3.0 THE PROPOSED ACTION

3.1 Description of the Proposed Action

The proposed action is to renew the GGNS OL, which would preserve the option for Entergy to continue to operate GGNS to provide base-load power throughout the 20-year license renewal period. For GGNS (Facility OL NPF-29), the requested renewal would extend the license expiration date from midnight November 1, 2024, to midnight November 1, 2044.

In summary, as explained in this ER, there are no changes related to license renewal with respect to operation of GGNS that would significantly affect the environment during the period of extended operation. In addition, there is no refurbishment or other construction activities anticipated in association with license renewal.

3.2 General Plant Information

The principal structures at GGNS consist of the containment structure, turbine building, auxiliary building, control building, diesel generator building, standby service water cooling towers and basins, enclosure building, radwaste building, ISFSI, radial collector well system, auxiliary cooling tower, and the natural draft cooling tower. [GGNS 2010a, Section 1.2.2.2] Figure 2.1-3 shows the general features of the facility and the exclusion area boundary (EAB). No residences are permitted within the GGNS EAB.

3.2.1 Reactor and Containment Systems

3.2.1.1 Reactor System

The site uses a BWR-6 boiling water reactor in the nuclear steam supply system and a closed-cycle cooling water system that withdraws make-up water from the Mississippi River Alluvium groundwater aquifer. General Electric supplied the nuclear steam supply system. GGNS achieved commercial operation in 1985.

The current licensed thermal power level, which is 3,898 megawatts-thermal with a maximum net power output of approximately 1,297 MWe, 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 addition, as a result of an EPU that is scheduled to occur in 2012, the licensed thermal power level will increase to 4,408 MWt, with a maximum net power output of approximately 1,475 MWe [GGNS 2010h, Attachment 4 - Section 2.1].

Fuel for GGNS is made of low-enrichment (less than 5% by weight) high-density ceramic uranium dioxide fuel pellets stacked within a Zircaloy-2 cladding tube that is evacuated, backfilled with helium, and sealed with Zircaloy end plugs in each end of the tube [GGNS 2010a, Sections 1.2.2.3.1 and 4.1.2.1.3.1]. Based on core design value, the maximum average burnup level of any fuel rod would continue to be less than 62,000 MWd/MTU, which ensures that peak burnups remain within the acceptable limits specified in Appendix B to Subpart A of 10 CFR Part 51 (Table B-1) [GGNS 2010h, Attachment 4 - Section 7.2].

3.2.1.2 Containment System

The containment structure encloses the reactor coolant system, the drywell, suppression pool, upper pool, and some of the engineered safety feature systems and supporting systems. The functional design basis of the containment, including its penetrations and isolation valves, is to contain with adequate design margin the energy released from a design basis loss-of-coolant accident and to provide a leak tight barrier against the uncontrolled release of radioactivity to the environment, even assuming a partial loss of engineered safety features. The enclosure building encloses the upper portion of the containment above the auxiliary building roof level, and provides a boundary for the standby gas treatment system, which maintains a negative pressure in the volume between the containment and enclosure building to ensure that leakage of radioactive materials from the containment is filtered prior to release to the environment in the unlikely event of a loss-of coolant accident. [GGNS 2010a, Section 1.2.2.2] These two containment systems and associated engineered safety features are designed and maintained so that off-site doses resulting from postulated design basis accidents are below the values stated in 10 CFR Part 100.

3.2.2 Cooling and Auxiliary Water Systems

3.2.2.1 Circulating Water System

The circulating water system (CWS) provides the main condenser with a continuous supply of cooling water to remove the heat rejected from the cycle utilizing natural draft and auxiliary cooling towers. 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 PSW system. [GGNS 2010a, Section 1.2.2.5.7] After implementation of EPU, scheduled to occur in 2012, circulating water makeup is estimated to be 27,860 gpm with 7,170 gpm being returned to the Mississippi River via blowdown [GEHNE, Section 3.3.1]; therefore, a maximum of 20,690 gpm of water would be consumed, mainly through evaporation and drift from the natural draft and auxiliary cooling towers.

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. [GGNS 2010a, Section 1.2.2.2]

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. [GGNS 2010a, Section 10.4.5.2] The auxiliary cooling tower is typically operated as needed in accordance with plant standard operating procedures to maintain circulating water temperatures in the desired control band. Therefore, water being supplied to the condenser is anticipated to be less than 90°F year round.

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. [USNRC 2006a, 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 (Figure 3.2-1). 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. [USNRC 1981, Section 4.2.4]

The requirements associated with thermal discharges as outlined in Condition Number L-3 of GGNS NPDES Permit MS0029521 are as follows: [GGNS 2011a]

> Thermal Mixing Zone: 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 a depth of 5 feet. The river edge shall be defined 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 Modeling: 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 the summer months (May–October). If these conditions occur and the plant is generating power, monitoring shall be performed upriver at PT.1 (surface/5 feet sub-surface), 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 months), the river stages which existed at the time of thermal modeling will then become the standard river stage during which a subsequent monitoring exercise must be performed if the river falls below that stage during each period of thermal monitoring.

GGNS is also required to conduct thermal monitoring during the winter and summer months preceding the submittal year of the permit renewal application and include the results in the submittal [MDEQ 2011a, pg. 17].

3.2.2.2 Plant Service Water System

PSW is supplied from four radial collector wells located in the floodplain that parallels the Mississippi River, with an additional new well scheduled to become operational in 2012 to enhance PSW availability (Figure 2.3-7). The radial collector wells, which are permitted with the MDEQ with a maximum capacity of 10,000 gpm (Table 2.3-3), are designed to derive water from the Mississippi River via induced infiltration. These wells were constructed by sinking a cylindrical concrete caisson into the alluvium aquifer, sealing the bottom with a concrete plug, and projecting as many as 12 horizontal, screened,16-inch perforated pipes horizontally near the base of the caisson into the aquifer (Figure 3.2-2). [USNRC 1981, Section 4.2.3; GGNS 2010a, Section 2.4.13.1.3.1]

Each radial 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 5,000 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. Water is collected in the radial wells and pumped, during normal operation, into a single underground main header which supplies the PSW system. In addition, supply makeup water to the standby service water cooling towers, administration building, and fire protection system is provided by the radial wells. Pumps at each radial collector well are provided with a recirculation line which discharges to the river bank via a 20-inch diameter pipeline. This recirculation line allows the purging of any sand and/or sediment that may accumulate in the laterals or wells prior to startup or use of the wells. [GGNS 2010a, Sections 2.4.13.1.3.1 and 9.2.10.2]

During normal operation, as many wells and pumps as required are operated to meet the plant demand. The makeup requirements for the circulating water system are expected to be the primary demand. [GGNS 2010a, Section 9.2.10.2] Table 2.3-3 shows the annual average withdrawal rates associated with the four radial wells for 2005, 2008, 2009, and 2010.

3.2.2.3 Standby Service Water System

The Standby Service Water (SSW) System consists of two forced draft cooling towers, two SSW pumps, one High Pressure Core Spray service water pump, and instrumentation necessary for providing a reliable source of heat rejection for plant components that require cooling during a normal or emergency plant shutdown or in the event of a reactor isolation. The SSW System is the ultimate heat sink for removal of reactor decay heat. [GGNS 2003, pg. 6]

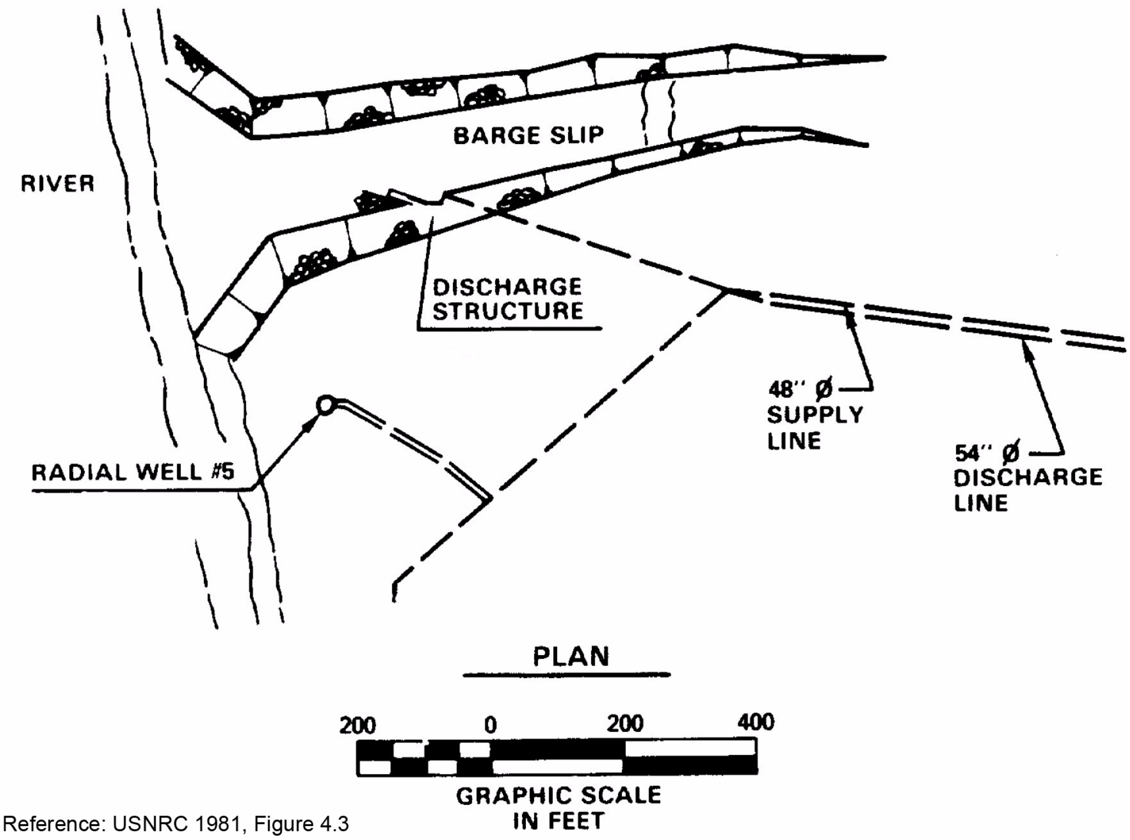
Makeup for both standby service water basins is provided automatically by the PSW System. In the event the PSW System is not available, the service water basins contain enough water (15 million gallons) to ensure the availability of the system for 30 days. [GGNS 2003, pgs. 6-7]

