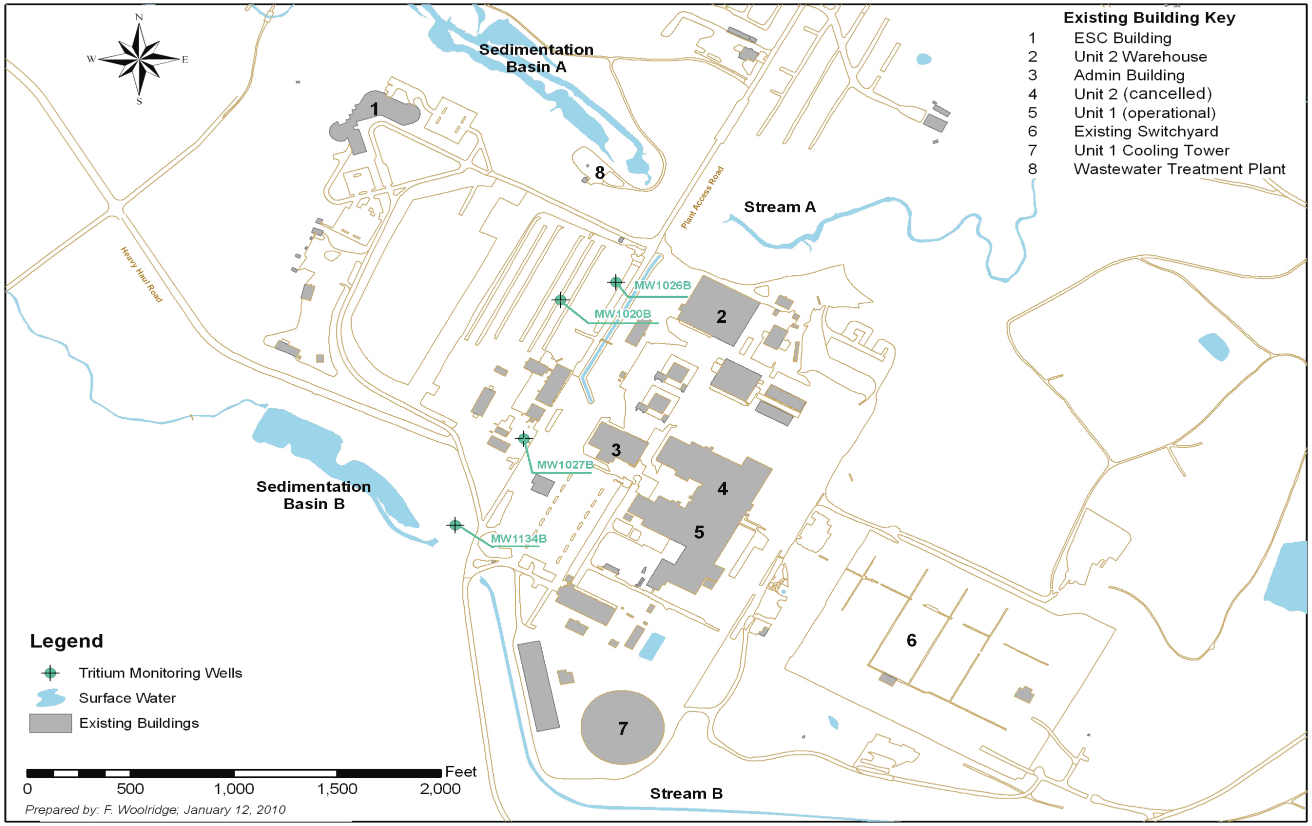
Annual Average Ambient Gamma Radiation Levels, 2004 - 2008

Year	Inner Ring Dose (mrem)	Outer Ring Dose (mrem)
2004	9.8	9.4
2005	9.2	8.8
2006	9.4	9.1
2007	10.7	10.5
2008	10.2	9.4
SOURCES: References 32,36, 40, 43, and 48		