Associated with each SSW basin is a forced draft cooling tower and associated fans for cooling the water returning to the basin. Each SSW cooling tower is divided into four cooling cells, two for each unit. Each cooling cell contains its own cooling fan and drift eliminators. As SSW is returned to the basin cooling towers through spargers, the cooling tower fans draw air through the sparger spray to remove the heat. [GGNS 2003, pg. 9]

Periodically, the addition of chemicals to the SSW System is required for control of scaling, biological growth, and general corrosion. Over time, the accumulation of fouling agents may require that the system be blown down to assist in water chemistry control. To accommodate the required blowdown, lines are connected to the SSW pump discharge lines with the blowdown flow routed to the plant discharge basin (NPDES Outfall 001). [GGNS 2003, pg. 8]

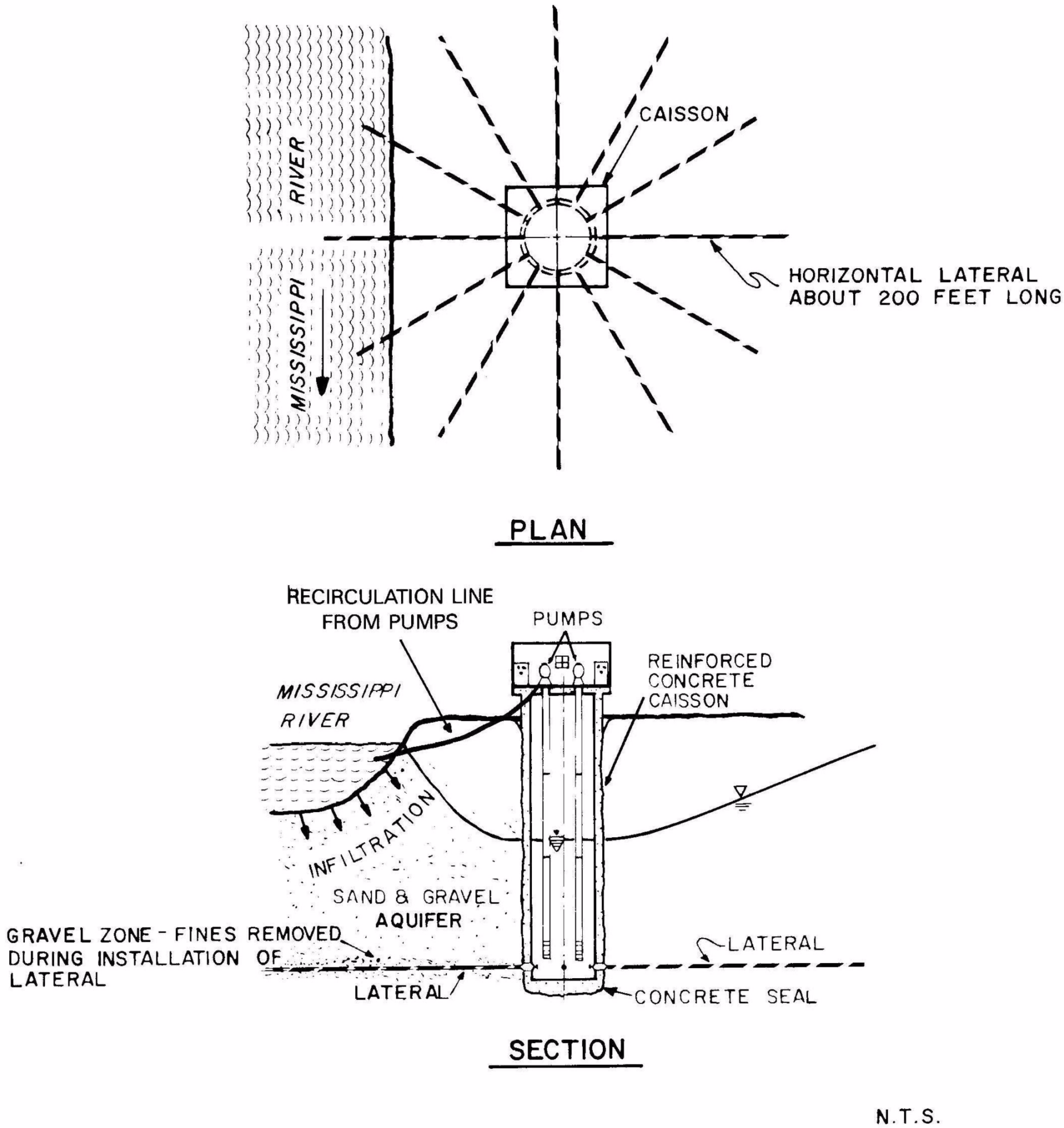
3.2.2.4 Domestic Water Well Systems

As previously discussed in Section 2.3.4.3, three wells (North Construction Well and the North and South Drinking Water Wells) are currently installed near the bluff in the Upland Complex terrace deposits for groundwater withdrawal. The North Construction Well and the North and South Drinking Water Wells (Construction Wells 1, 3, and 4, respectively, listed in Table 9.1-1) are used for domestic water, once-through cooling for plant air conditioners, and for regenerating the water softeners at the Energy Services Center. The CS&I Water Association #1 also supplies potable water needs for the GGNS recreational vehicle trailer park, firing range, Health Physics calibration laboratory, and environmental garden areas.



Reference: USNRC 1981, Figure 4.3

Figure 3.2-1
GGNS Discharge Structure



Reference: GGNS 2010a, Figure 2.4-30.

Figure 3.2-2
Radial Collector Well

3.2.3 Radioactive Waste Treatment Processes (Gaseous, Liquid, and Solid)

GGNS radioactive waste systems are designed to collect, treat, and dispose of radioactive and potentially radioactive wastes that are byproducts of plant operations. These byproducts include activation products resulting from the irradiation of reactor water and impurities therein (principally metallic corrosion products) and fission products resulting from their migration through the fuel cladding or uranium contamination within the reactor coolant system.

Radioactive wastes resulting from plant operations are classified as liquid, gaseous, or solid. Liquid radioactive wastes are generated from liquids received directly from portions of the reactor coolant system or were contaminated by contact with liquids from the reactor coolant system. Gaseous radioactive wastes are generated from gases or airborne particulates vented from reactor and turbine equipment containing radioactive material. Solid radioactive wastes are solids from the reactor coolant system, solids that came into contact with reactor coolant system liquids or gases, or solids used in the reactor coolant system or steam and power conversion system operation or maintenance.

3.2.3.1 Liquid Radwaste System

The design objective of the liquid radwaste system is to collect, process, recycle, or dispose of potentially radioactive wastes produced during the operation of the plant. Therefore, radioactivity concentrations which result from effluent releases during normal plant operation will be below the regulatory limits of 10 CFR Part 20 and will result in doses below the "as low as reasonably achievable" guidelines set forth in 10 CFR Part 50, Appendix I. [GGNS 2010a, Section 11.2.1.1]

The liquid effluents from the liquid radwaste system are continuously monitored, and the discharges are terminated if the effluents exceed preset radioactivity levels. These levels are specified in the ODCM. [GGNS 2010a, Section 11.2.1.1]

As discussed below, the liquid radwaste system is composed of a group of subsystems designed to collect and treat different types of liquid waste. These subsystems are designated as the equipment drain processing subsystem (clean radwaste), floor drain processing subsystem (dirty radwaste), chemical waste subsystem, and miscellaneous supporting subsystems. [GGNS 2010a, Section 11.2.2]

3.2.3.1.1 Equipment Drains (Clean Radwaste)

High quality, generally low conductivity (less than 100 μmho/cm) wastes collected in the various equipment drain sumps (floor and equipment drains system) located throughout the plant are pumped to one of the two equipment drain collector tanks located in the radwaste building. This subsystem will normally be operated on a batch basis 24 hours per day. [GGNS 2010a, Section 11.2.2.1]

The waste, collected in one of the two 40,000-gallon equipment drain collector tanks, is pumped at a maximum process flow rate of 300 gpm through a precoat-type filter. After being filtered, the waste is processed through a mixed deep-bed non-regenerative demineralizer and discharged into one of two 40,000-gallon sample tanks. If the demineralizer is not operating, the waste can be bypassed directly to the sample tank or processed in the floor drain demineralizer, depending on the water quality. Provisions are also available for interfacing with mobile filtration equipment or alternative waste processing equipment. [GGNS 2010a, Section 11.2.2.1]

Conductivity elements are located upstream and downstream of the equipment drain demineralizer to signal improper equipment operation. Prior to pumping the recycled water back to the condensate storage tank, samples are taken from the sample tank to assure that the water quality meets the requirements for reuse. If the water in a sample tank does not meet the specified requirements, it can be pumped back to the corresponding collector tank or the waste surge tank. [GGNS 2010a, Section 11.2.2.1]

In addition to the tanks which are considered part of the equipment drain processing subsystem, there are two waste surge tanks (interconnected) with a total capacity of 100,000 gallons. These tanks are normally used to collect surge volumes of liquid wastes for processing and can accommodate very large transient waste generation (e.g., discharge from the suppression pool and residual heat removal (RHR) systems). The waste collected in the waste surge tanks can be processed as equipment drain waste, except that the condensate precoat filter backwash wastes, produced during startup, which are normally collected by the condensate phase separator tanks, can also be collected in the waste surge tanks and transferred directly to the solid radwaste system for disposal. In the event neither the equipment drain nor floor drain processing equipment is available, there is adequate storage in the collector tanks for approximately three days accumulation of waste (assuming an average daily total input of 32,052 gallons). Both subsystem flow rates are adequate to process the anticipated waste volumes from both equipment drains and floor drains. [GGNS 2010a, Section 11.2.2.1]

3.2.3.1.2 Floor Drains (Dirty Radwaste)

Lower quality, intermediate-conductivity (between 100 and 1,000 µmho/cm) wastes collected in the various floor drain sumps (floor and equipment drains system) located in the drywell, containment, auxiliary building, and radwaste building and chemical drain subsystem wastes are pumped directly to the floor drain collector tank (capacity 30,000 gallons) in the radwaste building. Turbine building floor drains and drains from the control building are first routed through the liquid radwaste system floor drain oil separator; oil-free effluent from the oil separator is then allowed to overflow to the floor drain collector tank. These wastes will contain a lesser percentage of reactor coolant water than the waste treated as equipment drain waste. [GGNS 2010a, Section 11.2.2.2]

The floor drain waste is filtered and demineralized with the same type of equipment as the equipment drain waste. This subsystem will normally be operated on a batch basis 24 hours per day. As with the equipment drain subsystem, provisions are available for interfacing with mobile filtration equipment or alternative waste processing equipment. [GGNS 2010a, Section 11.2.2.2]

If it is impractical to clean up the floor drain subsystem inventory to meet condensate water quality standards, the water can either be discharged to the environment or sent back to the floor drain collector tank or waste surge tank. Prior to discharge of water to the environs, it may be processed through mobile filtration equipment or alternative waste processing equipment. Up to 100 percent of this waste may be discharged. All discharges will be monitored for concentration of radioactive material and evaluated for doses to unrestricted areas in accordance with the ODCM. [GGNS 2010a, Section 11.2.2.2]

There is sufficient storage capacity in the floor drain collector tank to accommodate the average flow from the floor drain subsystem for approximately 2.5 days (assuming an average daily input of 11,775 gallons). [GGNS 2010a, Section 11.2.2.2]

This subsystem is so sized that, in the event the equipment drain processing subsystem is unavailable, the floor drain subsystem can accommodate the entire equipment drain flow without detrimental effect on plant operation. [GGNS 2010a, Section 11.2.2.2]

3.2.3.1.3 Chemical Waste Subsystem

Chemical wastes from laboratory drains, equipment decontamination, and drains from systems that have chemical additives are transferred from the chemical waste sumps (floor and equipment drains system) located in various areas of the plant to the miscellaneous chemical waste receiver tank (capacity 10,000 gallons) located in the radwaste building. [GGNS 2010a, Section 11.2.2.3]

The Advanced Resin Cleaning Subsystem (ARCS) is located in the area where the resin regeneration equipment had previously been located on Elevation 93'-0" of the Turbine Building. The drains in the immediate vicinity are chemical waste drains. Even though the ARCS does not produce chemical wastes, the drains for the ARCS are routed to the chemical waste drains in the immediate vicinity. These ARCS drains will be mixed and processed along with dirty radwaste. Also, mobile filtration equipment or alternative waste processing equipment may be used to process this waste. [GGNS 2010a, Section 11.2.2.3]

3.2.3.1.4 Miscellaneous Support Subsystems

The following support items are included as part of the liquid radwaste system to serve the noted functions:

Oil Separation

The floor drain oil separator is used to prevent oil from entering the liquid radwaste processing stream, thus avoiding potential problems in attaining high-quality effluent for return to condensate storage or for plant discharge. Oil is separated from the water on the basis of the difference in their specific gravities. Oil which is collected on the surface of the water is removed by a skimming process. The oil-free effluent from the oil separator overflows, by gravity, to the floor drain collector tank. [GGNS 2010a, Section 11.2.2.4]

RWCU Phase Separation and Decay

Wastes resulting from the backwash of the reactor water cleanup (RWCU) system filter/demineralizers and fuel pool cooling and cleanup (FPC&CU) system filter/demineralizers are transferred from the containment and auxiliary building, respectively, to one of the two RWCU phase separator decay tanks located in the radwaste building. The RWCU decant pump draws off excess water and transfers it to the equipment drain collector tank for further processing. When sufficient decay of the RWCU and FPC&CU precoat material waste has been achieved, the contents of the tank are slurried with condensate and pumped to the solid radwaste system for disposal. [GGNS 2010a, Section 11.2.2.4]

Spent Resin

The spent resin tank collects exhausted resins from the equipment drain and floor drain demineralizers and condensate demineralizers. The spent resin pump is used to provide motive force to the spent resin tank sparger to slurry the resins and to transfer the resin slurry to the solid radwaste system for disposal. [GGNS 2010a, Section 11.2.2.4]

Condensate Phase Separation

Wastes resulting from the backwash of the condensate cleanup system precoat filters are transferred from the turbine building to one of two condensate phase separator tanks located in the radwaste building. Excess water is gravity drained to the waste surge tanks or RWCU phase separator decay tanks for further processing. When processing of the spent filter precoat material is desired, the contents of the tank are slurried with condensate and pumped to solid radwaste system for disposal. [GGNS 2010a, Section 11.2.2.4]

Removal of Resin Fines, Particles and Other Impurities

Liquid radwaste flow from the equipment drain demineralizer is filtered via the liquid radwaste cartridge filter before going into the equipment drain sample tanks and subsequently to the condensate storage tank. [GGNS 2010a, Section 11.2.2.4]

Alternative Liquid Radioactive Waste Processing Equipment

The radwaste system includes provisions for use of alternate liquid radioactive processing equipment. This equipment may include strainers, carbon bed filters, cartridge filters, a reverse osmosis unit, and other components which process liquid radioactive wastes. Alternative liquid waste processing equipment will be used in conjunction with existing radwaste system equipment such as collection tanks, transfer piping and demineralizers. [GGNS 2010a, Section 11.2.2.4]

3.2.3.1.5 Radioactive Releases

Control of liquid releases from the liquid radwaste system includes a radiation monitor, an effluent flow control valve, and dilution water flow rate monitoring equipment. The system design provides an automatic isolation signal in the event that the measured radioactivity level, release rate, or dilution water flow rate departs from preset ranges of values. This design ensures radioactive liquid releases will be controlled in accordance with applicable regulations and impacts to offsite areas will be consistent with as low as reasonably achievable (ALARA) concepts. [GGNS 2010a, Section 11.2.3]

3.2.3.1.6 Liquid Effluent Releases

Controls for limiting the release of radiological liquid effluents are described in the ODCM. Controls are based on (1) concentrations of radioactive materials in liquid effluents and projected dose or (2) dose commitment to a hypothetical member of the public.

The concentration of radioactive material released in liquid effluents to unrestricted areas is limited to ten times the effluent concentrations specified in 10 CFR Part 20, Appendix B, Table 2, Column 2 for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the concentration is limited to 2 x 10^{-4} microcuries/ml total activity. [GGNS 2009a, Section 6.11.1]

The dose or dose commitment to a member of the public from radioactive materials in liquid effluents released to unrestricted areas are limited during any calendar quarter to $\leq$ 0.015 mSv (1.5 mrem) to the total body and to $\leq$ 0.05 mSv (5 mrem) to any organ, and during any calendar year to $\leq$ 0.03 mSv (3 mrem) to the total body and to $\leq$ 0.10 mSv (10 mrem) to any organ. [GGNS 2009a, Section 6.11.2]

Radioactive liquid wastes are subject to the sampling and analysis program described in the ODCM.

3.2.3.2 Gaseous Waste Management Systems

The purpose of the gaseous radwaste system is to process and control the release of gaseous radioactive wastes to the site environs so that the total radiation exposure to persons outside the controlled area does not exceed the maximum limits of the applicable 10 CFR Part 20 regulations. [GGNS 2010a, Section 1.2.2.9.1]

Noncondensible radioactive offgas is continuously removed from the main condenser by the air ejector during plant operation [GGNS 2010a, Section 11.3.2.1]. The offgas system uses a catalytic recombiner to recombine radiolytically dissociated hydrogen and oxygen. After cooling (to approximately 130ºF) to strip the condensibles and reduce the volume, the remaining noncondensibles (principally air with traces of krypton and xenon) will be delayed in the ten-minute holdup system. The gas is cooled to 45ºF and filtered through a high efficiency particulate air (HEPA) filter. The gas is then passed through a desiccant dryer that reduces the dewpoint to approximately -90ºF and is then chilled to about 0ºF. Charcoal adsorption beds, operating in a refrigerated vault at about 0ºF, selectively adsorb and delay the xenons and kryptons from the bulk carrier gas (principally dry air). After the delay, the gas is again passed through a HEPA filter and discharged to the environment through the plant vent. [GGNS 2010a, Section 11.3.2.1.1] Continuous radiation monitors are provided and would isolate the offgas system on high radioactivity in order to prevent gas of unacceptably high activity from release. [GGNS 2010a, Section 1.2.2.9.1]

Gaseous effluents are released from the radwaste building vent, the turbine building vent, the containment vent, the auxiliary vent, and standby gas treatment A and B, when they operate. The mechanical vacuum pump exhausts to the turbine building vent, and the offgas system exhausts to the radwaste building vent. [GGNS 2010a, Section 11.3.3.2]

3.2.3.2.1 Gaseous Effluent Releases

Controls for limiting the release of radiological gaseous effluents are described in the ODCM. The gaseous radwaste system is used to reduce radioactive materials in gaseous effluents before discharge to meet the dose design objectives in 10 CFR Part 50, Appendix I. In addition, the limits in the ODCM are designed to provide reasonable assurance that radioactive material discharged in gaseous effluents would not result in the exposure of a member of the public in an unrestricted area in excess of the limits specified in 10 CFR Part 20, Appendix B.

The dose rate due to radioactive materials released in gaseous effluents from the site to areas at and beyond the site boundary is limited to $\leq$ 5 mSv/yr (500 mrem/yr) to the total body and $\leq$ 30 mSv/yr (3,000 mrem/yr) to the skin for noble gases, and $\leq$ 15 mSv/yr (1,500 mrem/yr) to any organ for Iodine-131, Iodine-133, tritium, and all radionuclides in particulate form with half-lives greater than eight days. [GGNS 2009a, Section 6.11.4]

The air dose due to noble gases released in gaseous effluents from the site to areas at and beyond the site boundary is limited to $\leq$ 0.05 mGy (5 mrad) for gamma radiation and $\leq$ 0.1 mGy (10 mrad) for beta radiation during any calendar quarter and $\leq$ 0.1 mGy (10 mrad) for gamma radiation and $\leq$ 0.2 mGy (20 mrad) for beta radiation during any calendar year. [GGNS 2009a, Section 6.11.5]

The dose to a member of the public from Iodine-131, Iodine-133, tritium, and radionuclides in particulate form with half-lives greater than eight days in gaseous effluents released from the site to areas at and beyond the site boundary is limited to $\leq$ 0.075 mSv (7.5 mrem) to any organ during any calendar quarter and $\leq$ 0.15 mSv (15 mrem) to any organ during any calendar year. [GGNS 2009a, Section 6.11.6]

The radioactive gaseous waste sampling and analysis program specifications provided in the ODCM address the gaseous release type, sampling frequency, minimum analysis frequency, type of activity analysis, and lower limit of detection.

3.2.3.3 Solid Waste Processing

The solid radwaste system, which is located in the Radwaste Building, is designed to provide solidification and packaging for radioactive wastes that are produced during shutdown, startup, and normal plant operation, and to store these wastes until eventual offsite burial. [GGNS 2010a, Section 11.4] The solid radwaste system has also been designed to limit the radiation exposure to personnel to ALARA per 10 CFR Part 50, Appendix I, during system operations.