6.2.3 Groundwater Monitoring Program

Nuclear Energy Institute 07-07 (August 2007) was developed to describe the industry's Groundwater Protection Initiative (GPI). The GPI identifies actions to improve utilities' management and response to instances where the inadvertent release of radioactive substances may result in detectable levels of plant-related materials in subsurface soils and water. In mid-2007, as part of the GPI, GGNS began monitoring groundwater from four onsite wells (MW1020B, MW-1026B, MW-1027B, MW-1134B) as shown in Figure 6.2-1 to monitor for potential radioactive releases via groundwater pathways at the site in accordance with nuclear fleet administrative and site procedures [References 18, 20, and 44]. Although still being evaluated, sampling of selected sentinel wells began inside the protected area in 2010 in an effort to determine which wells would best benefit GGNS' efforts in enhancing the sites existing monitoring program. Based on GGNS sampling efforts associated with this program, there have been no results that have exceeded any ODCM or regulatory reporting requirements, and operation at EPU is not expected to impact these results. Therefore, impacts are anticipated to be SMALL.

Figure 6.2-1: Radiological Groundwater Monitoring Wells



6.3 Radiological Consequences of Accidents

Extended power uprate does not significantly change the amount of radiation potentially released during an accident, and would not result in a significant increase in the probability or consequences of a radiological accident. Therefore, impacts are anticipated to be SMALL.

6.4 Other Potential Environmental Accidents

Extended power uprate does not significantly change the inventory, storage, usage, or control requirements for chemicals, industrial gases, oil, oil products, or other hazardous substances, and does not require the introduction or use of any new hazardous substances. Therefore, EPU would not result in a significant increase in the probability or consequences of an oil spill, chemical spill, industrial gas release, or other event involving a non-radioactive hazardous substance. Thus impacts are anticipated to be SMALL.

7.0 ENVIRONMENTAL EFFECTS OF URANIUM FUEL CYCLE ACTIVITIES AND FUEL AND RADIOACTIVE WASTE TRANSPORTATION

7.1 10 CFR 51.51, Table S-3 Compliance (Uranium Fuel Cycle Environmental Data)

The NRC included the environmental effects of the uranium fuel cycle required in 10 CFR 51.51 (Table S-3), including uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, reprocessing of irradiated fuel, transportation of radioactive materials and management of low-level wastes and high-level wastes related to uranium fuel cycle activities, in its 1981 GGNS FES for Units 1 and 2. Table S-3 was included in its entirety as Table 5.10 to the GGNS FES. The NRC concluded that the environmental impact of the Station to the U.S. population from radioactive gaseous and liquid releases (including radon) due to the uranium fuel cycle is insignificant when compared with the impact of natural background radiation. [Reference 69, Section 5.10] The NRC Staff's evaluation of the Station was based on operation of GGNS Units 1 and 2, with produced thermal power level for each unit at 3,833 MWt, or a combined total of 7,666 MWt. Although EPU would increase the licensed thermal power level of GGNS Unit 1 by approximately 13 percent to 4,408 MWt, it is still well below that previously evaluated by NRC Staff. Therefore, the NRC's evaluation and conclusions in the GGNS FES related to uranium fuel cycle environmental effects required by 10 CFR 51.51 and as cited in Table S-3, continues to bound the environmental impacts due to GGNS.

7.2 10 CFR 51.52, Table S-4 Compliance (Environmental Effects of Transportation of Fuel and Waste)

10 CFR 51.52 (Table S-4) describes the environmental impacts of transporting nuclear fuel and radioactive wastes. The tables were developed in the 1970s. Since that time most plants have increased both their uranium-235 enrichment and the fuel's burnup limits.

In 1988, the NRC generically evaluated the impacts of extended burnup fuel and increased enrichment on the uranium fuel cycle, including transportation of nuclear fuel and wastes, to determine whether higher burnup and enrichment could result in environmental impacts greater than those derived in Tables S-3 and S-4. The environmental assessment and finding of no significant impact (53 FR 6040, February 29, 1988) concluded that burnup limits of up to 50,000 megawatt-days per metric ton of uranium (MWd/MTU) or higher (as long as the maximum rod average burnup level of any fuel rod is no greater than 60,000 MWd/MTU) and uranium-235 enrichment up to 5 weight percent would have no significant adverse environmental effects on the uranium fuel cycle or the transport of nuclear fuel and wastes, and would not change the impacts presented in Tables S-3 and S-4.