3.2.3.3.1 General Description

The solid radwaste system consists of the following:

Waste Holding Tanks (3)

These tanks function as batch tanks to provide a starting point for the solids waste process. They also provide capability for dewatering resins and high-solid-content wastes and for mixing these wastes. The agitator provides homogeneous waste slurry. These tanks are vented to the Radwaste Building ventilation system. Overflows from the waste holding tanks are directed to the radwaste building floor drain sump for reprocessing through the liquid radwaste system. The holding tanks have the provisions to obtain representative waste samples that may be removed for chemical lab analysis if necessary. [GGNS 2010a, Section 11.4.2.2]

Waste Transfer Pumps (3)

These pumps transfer the homogenous waste stream from the waste holding tanks and may also function as transfer pumps for recycling wastes back to the liquid radwaste system for additional waste processing or storage. [GGNS 2010a, Section 11.4.2.2]

Bridge Crane

This crane is locally controlled and provides a means of moving containers from the fill area to the solid waste storage area and from the waste storage area to the shipping area. The crane is also used for moving empty containers to the fill area. [GGNS 2010a, Section 11.4.2.2]

Disposable Shipping Containers

For storage and transporting solid wastes, 55-gallon, United States Department of Transportation (USDOT) standard drums and other containers approved by USDOT and the waste disposal facility are used. [GGNS 2010a, Section 11.4.2.2]

Mobile Solidification Station

This station, located in the radwaste building railroad bay, provides interfaces with all liquid radwaste system tanks, which normally input to the solid radwaste system, and with necessary plant auxiliaries to accommodate the use of mobile, or portable, waste processing systems. [GGNS 2010a, Section 11.4.2.2]

None of the above tanks use compressed gases for transport or drying of resins or filter sludge. [GGNS 2010a, Section 11.4.2.2]

3.2.3.3.2 Management of Wet Wastes

When either of the two liquid radwaste filters reaches the end of its filtering cycle, the flow through the filter is terminated. The filter is then drained of excess water and the solid radioactive wastes centrifugally discharged from the precoat filter. The filter is capable of discharging a maximum of approximately 26.5 cubic feet, at one time, either as a wet sludge or as a dry cake (approximately 50% by weight moisture). The filter wastes are collected in the waste holding tank located directly below the filter. Once the filter waste has been collected in this tank, it is then pumped by the tank-associated waste transfer pump to the waste processing station. The wastes are normally pumped into liners and dewatered. If solidification is required, it is performed by a vendor, using their own operating procedures and process control program accepted by the USNRC or GGNS. High solids content wastes (reactor water cleanup backwash, fuel pool cooling and cleanup wastes, spent resins, condensate resin cleaning, condensate precoat filter backwash), which are not filtered, are sluiced directly to the waste processing station. After sufficient time for the solids to settle is allowed, excess water is decanted and then processed as described above. [GGNS 2010a, Section 11.4.2.3]

After capping, smear swipe sampling, and decontamination (if required), the container is moved by the solid radwaste handling crane to the appropriate storage area. When it is time to ship the container offsite for burial or further processing, the solid radwaste handling crane picks up the container and moves it onto the waiting truck. [GGNS 2010a, Section 11.4.2.3]

The decontamination station is used for cleaning and inspection of the filled shipping containers. After decontamination, a smear swipe is taken of the side of the container and analyzed for gross beta-gamma and alpha surface contamination. The container is also classified as to its dose rate at a specified distance; this determines its storage location in the decay area and shielding requirements for shipment. [GGNS 2010a, Section 11.4.2.3]

3.2.3.3.3 Management of Dry Wastes

The solid radwaste system also disposes of dry waste consisting of small tools, air filters, miscellaneous paper, rags, equipment parts which cannot be effectively decontaminated, wood, and solid laboratory waste. Compressible wastes can be shipped offsite and compacted to reduce their volume. Noncompressible wastes are packaged manually in appropriate containers. Because of its low activity, this waste can be stored until enough is accumulated to permit economic transportation offsite for final disposal or further processing. [GGNS 2010a, Section 11.4.2.4.8]

Storage areas for dry waste are provided in various locations throughout the plant. These areas are posted in accordance with the requirements of 10 CFR Part 20 and are arranged to maintain personnel exposures ALARA. [GGNS 2010a, Section 11.4.2.4.8]

3.2.3.3.4 Low-Level Mixed Wastes

Although low-level mixed wastes would be managed and transported to an offsite facility licensed to accept and manage the wastes in accordance with appropriate site and company procedures, there is currently no mixed waste being generated or stored on the GGNS site.

3.2.3.3.5 Radwaste Storage—License Renewal Term

GGNS has developed long-term plans which would ensure that radwaste generated during the license renewal term would either be stored on-site in existing structures or shipped to an offsite licensed facility for processing and disposal. Long-term plans, including during the license renewal term, do not include constructing additional onsite storage facilities to accommodate generated radwaste.

3.2.3.3.6 Spent Fuel Storage

The GGNS ISFSI pad (Phase I and Phase II) is designed with 92 cask storage locations. This configuration will provide storage for 88 Holtec storage casks with four spare cask storage locations provided for cask unloading, if required. This provides for storage of 5,984 GGNS spent fuel assemblies at 68 assembles per cask. [Entergy 2010a]

3.2.4 Transportation of Radioactive Materials

GGNS radioactive waste shipments are packaged in accordance with USNRC and USDOT requirements. The type and quantities of solid radioactive waste generated at and shipped from GGNS vary from year to year, depending on plant activities. GGNS currently transports radioactive waste to a licensed processing facility in Tennessee such as the Studsvik, Duratek (owned by Energy Solutions), or Race (owned by Studsvik) facilities, where the wastes are further processed prior to being sent to a facility such as EnergySolutions in Clive, Utah. GGNS may also transport material from an offsite processing facility to a disposal site or back to the plant site for reuse or storage.

3.2.5 Radiological Environmental Monitoring Program

The GGNS REMP is designed for the following:

- Analyzing important pathways for anticipated types and quantities of radionuclides released into the environment.
- Considering the possibility of a buildup of long-lived radionuclides in the environment and identifying physical and biological accumulations that may contribute to human exposures.

- Considering the potential radiation exposure to plant and animal life in the environment surrounding GGNS.
- Correlating levels of radiation and radioactivity in the environment with radioactive releases from station operation.

The GGNS REMP was established in 1978 prior to the station becoming operational (1985) to provide data on background radiation and radioactivity normally present in the airborne, direct radiation, waterborne and ingestion pathways. The REMP includes sampling indicator and control locations within an I8-mile radius of the plant [GGNS 2009a, Section 3.1]. The REMP utilizes indicator locations near the site to show any increases or buildup of radioactivity that might occur due to station operation and control locations farther away from the site to indicate the presence of only naturally occurring radioactivity. GGNS personnel compare indicator results with control and preoperational results to assess any impact GGNS operation might have had on the surrounding environment.

3.2.6 Groundwater Protection Monitoring Program

In May 2006 NEI approved the GPI, an industry-wide voluntary effort to enhance nuclear power plant operators' management of groundwater protection. Industry implementation of 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 and also describes more open and transparent communication of those instances to external stakeholders. Aspects addressed by the initiative include site hydrology and geology, site risk assessment, onsite groundwater monitoring, and remediation. In August 2007 NEI published updated guidance on implementing the GPI as NEI 07-07 "Industry Ground Water Protection Initiative—Final Guidance Document." The goal of the GPI is to reduce any impact on groundwater from the accidental release of licensed material to the environment. In addition to the GPI, the Underground Piping and Tanks Integrity Initiative (NEI 09-14) was developed and is being implemented by the industry to proactively manage the reliability of underground piping and tanks with a goal of protecting structural integrity and preventing leaks.

In 2007, after the initial site characterization was completed, GGNS began sampling groundwater from existing onsite wells situated in the Upland Complex aquifer to monitor for potential releases of licensed material via groundwater pathways at the site in accordance with nuclear fleet administrative and site procedures [Entergy 2008a; Entergy 2011a; GGNS 2011j]. Since 2007, additional wells have been installed and existing wells situated in the Catahoula aquifer were sampled to further enhance GGNS' monitoring efforts. GGNS has sampled several onsite wells since 2007 for informational purposes. Representative wells currently sampled under the GPI program are shown in Figure 3.2-3. Results associated with GGNS groundwater monitoring efforts are discussed in Section 9.1.3.8.

Elements of the GPI related to site characterization, risk evaluation, groundwater monitoring program, precipitation studies, remediation protocols, voluntary reporting, and briefings to external stakeholders of accidental releases of licensed material to the environment are conducted and implemented in accordance with Entergy Nuclear's fleet radiological groundwater monitoring program procedure. [Entergy 2011a]

In regard to the Buried Piping Integrity Initiative and the subsequent Underground Piping and Tanks Integrity Initiative programs, GGNS initiated compliance in accordance with the schedule and program elements cited in NEI 09-14 (Revision 1). GGNS has completed the risk ranking of buried piping segments, developed an inspection plan for underground piping and tanks, and is currently implementing inspections in accordance with the schedule outlined in the Buried Piping Integrity Initiative.

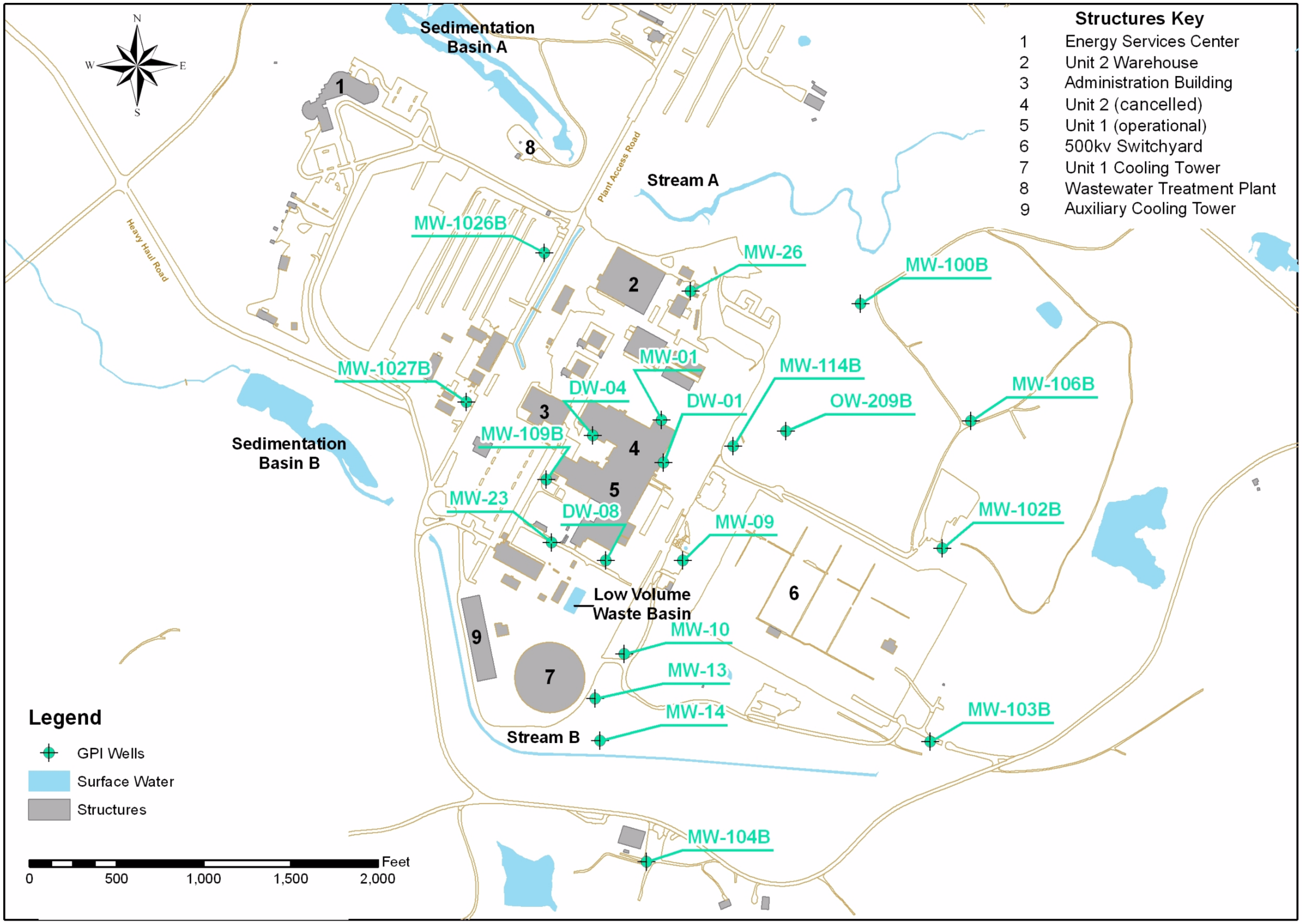


Figure 3.2-3
Radiological Groundwater Monitoring Wells

3.2.7 Meteorological System

3.2.7.1 Permanent and Backup Towers

GGNS has a primary and backup tower at heights of 162 ft and 33 ft, respectively, for monitoring and collecting meteorological data. The 162 ft tower has the following equipment installed at each of the indicated levels (all heights above grade) [GGNS 2010a, Section 2.3.3.1]:

Surface	Tipping bucket rain gauge
	Delta temperature (utilizes 33- and 162-foot temperature sensors)
33 feet	Wind speed sensor
	Wind direction sensor
	Temperature sensor
	Relative humidity sensor
162 feet	Wind speed sensor
	Wind direction sensor
	Temperature sensor

The 33-ft tower has temperature, wind speed and wind direction sensors. [GGNS 2010a, Table 2.3-170]

Meteorological data from the primary tower are supplemented with information from the backup meteorological system. The backup system monitors temperature, wind speed, wind direction, and sigma theta. The information from the backup system is supplied to the control room via a telemetry system and is utilized to ensure data availability should a temporary loss of information from the permanent tower occur. [GGNS 2010a, Section 2.3.3.1]

3.2.7.2 Meteorological Data Processing

The primary tower serves as a representative observation station (i.e., meteorological conditions at that location are considered to be representative of the site). The 162-foot meteorological tower with base elevation of 156 feet MSL is located approximately 5,300 feet northwest of the control building of the station. The nearest bluffs are 362 feet to the west of the meteorological tower. There are trees approximately 50 feet high along these bluffs. Approximately 50 feet below the bluffs, the floodplain extends 4,500 feet to the west to meet the Mississippi River at an elevation of 65 feet MSL. To the south and to the east, the nearest trees are approximately 489 feet and 396 feet from the tower, respectively. Tree heights in these directions are between 50 to

60 feet. A country road passes the meteorological tower 600 feet to the north. The meteorological tower is surrounded by a fence which is eight feet high. An instrument shack about eight feet high is installed approximately 400 feet north of the tower. The immediate vicinity of the tower is covered by Bermuda grass which is mowed as necessary. The soil beneath the grass is loess. [GGNS 2010a, Section 2.3.3.1]

The data processing procedure for GGNS meteorological data involves data collection (recorded in digital form), data editing and consolidation, and data analysis. Computer software has been developed to process the collected data as it relates to data editing, consolidation and analysis. [GGNS 2010a, Section 2.3.3.2.1]

All wind speeds are recorded in miles per hour. Wind directions are recorded on a 0-360° scale. Temperatures are recorded in degrees Fahrenheit. The precipitation is a step trace, each step representing 0.01 inches. Relative humidity is recorded on a 0–100% scale. Sigma Theta is calculated and recorded in degrees. [GGNS 2010a, Section 2.3.3.2.2.1]

The digital data package is received by the plant data computer at least every ten seconds. It is recorded each time the value varies by a specified deadband. Each piece of data is checked to assure it is between the minimum and maximum instrument limits. This quality indication and the time are recorded with each value. [GGNS 2010a, Section 2.3.3.2.2.2]

An average is calculated every fifteen minutes and each hour from the readings. The quality of the samples is reflected in the quality of the average. This quality indication and the time the average was calculated is recorded with each value. [GGNS 2010a, Section 2.3.3.2.2.2]

The meteorological data are available to the main control room and personnel via the plant computer. A reading every ten seconds or less, a fifteen-minute average, and an hourly average are available for each of the following parameters [GGNS 2010a, Section 2.3.3.2.2.2]:

- Wind speed - 10-meter (33 foot) and 50-meter (162 foot) elevations
- Wind direction - 10-meter (33 foot) and 50-meter (162 foot) elevations
- Temperature - 10-meter (33 foot) and 50-meter (162 foot) elevations
- Differential temperature (T) - 10-meter (33 foot) and 50-meter (162 foot) elevations
- Relative Humidity - 10-meter (33 foot) elevation (every ten seconds or less, and hourly only)
- Precipitation - ground level
- Sigma Theta - 10-meter (33 foot) and 50-meter (162 foot) elevations (fifteen minutes and hourly only)

- Aspirator flow - 10-meter (33 foot) and 50-meter (162 foot) elevations (fifteen minutes and hourly only)

The meteorological data are gathered from the plant data computer recordings on request. The data can also be acquired from data storage modules in the MET Shack. The quality of the hourly averages is used to determine the data reliability. The data are then available for correction or change and reliability is evaluated again. [GGNS 2010a, Section 2.3.3.2.3]

The hourly readings are used to calculate joint frequency distributions from wind speeds and wind direction data for the 10 meter and 50 meter levels. These frequency distributions are summarized on request for each Pasquill Stability Class. [GGNS 2010a, Section 2.3.3.2.3]

3.2.7.3 Meteorological Instrumentation Inspection and Maintenance

GGNS has established procedures for the inspection and maintenance of the onsite meteorological instrumentation. Routine inspections are made to ensure proper operation of equipment and that no damage to the tower, shack, or any other structure or equipment has occurred. [GGNS 2010a, Section 2.3.3.3]

Semiannual visual inspections of the tower and equipment are made to determine the conditions of sensors, cabinets, wiring, and individual components. Semi-annual checks for proper instrumentation readings are made at various points. A check for the "As-Found" and "Final" data condition are made to verify proper operation of the equipment. A check on the batteries and battery charger is made. The tower cables are adjusted for proper tension, and the following instrumentation calibrated on the primary tower [GGNS 2010a, Section 2.3.3.3]:

- 2 - Temperature sensor - Elevation 33'–162' (10–50 meters)
- 1 - Relative Humidity - Elevation 33' (10 meters)
- 1 - Wind speed - Elevation 33', 162' (10 meters, 50 meters)
- 1 - Wind direction - Elevation 33', 162' (10 meters, 50 meters)
- 1 - Rain gauge - Surface near primary tower

The following instruments are calibrated on the back-up tower [GGNS 2010a, Section 2.3.3.3]:

- 1 - Temperature sensor, Elevation 33' (10 meters)
- 1 - Wind speed, Elevation 33' (10 meters)
- 1 - Wind direction, Elevation 33' (10 meters)

3.2.8 Nonradioactive Waste Systems

3.2.8.1 Resource Conservation and Recovery Act (RCRA) Wastes

Nonradioactive waste is produced from plant maintenance, cleaning, and operational processes. The majority of waste types generated at GGNS are recyclables consisting of universal waste batteries, universal waste fluorescent lamps, scrap metals, used oil, used oil filters, used tires, electronics for recondition, and mercury-containing equipment. The majority of nonhazardous wastes generated typically consist of blasting media, oil contaminated wastes, wastewater and wastewater sludges, and occasional project specific wastes. Since GGNS is classified as a small quantity generator, hazardous wastes routinely make up only a small percentage of the total wastes generated, which consist of aerosols, oil and solvent waste, paint wastes, spent and off-specification (e.g., shelf-life expired) chemicals, and occasional spill cleanup debris.

Nonradioactive wastes are collected in central collection areas and managed in accordance with Entergy's fleet waste management procedure. [Entergy 2008b] The materials are received in various forms and are packaged to meet all regulatory requirements prior to final disposition at an offsite facility licensed to receive and manage the material. Typical waste types tracked by quantities at the facility are shown in Table 3.2-1. Although waste quantities generated each year may vary due to outages or specific project activities, GGNS has been very successful in the amount of wastes that have been recycled on an annual basis over the previous five years as shown in Table 3.2-1.

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 (EN) Waste Minimization Plan. [Entergy 2008h] This Plan, which also identifies waste streams (current and potential) generated at the facility, is used in conjunction with Entergy fleet 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 fleet procedures to minimize waste generation to the maximum extent practicable. [Entergy 2008b; Entergy 2008c; Entergy 2011c]

Table 3.2-1
Nonradioactive Waste Generation (Typical Pounds)

Waste Stream	2006[(1)]	2007[(2)]	2008[(3)]	2009[(4)]	2010[(5)]
Hazardous Wastes	3,450	1,580	2,727	1,767	1,780
Nonhazardous Wastes	14,914	424,035[a]	44,515	21,231	80,885
Recycled Wastes	35,217	185,605	76,613	50,502	101,334

References: (1) GGNS 2007b; (2) GGNS 2008c; (3) GGNS 2009b; (4) GGNS 2010c; (5) GGNS 2011f

a. Waste generation increased due to a one-time intensive site cleanup activity.