In 1999, in connection with the Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants, the NRC reviewed transporting higher enrichment and higher burnup fuel to a geologic repository [Reference 72]. The conclusion of that evaluation was that Table S-4 applies to spent fuel enriched up to 5% uranium-235 with average burnup for the peak rod to current levels approved by NRC up to 62,000 MWd/MTU, provided higher burnup fuel is cooled for at least 5 years before being shipped.

The additional energy requirements for EPU are met by an increase in bundle enrichment, an increase in the reload fuel batch size, and/or changes in the fuel loading pattern to maintain the desired plant operating cycle length. The equilibrium core evaluated for the EPU has an average enrichment well below 4.5% uranium-235 by weight. The current typical average enrichment of a batch is approximately 4% by weight uranium-235.

The EPU evaluation also considered a possible future change to a 24-month cycle; the combination of the EPU and the longer cycle length could result in an increase in batch size from 312 to about 380 assemblies. The maximum average burnup level of any fuel rod would continue to be less than 62,000 MWd/MTU, and reload design goals would maintain the GGNS fuel cycles within the burnup and enrichment limits bounded by the impacts analyzed in Table S-4. Therefore, GGNS concludes that impacts to the uranium cycle and transport of nuclear fuel from the proposed action would be SMALL and not require mitigation.

8.0 DECOMMISSIONING EFFECTS

The 1981 GGNS FES did not evaluate the environmental effects of decommissioning. In 1988, NRC published the Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities (NUREG-0586) that discusses decommissioning of nuclear power plants [Reference 70]. Procedures for decommissioning a nuclear power plant are found in federal regulations at 10 CFR 50.75, 50.82, 51.23, and 51.95.

Prior to any decommissioning activity at GGNS, EOI would submit a post-shutdown decommissioning activities report to describe planned decommissioning activities, any environmental impacts of those activities, a schedule, and estimated costs. Implementation of an EPU does not affect GGNS' ability to maintain financial reserves for decommissioning.

The potential environmental impacts on decommissioning associated with the proposed EPU would be due to the increased neutron fluence. As a result, the amount of activated corrosion products could increase, and consequently, the post-shutdown radiation levels could increase. GGNS expects the increases in radiation levels as a result of operations under the proposed EPU conditions to have SMALL impacts, and would be addressed in the post-shutdown decommissioning activities report.

9.0 RADIOLOGICAL IMPACTS SUMMARY

As discussed in the sections above, the proposed EPU would not result in any significant radiological impacts. GGNS also anticipates that there would be no significant radiological cumulative impacts related to the proposed EPU. Table 9.0-1 summarizes the radiological environmental impacts of the proposed EPU at GGNS.

Table 9.0-1 Summary of Radiological Environmental Impacts	
Radioactive Gaseous Effluent	**SMALL Impact:** Radioactive gaseous effluents are expected to increase by ~13% under EPU conditions, resulting in a small increase in volume of releases and calculated doses, but well below any regulatory limit.
Offsite Radiation Doses	**SMALL Impact:** Offsite radiation doses would increase but only in a very small amount. Doses would continue to be well below any regulatory limit and the radiological environmental monitoring program may not be able to detect any difference in the surrounding area due to the small increase.
Radioactive Liquid Effluents	**SMALL Impact:** Radioactive liquid effluents are expected to increase slightly under EPU conditions, resulting in a small increase in volume of releases and in calculated doses, but well below any regulatory limit.
Radioactive Solid Wastes	**SMALL Impact:** Radioactive solid wastes are expected to increase slightly under EPU. However, this increase does not affect the design capability of the solid radwaste system and total volume capacity for handling solid waste; therefore, continues to be bounded by Table S-3 of 10 CFR 51.52.
Occupational Doses	**SMALL Impact:** Occupational dose may increase during installation of EPU components and operation in the EPU condition. ALARA programs and procedures would control the working conditions and resulting doses. No challenge to any limit would be present and as programs improve, the resulting occupational doses should continue to decrease.
Postulated Accident Doses	**SMALL Impact:** EPU does not significantly change the amount of radiation potentially released during an accident, or result in a significant increase in the probability or consequences of a radiological accident.