3.2.8.2 Wastewater Discharges

Chemical additives approved by MDEQ are used to control the pH, scale, and corrosion in the circulating water system. These liquids are combined with cooling water discharges that flow to the Mississippi River 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. The current GGNS NPDES permit authorizes discharges from 11 outfalls (three external and eight internal). The outfalls and their associated effluent limits are listed in Table 3.2-2.

As shown in Table 3.2-2, NPDES Outfall 006 is a holding basin that receives low volume wastewaters. Although wastewaters transferred to this basin may contain small quantities of water treatment chemicals, the basin is clay-lined to prevent the potential for any groundwater infiltration. In addition, no groundwater monitoring requirements are imposed by the NPDES Permit as it relates to this basin.

Table 3.2-2
NPDES Permitted Outfalls

Outfall	Description	Parameter	Limit
001	Discharge Basin	Flow Temperature Free Available Chlorine[a] Chlorination[a] pH	Report only (monthly average and maximum) Report only (monthly average and maximum) 0.2 mg/l monthly average 0.5 mg/l monthly maximum 120 minutes daily maximum (6.0–9.0 SU)
002	Cooling Tower Blowdown	Flow Free Available Chlorine Chlorination Zinc	Report only (monthly average and maximum) 0.2 mg/l monthly average 0.5 mg/l monthly maximum 120 minutes daily maximum 1.0 mg/l monthly average 1.0 mg/l monthly maximum
004	Standby Service Water A	Flow Free Available Chlorine Chlorination Zinc	Report only (monthly average and maximum) 0.2 mg/l monthly average 0.5 mg/l monthly maximum 120 minutes daily maximum 1.0 mg/l monthly average 1.0 mg/l monthly maximum
005	Standby Service Water B	Flow Free Available Chlorine Chlorination Zinc	Report only (monthly average and maximum) 0.2 mg/l monthly average 0.5 mg/l monthly maximum 120 minutes/ daily maximum 1.0 mg/l monthly average 1.0 mg/l monthly maximum

**Table 3.2-2 (Continued)
NPDES Permitted Outfalls**

Outfall	Description	Parameter	Limit
006	Low Volume Waste Basin[b]	Flow Oil and Grease Total Suspended Solids	Report only (monthly average and maximum) 15 mg/l monthly average 20 mg/l monthly maximum 30 mg/l monthly average 100 mg/l monthly maximum
007	Stormwater	Flow Total Suspended Solids Oil and Grease Total Residual Chlorine	Report only (monthly average and maximum) 30 mg/l monthly average 100 mg/l monthly maximum 15 mg/l monthly average 20 mg/l monthly maximum Report only (monthly average and maximum)
010	Sewage Treatment Plant	Flow Biochemical Oxygen Demand Total Suspended Solids Fecal Coliform Total Residual Chlorine pH	Report only (monthly average and maximum) 30 mg/l monthly average 45 mg/l monthly maximum 30 mg/l monthly average 45 mg/l monthly maximum 200/100 ml monthly average[c] 400/100 ml monthly maximum[c] 2,000/100 ml monthly average[d] 4,000/100 ml monthly maximum[d] Report only (monthly average) 0.5 mg/l monthly maximum (6.0–9.0 SU)
011	Liquid Radwaste	Flow Total Suspended Solids	Report only (monthly average and maximum) Report only (monthly average) 30 mg/l monthly maximum
013	Sedimentation Basin A	Flow Total Suspended Solids Zinc Iron[e] pH	Report only (annual average and maximum) Report only (annual average and maximum) Report only (quarterly average) 0.065 mg/l quarterly maximum Report only Report only (minimum and maximum)
014	Sedimentation Basin B	Flow Total Suspended Solids Zinc Arsenic[e] Copper[e] pH	Report only (annual average and maximum) Report only (annual average and maximum) Report only (quarterly average) 0.065 mg/l quarterly maximum Report only Report only (6.0–9.0 SU)

Table 3.2-2 (Continued)
NPDES Permitted Outfalls

Outfall	Description	Parameter	Limit
016	Energy Services Center	Flow Total Residual Chlorine pH	Report only (annual average and maximum) Report only (annual average) 0.5 mg/l annual maximum (6.0–9.0 SU)

Reference: GGNS 2011a

a. Required when PSW bypasses the cooling towers and discharges directly to the Discharge Basin.
b. Clay-lined basin.
c. Limit applies only during the months of May–October.
d. Limit applies only during the months of November–April.
e. Permit condition requires monthly sampling for 12 months.

3.2.8.3 Air Emissions

GGNS is classified as a minor air emission source. Although GGNS may periodically utilize a portable auxiliary boiler or generator(s) during outages, nonradioactive gaseous effluents result primarily from testing of emergency generators and diesel pumps. To be protective of Mississippi's ambient air quality standards and 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. Permitted emission points and associated requirements are shown in Table 3.2-3.

Table 3.2-3
Air Permitted Emission Points

Emission Point	Description	Permit Condition
AA-001	Division 1 Standby Emergency Diesel Generator	Fuel Sulfur Limit Operational Run Time Opacity
AB-001	Division 2 Standby Emergency Diesel Generator	
AC-001	Division 3 Standby Emergency Diesel Generator	
AA-002	Fire Water Pump Diesel Engine A	
AB-002	Fire Water Pump Diesel Engine B	
AC-002	Energy Services Center Diesel Generator	
AA-003	Operations Support Center Diesel Generator	

Table 3.2-3 (Continued)
Air Permitted Emission Points

Emission Point	Description	Permit Condition
AB-003	Division 1 Diesel Start Engine	Fuel Sulfur Limit Opacity
AC-003	Division 2 Diesel Start Engine	
AD-003	Division 3 Diesel Start Engine	
AE-003	Water Well Diesel Engine	Fuel Sulfur Limit Operational Run Time Opacity
AA-004	Outage Equipment	
AA-008	Unit 1 CWS Cooling Tower	None
AA-009	Standby Service Water A Cooling Tower	
AA-010	Standby Service Water B Cooling Tower	
AA-011	Telecommunications Emergency Diesel Generator	Fuel Sulfur Limit Operational Run Time Opacity

Reference: GGNS 2004

3.2.8.4 Nonradioactive Spills

The use and storage of chemicals at GGNS are controlled in accordance with Entergy's fleet chemical control procedure and site-specific spill prevention plans [Entergy 2011c; GGNS 2006c; GGNS 2011k]. In addition, as previously discussed in Section 3.2.8.1, nonradioactive wastes are managed in accordance with Entergy's waste management procedure which contains preparedness and prevention control measures. [Entergy 2008b] These procedures and plans are designed to prevent and minimize the potential for a chemical release to the environment.

3.2.9 Maintenance, Inspection, and Refueling Activities

Various programs and activities currently at the site maintain, inspect, test, and monitor the performance of plant equipment. These programs and activities include, but are not limited to, those implemented to:

- Meet the requirements of 10 CFR Part 50, Appendix B (Quality Assurance), Appendix R (Fire Protection), Appendices G and H, Reactor Vessel Materials.
- Meet the requirements of 10 CFR 50.55a, American Society of Mechanical Engineers, Boiler and Pressure Vessel Code, Section XI, In-service Inspection and Testing Requirements.

- Meet the requirements of 10 CFR 50.65, the maintenance rule.

- Maintain water chemistry in accordance with EPRI guidelines.

Additional programs include those implemented to meet Technical Specification surveillance requirements, those implemented in response to USNRC generic communications, and various periodic maintenance, testing, and inspection procedures necessary to manage the effects of aging on structures and components. Certain program activities are performed during the operation of the units, while others are performed during scheduled refueling outages.

3.2.10 Power Transmission Systems

3.2.10.1 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 (Figure 2.1-2) 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 Extra High Voltage (EHV) switchyard. [MP&L, 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 three miles of this section of the route is located 1/4 to 1/2 mile west of U.S. 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 ROW for 2.2 miles in Warren County. [MP&L, Section 3.9.3.1] The ROW width associated with this line is approximately 200 feet. 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. [MP&L, Section 3.9.1.3] Major highways crossed by this line are U.S. 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. 61, this route does not cross any heavily traveled roads or approach any populous areas. [MP&L, Section 3.9.3.3] The ROW width associated with this line is approximately 200 feet.

- 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.

EMI would continue to utilize the 500 kV switchyard located on the GGNS property and the associated in-scope transmission lines discussed above for system flow even in the absence of GGNS.

3.2.10.2 Out-of-Scope Transmission Lines

The transmission lines which are not within the scope of license renewal include the following:

- 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. It is not used for distributing power from the Station to the electrical grid. [MP&L, Section 3.9.1.4]

- The Ray Braswell line was constructed for purposes of connecting GGNS Unit 2 to the grid. However, EOI formally requested the USNRC to terminate the Construction Permit and officially cancel the second unit at GGNS, which was granted by the USNRC in August 1991. The Ray Braswell line is not connected to GGNS Unit 1 but is used by Entergy for system transmission flow.

- There are 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.

3.2.10.3 Transmission Line Ownership

As previously stated in Section 1.2, EMI owns and operates the in-scope transmission lines identified above. EMI's Transmission Group is responsible for maintenance associated with the lines, such as maintaining clearances and vegetation management as discussed below.