10.0 REFERENCES

1. 40 CFR 81.319, Subpart C - Section 107 Attainment Status Designations, Louisiana.

2. 40 CFR 81.325, Subpart C - Section 107 Attainment Status Designations, Mississippi.

3. 57 FR No. 4, 1992. Endangered Wildlife and Plants; Threatened Status for the Louisiana Black Bear and Related Rules, Final Rules. January 7, 1992.

4. 66 FR No. 75, 2001. Endangered and Threatened Wildlife and Plants; 12-month Finding for a Petition To List the Sicklefin Chub (Macrhybopsis meeki) and the Sturgeon Chub (Macrhybopsis gelida) as Endangered, Notice of 12-Month Petition Finding. April 18, 2001.

5. AAI (American Aquatics, Inc.). 2006. Correspondence from J. Fred Heitman, American Aquatics, Inc. to Derek Richard, Enercon Services, Grand Gulf Nuclear Station Mussel Survey. December 4, 2006.

6. Audubon, 2005. National Audubon Society, Inc. Waterbirds, White Ibis. Copyright 2005. Accessed on the Internet @ http://web1.audubon.org/waterbirds/species.php?speciesCode=whiibi&tab=conStatus on February 16, 2010.

7. Enercon. 2010a. Correspondence to Rick Buckley, Entergy Nuclear from Jim Thomas, Enercon Services, Radial Well Withdrawal Impacts Calculation ENTGGG071-CALC-00 I, Grand Gulf Nuclear Station Unit 1. May 19, 2010.

8. Enercon. 2010b. Correspondence to Curtis B. James, Assistant Field Supervisor, U.S. Fish and Wildlife Service, Mississippi Field Office, Jackson, MS, from James A. Thomas, Enercon. January 18, 2010.

9. Enercon. 2010c. Correspondence to Dr. Sherry Surrette, Mississippi Natural Heritage Program, Mississippi Museum of Natural Science, Department of Wildlife, Fisheries and Parks, Jackson, MS, from James A. Thomas, Enercon. January 18, 2010.

10. Enercon. 2010d. Correspondence to Mr. H. T. Holmes, State Historic Preservation Office, Mississippi Department of Archives and History, Jackson, MS, from James A. Thomas, Enercon. January 18, 2010.

11. ENSR (ENSR Corporation). 2005. Appendix B, Review of Lower Mississippi Fishes. March 2005.

12. ENSR (ENSR Corporation). 2007. Impingement Mortality and Entrainment Characterization Study (IMECS), Entergy – Waterford 3. December 2007.

13. Entergy. 2008a. Fleet Procedure EN-EV-115, Environmental Reviews and Evaluations, Revision 5, March 27, 2008.

14. Entergy. 2008b. Fleet Procedure EN-EV-121, Cultural Resources Protection Plan, Revision 1, March 27, 2008.

15. Entergy. 2008c. Fleet Procedure EN-EV-104, Waste Minimization. March 27, 2008.

16. Entergy. 2008d. Fleet Procedure EN-EV-106, Waste Management Program. August 18, 2008.

17. Entergy. 2008e. Fleet Procedure EN-EV-112, Chemical Control Program. December 17, 2008.

18. Entergy. 2008f. Fleet Procedure EN-CY-109, Sampling and Analysis of Groundwater Monitoring Wells, Revision 2, April 1, 2008.

19. Entergy. 2009a. Email correspondence from Stephen Parrish, Entergy Transmission Line Design, to Ricky Buckley, ESI Business Development and Bert Shoenberger, Entergy Project Management, Baxter-Wilson and Franklin 500 kV Transmission Lines Acute Shock Analysis. December 2, 2009.

20. Entergy. 2009b. Fleet Procedure EN-CY-111, Radiological Ground Water Monitoring Program, Revision 0, June 1, 2009.

21. Entergy. 2010a. Email correspondence from Stephen Parrish, Entergy Transmission Line Design, to Ricky Buckley, ESI Business Development and Bert Shoenberger, Entergy Project Management, GGNS 500 kV Transmission Line Acute Shock Analysis. January 27, 2010.

22. Entergy. 2010b. Email correspondence from Stephen Parrish, Entergy Transmission Line Design, to Ricky Buckley, ESI Business Development and Bert Shoenberger, Entergy Project Management, GGNS 500 kV Transmission Line Acute Shock Analysis. January 28, 2010.

23. EPA (Environmental Protection Agency). 2009. Criteria Pollutant Area Summary Report. http://www.epa.gov/air/oaqps/greenbook/ancl2.html. Accessed January 4, 2010.

24. FEOW (Freshwater Ecoregions of the World). 2009. Lower Mississippi Ecoregion Description. http://www.feow.org/ecoregion_details.php?eco=149. Accessed June 24, 2009.

25. GEHNE (GE Hitachi Nuclear Energy). 2009. GE Hitachi Nuclear Energy. Project Task Report Entergy Operations, Inc. Grand Gulf Nuclear Station Unit 1 Extended Power Uprate Task T0801: Gaseous Waste Management, Revision 0. August 2009.

26. GEHNE (GE Hitachi Nuclear Energy). 2010a. GE Hitachi Nuclear Energy. Project Task Report Entergy Operations, Inc. Grand Gulf Nuclear Station Extended Power Uprate Task T0605: Main Condenser/Circulating Water/Normal Heat Sink Performance & Discharge Limits, Revision 0. March 2010.

27. GEHNE (GE Hitachi Nuclear Energy). 2010b. GE Hitachi Nuclear Energy. Project Task Report Entergy Operations, Inc. Grand Gulf Nuclear Station Extended Power Uprate Task T0800: Liquid and Solid Waste Management, Revision 0. March 2010.

28. GEHNE (GE Hitachi Nuclear Energy). 2010c. Project Task Report, Entergy Operations, Inc., Grand Gulf Nuclear Station, Extended Power Uprate, Task T0803 Radiation Levels, Revision 0. April 2010.

29. GGNS (Grand Gulf Nuclear Station). 2003. Grand Gulf Nuclear Station National Pollutant Discharge Elimination System Permit MS0029521. July 4, 2003.

30. GGNS (Grand Gulf Nuclear Station). 2004. Grand Gulf Nuclear Station, Facility No. 0420-00023, Modification of Existing Source AA-003, Correspondence GEXO-2004/00088. December 30, 2004.

31. GGNS (Grand Gulf Nuclear Station). 2005a. Grand Gulf Nuclear Station (GGNS) 2004 Annual Radioactive Effluent Release Report (ARERR), Correspondence GNRO-2005/00012. April 27, 2005.

32. GGNS (Grand Gulf Nuclear Station). 2005b. Grand Gulf Nuclear Station (GGNS) 2004 Annual Radiological Environmental Operating Report (AREOR), Correspondence GNRO-2005/00011. April 27, 2005.

33. GGNS (Grand Gulf Nuclear Station). 2005c. Grand Gulf Early Site Permit Application, Revision 2, Part 3 – Environmental Report, Section 2.0, Environmental Description through Table 2.7-120 (Continued). October 3, 2005.

34. GGNS (Grand Gulf Nuclear Station). 2005d. Grand Gulf Early Site Permit Application, Revision 2, Part 2 - Site Safety Analysis Report. Section 2.0, Site Characteristics through Table 2.5-27. October 3, 2005.

35. GGNS (Grand Gulf Nuclear Station). 2006a. Grand Gulf Nuclear Station (GGNS) 2005 Annual Radioactive Effluent Release Report (ARERR), Correspondence GNRO-2006/00018. April 27, 2006.

36. GGNS (Grand Gulf Nuclear Station). 2006b. Grand Gulf Nuclear Station (GGNS) 2005 Annual Radiological Environmental Operating Report (AREOR), Correspondence GNRO-2006/00017. April 26, 2006.

37. GGNS (Grand Gulf Nuclear Station). 2006c. Grand Gulf Nuclear Station Water Use Program (Annual Water Use Survey - 2005), Correspondence GEXO-2006/00048. August 17, 2006.