3.2.10.4 Transmission Line Patrol Process

The Baxter-Wilson and Franklin transmission lines are inspected by air and/or ground at least three times per year [Entergy 2009a, Section 5.1.5.1]. During the inspections, the line name and number and span number(s) are noted where encroaching vegetation is identified, along with the type of encroachment and the recommended mitigation measures to remove this possible threat (pruning, mowing, herbicide application, or tree or vine cutting). This information is then entered into Entergy's Vegetation Work Management System where it is prioritized and corrected. [Entergy 2009a, Section 5.1.5.3]

3.2.10.5 Vegetation Management Practices

Entergy uses both mechanical and hand-clearing methods (trimming, pruning, tree removal, and mowing) as well as herbicide applications to manage ROW vegetation as discussed below. The appropriate method is chosen based on public safety, personnel safety, long-term cost effectiveness, and impact to the environment. [Entergy 2008f, Response No. 14]

- Mechanical and Hand-Clearing Methods

  Various types of treatments to control and manage ROW vegetation are utilized, including hand-clearing, cutting, pruning, trimming, tree removal, and mowing using manual crews on the ground or with bucket trucks with aerial lifts. These activities are performed in accordance with current specifications and arboricultural standards. Larger trees are generally trimmed or pruned to achieve adequate clearances from transmission lines. Mowing small trees and other woody vegetation at or near ground level may be performed to prepare the area for follow-up herbicide treatments and to control vegetative growth in the ROW. In special/sensitive areas (i.e., streams, ditches, ponds, or other easily erodible areas), maintenance is performed in a manner that minimizes or prevents erosion. Appropriate ground cover (for example: re-seeded grasses, straw, or rock) may be added to minimize erosion. [Entergy 2008f, Response No. 14] Brush and debris are left as is after cutting, except in places that are not appropriate because of land use or by the demands of the landowners objecting to leaving the brush. No brush (trees and branches) is left in roads, creeks, rivers, or croplands. [Entergy 2009a, Attachment 1, Section 7.3.1]

- Herbicide Application

  Chemical herbicide floor applications are performed within all areas of the ROW floor containing undesirable woody vegetation which has the potential to grow near or into the electrical lines. [Entergy 2009a, Attachment 2, Section 7.3.3] All undesirable woody vegetation within the ROW corridor floor, regardless of size, is treated to satisfactorily control that vegetation. All trees and/or brush 12 feet tall or taller are cut down and then the stumps treated with the proper herbicide(s) for plant control. [Entergy 2009a, Attachment 2, Section 7.3.5.4]

  For managing vegetation in wetland and aquatic habitat areas along transmission line ROWs, Entergy employs personnel on foot equipped with backpack sprayers as the standard method when applying herbicides. This manual application approach is the most unobtrusive method, allowing selective-type herbicides to be applied safely, effectively, and with limited impact to the environment. Other application methods may be used when conditions warrant (e.g., personnel safety threatened by unstable terrain or in areas that are difficult to access). Entergy only uses USEPA-approved herbicides specifically approved for wetlands and aquatic area applications as specified on the herbicide's specimen label and the material safety data sheet. Only contractors with USDA state-approved herbicide licenses are allowed to apply herbicides on the ROW. [Entergy 2008f, Response No. 14]

As discussed in Section 9.1.3.11, GGNS periodically utilizes herbicides at the site. Herbicides typically consist of six products that control grass, brush, and trees and may either be hand-applied or mechanically applied. Although there is no ROW associated with the in-scope 500 kV transmission line from the plant to the switchyard, any herbicide usage under this line would be conducted in accordance with the manufacturer's label.

3.2.10.6 Franklin Line—Specific Conditions

A segment of the Franklin transmission line must also meet the requirements of the USDA—Forest Service Special Use Permit for the construction, operation, and maintenance of the line that passes through the Bude Range District of Homochitto National Forest (approximately 38.6 acres of ROW) [USDA 1976]. Also, in 2003, Entergy entered into a partnership with the National Wild Turkey Federation to maintain transmission line ROWs on the Homochitto National Forest using low-toxicity herbicides in lieu of mechanical clearing for the purpose of producing a more open, grassy habitat [USNRC 2006a, Section 2.7.1.1].

3.2.10.7 Avian Protection

Avoiding avian collisions with transmission lines is largely a function of avoiding important habitat areas when possible, avoiding the bisecting of resting and feeding areas for sensitive species when possible, and using devices such as bird diverters. For 500 kV transmission lines such as Baxter-Wilson and Franklin, Entergy utilizes as guidance the Avian Power Lines Interaction Committee suggested practices for minimizing avian interactions with transmission lines, where appropriate [Entergy 2008f, Response No. 15]. In accordance with Entergy Transmission's practices, avian mortalities are required to be reported by employees. When mortalities do occur, these events are recorded, the potential causes along with past outage data are analyzed, and a decision is made on what retrofit would mitigate the situation, if any. [Entergy 2010c; Entergy 2011b]

Based on discussion with Entergy's Transmission personnel, there have been no recorded avian mortalities or any concerns raised in the past along the Baxter-Wilson and Franklin transmission line corridors. Therefore, there has been no need to implement protective or mitigation measures. [Entergy 2010c]

3.3 Refurbishment Activities

In accordance with 10 CFR 51.53(c)(2), a license renewal applicant's environmental report must contain a description of the proposed action, including the applicant's plans to modify the facility or its administrative control procedures as described in accordance with 10 CFR 54.21 of this chapter. This report must describe in detail the modifications directly affecting the environment or affecting plant effluents that affect the environment.

The objective of the review required by 10 CFR 54.21 is to determine whether the detrimental effects of aging could preclude certain systems, structures, and components from performing in accordance with the current licensing basis during the additional 20 years of operation requested in the license renewal application.

The evaluation of structures and components as required by 10 CFR 54.21 has been completed and is described in the body of the GGNS License Renewal Application. This evaluation did not identify the need for refurbishment of structures or components for purposes of license renewal as described in the GEIS and there are no such refurbishment activities planned at this time.

3.4 Programs and Activities for Managing the Effects of Aging

The programs for managing the effects of aging on certain structures and components within the scope of license renewal at the site are described in the body of the license renewal application (see Appendix B of the GGNS License Renewal Application). The evaluation of structures and components required by 10 CFR 54.21 identified some new activities necessary to continue operation of the site during the additional 20 years beyond the initial license term. These activities are described in the body of the license renewal application. The additional inspection activities are consistent with normal plant component inspections and therefore are not expected to cause significant environmental impact.

3.5 Employment

The non-outage work force at the site consists of approximately 690 persons (Table 3.5-1). There are no plans to add employees to support plant operations during the extended license renewal period. During refueling outages, which usually last 25–30 days, there is typically an additional 700–900 contractor employees on-site. Although GGNS plans to change to a 24-month refueling cycle in the future, current refueling outages occur every 18 months. The number of workers required on-site for normal plant outages during the period of extended operation is expected to be consistent with the number of additional workers used for past outages at the site.

Based on the comparison of the GGNS April 2003 employed workforce (700) shown in Table 2-13 of NUREG-1817 to that of the November 2009 employed workforce (690) shown in Table 3.5-1, Entergy considers Table 3.5-1 representative of the current 2011 GGNS employed workforce.

Table 3.5-1
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

**Table 3.5-1 (Continued)
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
Cobb (Georgia)	1
Marietta	1

Table 3.5-1 (Continued)
Employee Residence Information (November 2009)

County, State, and City	Employees (Entergy and Baseline Contractors)
Claiborne (Louisiana)[a]	1
Homer	1
Concordia (Louisiana)[a]	3
Ferriday	1
Ridgecrest	1
Vidalia	1
Madision (Louisiana)[a]	2
Tallulah	2
Richland (Louisiana)[a]	2
Delhi	2
TOTAL	**690**

Reference: GGNS 2009c

a. Based on Parish, State, and City

4.0 ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION

4.0.1 Discussion of GEIS Categories for Environmental Issues

The USNRC has identified and analyzed 92 environmental issues that it considers to be associated with nuclear power plant license renewal and has designated the issues as Category 1, Category 2, or NA (not applicable). USNRC designated an issue as Category 1 if the following criteria were met:

- The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristic.
- A single significance level (i.e., small, moderate, or large) has been assigned to the impacts that would occur at any plant, regardless of which plant is being evaluated (except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent-fuel disposal).
- Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely to be not sufficiently beneficial to warrant implementation.

If the USNRC concluded that one or more of the Category 1 criteria could not be met, USNRC designated the issue Category 2, which requires plant-specific analysis. USNRC designated two issues as NA, signifying that the categorization and impact definitions do not apply to these issues. USNRC rules do not require analyses of Category 1 issues that were resolved using generic findings (10 CFR Part 51, Appendix B, Table B-1) as described in the GEIS [USNRC 1996, Section 1.7.2]. Therefore, an applicant may reference the GEIS findings for Category 1 issues, absent new and significant information.

4.0.2 Category 1 License Renewal Issues

Entergy has determined that, of the 69 Category 1 issues, 11 are not applicable to the GGNS site because they apply to design or operational features that do not exist at the facility. In addition, because GGNS does not plan to conduct refurbishment activities, the USNRC findings for the seven issues applicable to refurbishment do not apply. Table 4.0-1 lists these 18 issues and provides a brief explanation of why they are not applicable to the site. Table 4.0-2 lists the 51 issues applicable to the site. Entergy reviewed the USNRC findings on these 51 issues and identified no new and significant information that would invalidate the findings for the site (Section 5.0). Therefore, Entergy adopts by reference the USNRC findings for these Category 1 issues.

In addition, although not yet regulatory requirements, Entergy also reviewed the USNRC findings on new Category 1 issues proposed per 74 FR 38117 for purposes of completeness but not in order to satisfy governing regulatory requirements. Based on Entergy's review, there was no new and significant information that would invalidate the findings for the site. Therefore, Entergy adopts by reference the USNRC findings for these proposed new Category 1 issues.

Table 4.0-1
Category 1 Issues Not Applicable to GGNS

Category 1 Issue	Comment
Surface Water Quality, Hydrology, and Use (for all plants)	
Impacts of refurbishment on surface water quality	No refurbishment activities planned.
Impacts of refurbishment on surface water use	No refurbishment activities planned.
Altered current patterns at intake and discharge structures	GGNS utilizes a closed-cycle cooling system.
Altered salinity gradients	GGNS does not discharge to an estuary.
Altered thermal stratification of lakes	GGNS is not located on a lake.
Eutrophication	GGNS does not discharge to a lake or reservoir.
Water use conflicts (plants with once-through cooling systems)	GGNS utilizes a closed-cycle cooling system.
Aquatic Ecology (for all plants)	
Refurbishment	No refurbishment activities planned.
Entrainment of phytoplankton and zooplankton	GGNS utilizes groundwater for cooling purposes and does not have an intake structure.
Aquatic Ecology (for plants with cooling tower based heat dissipation systems)	
Entrainment of fish and shellfish in early life stages for plants with cooling-tower-based heat dissipation systems	GGNS utilizes groundwater for cooling purposes and does not have an intake structure.
Impingement of fish and shellfish for plants with cooling-tower-based heat dissipation systems	GGNS utilizes groundwater for cooling purposes and does not have an intake structure.
Groundwater Use and Quality	
Impacts of refurbishment on groundwater use and quality	No refurbishment activities planned.
Groundwater quality degradation (saltwater intrusion)	GGNS is located on a freshwater body.
Groundwater quality degradation (cooling ponds in salt marshes)	GGNS is located on a freshwater body and does not use cooling ponds.