38. GGNS (Grand Gulf Nuclear Station). 2007a. Correspondence to Lisa May-McKenzie, Mississippi Department of Environmental Quality, Office of Land and Water Resources, from Rusty Shaw, Grand Gulf Nuclear Station, Groundwater Withdrawal Permit Modification, GEXO-2007/00063. September 6, 2007.

39. GGNS (Grand Gulf Nuclear Station). 2007b. Grand Gulf Nuclear Station (GGNS) 2006 Annual Radioactive Effluent Release Report (ARERR), Correspondence GNRO-2007/00023. April 30, 2007.

40. GGNS (Grand Gulf Nuclear Station). 2007c. Grand Gulf Nuclear Station (GGNS) 2006 Annual Radiological Environmental Operating Report (AREOR), Correspondence GNRO-2007/00024. April 30, 2007.

41. GGNS (Grand Gulf Nuclear Station). 2008a. Grand Gulf Nuclear Station Unit 3 Combined License Application, Part 2: Final Safety Analysis Report, Revision 0. February 2008.

42. GGNS (Grand Gulf Nuclear Station). 2008b. Grand Gulf Nuclear Station (GGNS) 2007 Annual Radioactive Effluent Release Report (ARERR), Correspondence GNRO-2008/00019. April 28, 2008.

43. GGNS (Grand Gulf Nuclear Station). 2008c. Grand Gulf Nuclear Station (GGNS) 2007 Annual Radiological Environmental Operating Report (AREOR), Correspondence GNRO-2008/00018. April 29, 2008.

44. GGNS (Grand Gulf Nuclear Station). 2008d. Site Procedure 08-S-03-10, Chemistry Sampling Program, Revision 46. October 30, 2008.

45. GGNS (Grand Gulf Nuclear Station). 2008e. Grand Gulf Nuclear Station Unit 3 Combined License Application, Part 3: Environmental Report, Revision 0. February 2008.

46. GGNS (Grand Gulf Nuclear Station). 2009a. Email correspondence from Beverly Raines, GGNS Human Resources, GGNS Employee Information, to Ricky Buckley, ESI Business Development. November 3, 2009.

47. GGNS (Grand Gulf Nuclear Station). 2009b. Grand Gulf Nuclear Station (GGNS) 2008 Annual Radioactive Effluent Release Report (ARERR) – Corrected Copy, Correspondence GNRO-2009/00041. July 9, 2009.

48. GGNS (Grand Gulf Nuclear Station). 2009c. Grand Gulf Nuclear Station (GGNS) 2008 Annual Radiological Environmental Operating Report (AREOR), Correspondence GNRO-2009/00025. April 29, 2009.

49. GGNS (Grand Gulf Nuclear Station). 2010a. Grand Gulf Nuclear Unit 1 Updated Final Safety Analysis Report. April 5, 2010.

50. GGNS (Grand Gulf Nuclear Station). 2010b. Email correspondence from Michael Michalski, GGNS Chemistry Contractor, 2008 Water Usage, to Ricky Buckley, ESI Business Development. February 15, 2010.

51. GGNS (Grand Gulf Nuclear Station). 2010c. Email correspondence from Michael Michalski, GGNS Chemistry Contractor, Groundwater Withdrawal - 2009, to Ricky Buckley, ESI Business Development. February 15, 2010.

52. GGNS (Grand Gulf Nuclear Station). 2010d. Email correspondence from Charles Shepphard, GGNS Chemistry, GGNS Water Use Figures, to Ricky Buckley, ESI Business Development. January 4, 2010.

53. LandView 6 Census 2000 Population Estimator.

54. LP&L (Louisiana Power & Light Company). 1981. Waterford Steam Electric Station, Unit Number 3, Environmental Report, Operating License Stage, Docket No. 50-382. August 1981.

55. LWFD (Louisiana Wildlife and Fisheries Department). 2008. Rare, Threatened, & Endangered Species, & Natural Communities, Tracked by the Louisiana Natural Heritage Program, Tensas Parish, April 2008. Accessed on the Internet on 12/18/2009 *at* www.wlf.louisiana.gov/pdfs/experience/naturalheritage/tensas.pdf.

56. MDAH (Mississippi Department of Archives and History). 2010a. Email correspondence from Pamela Edwards Lieb, Mississippi Department of Archives and History, Chief Archaeologists, Curator of Archaeological Collections, GGNS Radial Well Project, to Ricky Buckley, ESI Business Development. May 3, 2010.

57. MDAH (Mississippi Department of Archives and History). 2010b. Correspondence to Clay Cromwell, Wildlife Technical Services, Inc., Proposed Radial Well #6, Grand Gulf Nuclear Station (Energy Operations, Inc.), MDAH Project Log #02-096-10, Claiborne County, from Jim Woodrick, Mississippi Department of Archives and History, Review and Compliance Officer. May 13, 2010.

58. MDEQ (Mississippi Department of Environmental Quality). 2006. Mississippi Commission of Environmental Quality, Regulation LW-2, Surface Water and Groundwater Use and Protection, Amended by the Commission on Environmental Quality. January 26, 2006.

59. MDEQ (Mississippi Department of Environmental Quality). 2007. Correspondence to Rusty Shaw, Entergy Operations, Groundwater Withdrawal, Grand Gulf Nuclear Station from James Crawford, Mississippi Department of Environmental Quality. October 8, 2007.

60. MDEQ (Mississippi Department of Environmental Quality). 2009. Mississippi Department of Environmental Quality, Office of Land and Water Resources, Groundwater Planning and Protection Division, Records of Public-Supply Wells in Mississippi. 2009.

61. MDWFP. (Mississippi Department of Wildlife Fisheries and Park). 2001. Mississippi Department of Wildlife, Fisheries and Parks, Museum of Natural Science, Endangered Species of Mississippi. 2001.

62. MNHP (Mississippi Natural Heritage Program). 2003. Endangered Species of Mississippi. Museum of Natural Science, Mississippi Dept. of Wildlife, Fisheries, and Parks, Jackson, MS. July 2003. Accessed on the Internet on 12/18/2009 at http://museum.mdwfp.com/downloads/science/endangered_species_list09.pdf.

63. MNHP (Mississippi Natural Heritage Program). 2006. Correspondence to William Wenstorm, Enercon from Melanie Caudill, Data Manager/Biologist, Mississippi Natural Heritage Program Mississippi Dept. of Wildlife, Fisheries, and Parks, Jackson, MS. August 11, 2006.

64. MNHP (Mississippi Natural Heritage Program). 2010. Correspondence to Jim Thomas, Enercon from Joelle Carney, Data Manager/Conservation Biologist, Mississippi Natural Heritage Program Mississippi Dept. of Wildlife, Fisheries, and Parks, Jackson, MS. February 3, 2010.

65. MP&L (Mississippi Power & Light Company). 1978. Mississippi Power & Light Company, Middle South Energy, Inc., "Grand Gulf Nuclear Station Units 1 and 2, Final Environmental Report," Docket Nos. 50-416 and 50-417. 1978.

66. MRLCC (Multi-Resolution Land Characteristics Consortium). 2001. National Land Cover Database (NLCD 2001) Multi-Zone Download Site. U.S. Department of Interior, U.S. Geological Survey. Downloaded on 2/12/2010 from http://www.mrlc.gov/nlcd_multizone_map.php.

67. NEI (Nuclear Energy Institute). 2009. U.S. Electricity Production Costs, 1995-2008, in 2008 cents per kilowatt-hour. May 2009.

68. NIEHS/NIH. (National Institute of Environmental Health Sciences and National Institutes of Health). 2002. "EMF Electric and Magnetic Fields Associated with the Use of Electric Power," Prepared by the National Institute of Environmental Health Sciences and National Institutes of Health, Sponsored by the NIEHS/DOE EMF Rapid Program. June 2002.

69. NRC (Nuclear Regulatory Commission). 1981. *Final Environmental Statement Related to the Operation of Grand Gulf Nuclear Station, Units 1 and 2* Docket Nos. 50-416 and 50-417, NUREG-0777. September 1981.

70. NRC (U.S. Nuclear Regulatory Commission). 1988. *Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities*. NUREG-0586. Office of Nuclear Regulatory Research. Washington, D.C. August 1988.

71. NRC (Nuclear Regulatory Commission). 1996. Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS), NUREG-1437, Volumes 1 and 2, Office of Nuclear Reactor Regulation. May 1996.

72. NRC (Nuclear Regulatory Commission). 1999. Generic Environmental Impact Statement for License Renewal of Nuclear Plants. Section 6.3, “Transportation,” and Table 9-1, “Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants.” NUREG-1437, Volume 1, Addendum 1. Office of Nuclear Reactor Regulation. August 1999.

73. NRC (Nuclear Regulatory Commission). 2006. *Environmental Impact Statement for an Early Site Permit (ESP) at the Grand Gulf ESP Site*, Final Report, NUREG-1817. April 2006.

74. NRC (Nuclear Regulatory Commission). 2009. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS)*, Draft Report for Comment, NUREG-1437, Volume 1, Revision 1, Office of Nuclear Reactor Regulation. July 2009.

75. NRC (Nuclear Regulatory Commission). 2010. NUREG-0713, Volume 30, Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities, 2008 Forty-First Annual Report, Appendix C. January 2010.

76. Schramm, H.L. 2004. Status and Management of Mississippi River Fisheries. USGS Mississippi Cooperative Fish and Wildlife Research Unit, Mississippi State, Mississippi, *in* Proceedings of the second International symposium on the management of large rivers for fisheries, Vol. 1, 302-334 pp.

77. USACE (United States Army Corp of Engineers). 2004. The Mississippi River and Tributaries Project. http://www.mvn.usace.army.mil/pao/bro/misstrib.htm. Accessed June 24, 2009.

78. USCB (United States Census Bureau). 2008. Population Estimates: All Incorporated Places 2000 to 2008, http://www.census.gov/popest/cities/cities.html. Accessed December 18, 2009.

79. USFWS (U.S. Fish and Wildlife Service). 2007. Correspondence to Dr. Sam Damico from Kathy Lunceford, Fish and Wildlife Biologist, Mississippi Field Office, Jackson, MS. November 5, 2007

80. USFWS (U.S. Fish and Wildlife Service). 2008. Mississippi List of Threatened and Endangered Species by County. Mississippi Ecological Services, U.S. Fish and Wildlife Service, Southeast Region website. August, 2008. Accessed on the Internet on 12/18/2009 at http://www.fws.gov/mississippiES/pdf/SpeciesbyCounty.pdf.

81. USFWS (United States Fish and Wildlife Service). 2009. Lower Mississippi Fisheries Coordination Office Station Facts. Vicksburg, MS.

82. USFWS (United States Fish and Wildlife Service). 2010a. Correspondence to James Thomas, Enercon from Stephen M. Ricks, Field Supervisor, United States Department of the Interior, Fish and Wildlife Service, Mississippi Field Office, Jackson, MS. February 8, 2010.

83. USFWS (United States Fish and Wildlife Service). 2010b. Correspondence to Clay Cromwell, Wildlife Technical Services from Stephen M. Ricks, Field Supervisor, United States Department of the Interior, Fish and Wildlife Service, Mississippi Field Office, Jackson, MS. April 28, 2010.

84. USGS (United States Geological Survey). 1998. Mississippi River *in* Status and Trends of the Nation's Biological Resources. Vol.2. 351-384 pp. Mac, M. J., P. A. Opler, C. E. Puckett Haecker, and P. D. Doran, eds.

85. WTS (Wildlife Technical Services). 2010a. Correspondence to Stephen Ricks, U.S. Fish and Wildlife Service, Jackson, MS, from Clay Cromwell, Wildlife Technical Services. April 28, 2010.

86. WTS (Wildlife Technical Services). 2010b. Correspondence to Jim Woodrick, Mississippi Department of Archives and History, Review and Compliance Officer, Jackson, MS, from Clay Cromwell, Wildlife Technical Services. February 5, 2010.