Table 4.0-1 (Continued)
Category 1 Issues Not Applicable to GGNS

Category 1 Issue	Comment
Terrestrial Resources	
Cooling pond impacts on terrestrial resources	GGNS does not use cooling ponds.
Human Health	
Radiation exposures to the public during refurbishment	No refurbishment activities planned.
Occupational radiation exposures during refurbishment	No refurbishment activities planned.
Socioeconomics	
Aesthetic impacts (refurbishment)	No refurbishment activities planned.

Table 4.0-2
Category 1 Issues Applicable to GGNS

Surface Water Quality, Hydrology, and Use (for all plants)
Temperature effects on sediment transport capacity
Scouring caused by discharged cooling water
Discharge of chlorine or other biocides
Discharge of sanitary wastes and minor chemical spills
Discharge of other metals in waste water
Aquatic Ecology (for all plants)
Accumulation of contaminants in sediments or biota
Cold shock
Thermal plume barrier to migrating fish
Distribution of aquatic organisms
Premature emergence of aquatic insects
Gas supersaturation (gas bubble disease)
Low dissolved oxygen in the discharge
Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses
Stimulation of nuisance organisms (e.g., shipworms)
Aquatic Ecology (for plants with cooling-tower-based heat dissipation systems)
Heat shock for plants with cooling tower-based heat dissipation systems
Groundwater Use and Quality
Groundwater use conflicts (potable and service water; plants that use less than 100 gpm)
Groundwater quality degradation (Ranney wells)
Terrestrial Resources
Cooling tower impacts on crops and ornamental vegetation
Cooling tower impacts on native plants
Bird collisions with cooling towers
Power line right-of-way management (cutting and herbicide application)
Bird collisions with power lines
Impacts of electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock)
Floodplains and wetlands on power line right-of-way
Air Quality
Air quality effects of transmission lines
Land Use
Onsite land use
Power line right-of-way land use impacts

Table 4.0-2 (Continued)
Category 1 Issues Applicable to GGNS

Human Health
Microbiological organisms (occupational health)
Noise
Radiation exposures to public (license renewal term)
Occupational radiation exposures (license renewal term)
Socioeconomics
Public services: public safety, social services, and tourism and recreation
Public services: education (license renewal term)
Aesthetic impacts (license renewal term)
Aesthetic impacts of transmission lines (license renewal term)
Postulated Accidents
Design basis accidents
Uranium Fuel Cycle and Waste Management
Offsite radiological impacts (individual effects from other than the disposal of spent fuel and high-level waste)
Offsite radiological impacts (collective effects)
Offsite radiological impacts (spent fuel and high-level waste disposal)
Nonradiological impacts of the uranium fuel cycle
Low-level waste storage and disposal
Mixed waste storage and disposal
Onsite spent fuel
Nonradiological waste
Transportation
Decommissioning
Radiation doses (decommissioning)
Waste management (decommissioning)
Air quality (decommissioning)
Water quality (decommissioning)
Ecological resources (decommissioning)
Socioeconomic impacts (decommissioning)

4.0.3 Category 2 License Renewal Issues

USNRC designated 21 issues as Category 2. Sections 4.1 through 4.21 address these issues, beginning with a statement of the issue. Entergy has determined that, of the 21 issues, eight are not applicable to the GGNS site because they apply to design or operational features that do not exist at the facility. In addition, because GGNS does not plan to conduct refurbishment activities, the four issues applicable to refurbishment do not apply. Where the issue does not apply to the site, the section explains the basis.

For the nine issues applicable to the site, the corresponding sections contain the required analyses. These analyses include conclusions regarding the significance of the impacts relative to renewal of the GGNS OL for the site and, when applicable, discuss potential mitigative alternatives to the extent required. Entergy has identified the significance of the impacts associated with each issue as SMALL, MODERATE, or LARGE consistent with the criteria that USNRC 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.

In accordance with NEPA practice, Entergy considered ongoing and potential additional mitigation in proportion to the significance of the impact to be addressed (i.e., impacts that are small receive less mitigative consideration than impacts that are large).

4.0.4 "NA" License Renewal Issues

USNRC determined that its categorization and impact-finding definitions did not apply to electromagnetic fields (chronic effect) and environmental justice. USNRC noted that applicants currently do not need to submit information on chronic effects from electromagnetic fields (10 CFR Part 51, Appendix B, Table B-1, Footnote 5). For environmental justice, USNRC does not require information from applicants but noted that the issue would be addressed in individual license renewal reviews (10 CFR Part 51, Appendix B, Table B-1, Footnote 6). Entergy has included environmental justice demographic information in Section 2.6 to assist the USNRC in this review.

4.0.5 Proposed New or Expanded Category 2 Issues

As previously discussed in Section 1.1, Entergy provided information in this ER concerning those Category 2 issues, either new or with expanded scope, that are currently in the proposed amendment to 10 CFR Part 51 [74 FR 38117]. This information was provided for purposes of completeness but not in order to satisfy governing regulatory requirements. Table 1.1-2 lists these Category 2 issues, along with the ER section(s) that provide a discussion of the issue.

Based on information provided in this ER, Entergy has concluded the following regarding associated impacts with these new or expanded Category 2 issues:

- Water Use Conflict Issues (Terrestrial and Aquatic Resources)

  Since GGNS is located on a large river with low flows greater than 3.15×10^{12} ft^3 per year and withdraws water from the alluvial aquifer for plant cooling purposes, these issues are not applicable.

- Groundwater and Soil Contamination

  There is no surface or sub-surface areas on-site that are contaminated with nonradiological industrial constituents and no ongoing spill or release corrective action measures required by EPA or State regulated cleanup or monitoring programs; there are no groundwater monitoring requirements associated with GGNS NPDES Permit MS00029521; there have been no spills over the previous five years that have triggered any regulatory reporting requirement; and GGNS has adequate spill prevention measures in place. Therefore, contamination impacts on groundwater and soil during the GGNS license renewal term is anticipated to be SMALL.

- Radionuclides Released to Groundwater

  Tritium has been detected in onsite groundwater in the Upland Complex aquifer. No plant-related tritium has been detected in groundwater sampled from the Catahoula aquifer nor in GGNS' onsite non-community, non-transient water supply system which withdraws groundwater from the Upland Complex. There has also been no tritium detected in offsite REMP wells or the nearest offsite resident well. Although groundwater in the Upland Complex and Catahoula aquifers is considered suitable for potable water purposes, the nearest well that provides water to a residence is located on Bald Hill Road, approximately one mile south-southeast from the center of GGNS Unit 1. There are no residences on Grand Gulf Road bordering the GGNS property with functioning wells. Further, there are no potentially affected residences that exist to the west of GGNS, as the GGNS property borders the Mississippi River, which provides a hydraulic boundary to groundwater transport to the west. Based on data collected since 2007, there is no indication that tritium is migrating off the GGNS plant site property at detectable concentrations. Therefore, it is concluded that radiological impacts to groundwater during the GGNS license renewal term would be SMALL.

- Impacts of Continued Plant Operations on Terrestrial Ecosystems

  Entergy has existing best management programs in place to ensure that terrestrial resources on the GGNS site and associated in-scope transmission line ROWs are protected. In addition, although the radial wells withdraw groundwater from the alluvial aquifer underlying the floodplain at GGNS, there is minimal impact on wetland terrestrial habitats due to the close hydraulic connection with the river. Further, GGNS is located on a large river, and thus there is minimal impact on in-stream and terrestrial riparian ecological communities associated with the use of groundwater for cooling tower makeup. There are also no refurbishment activities required for renewal of the GGNS OL. Therefore, impacts on terrestrial ecosystems during the GGNS license renewal term would be SMALL.

- Minority and Low-income Populations

  Entergy considered disproportionately high and adverse impacts or effects on members of the public, including minority and low-income populations (Sections 2.6.2 and 4.22), and determined that minority and low-income populations would not be disproportionately affected as a result of the renewal of the GGNS OL.

- Cumulative Impacts

  Entergy considered the potential impacts from GGNS' continued operation during the license renewal term and other past, present, and future actions in the vicinity of the site (Section 4.23). The assessment determined that the potential cumulative impacts resulting from GGNS continued operation during the license renewal term would be SMALL to MODERATE due to potential incremental offsite land use and ecological resource changes, which would be effectively mitigated, MODERATE for aquatic resources due to offsite climate change impacts, SMALL to LARGE beneficial for socioeconomics, and SMALL for remaining resources.

4.0.6 Format of Category 2 Issue Review

The review and analysis for the Category 2 issues (Table 4.0-3), along with environmental justice and cumulative impacts, are found in Sections 4.1 through 4.23. The format for the review of the issues, Sections 4.1 through 4.21, is described below.

- *Issue*: A brief statement of the issue.
- *Description of Issue*: A brief description of the issue.
- *Findings from Table B-1, Appendix B to Subpart A*: The findings for the issue from Table B-1, Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants, Appendix B to Subpart A.
- *Requirement*: Restatement of the requirement from 10 CFR 51.53(c)(3)(ii).
- *Background:* A background excerpt from the applicable section of the GEIS. The specific section of the GEIS is referenced for the convenience of the reader.

- *Analysis of Environmental Impact:* An analysis of the environmental impact as required by 10 CFR 51.53(c)(3)(ii). The analysis takes into account information provided in the GEIS, Appendix B to Subpart A of 10 CFR Part 51, as well as current specific information.
- *Conclusion*: For issues applicable to the site, the conclusion of the analysis along with the consideration of mitigation alternatives as required by 10 CFR 51.45(c) and 10 CFR 51.53(c)(3)(iii).

Table 4.0-3
Category 2 License Renewal Issues

Category 2 Issue	Applicability
Water use conflicts (plants with cooling ponds or cooling towers using make-up water from a small river with low flow)	Not Applicable
Entrainment of fish and shellfish in early life stages for plants with once-through and cooling pond heat dissipation systems	Not Applicable
Impingement of fish and shellfish for plants with once-through and cooling pond heat dissipation systems	Not Applicable
Heat shock for plants with once-through and cooling pond heat dissipation systems	Not Applicable
Groundwater use conflicts (potable, service water, and dewatering; plants that use > 100 gpm)	Not Applicable
Groundwater use conflicts (plants using cooling towers withdrawing make-up water from a small river)	Not Applicable
Groundwater use conflicts (Ranney wells)	Applicable
Groundwater quality degradation (cooling ponds at inland sites)	Not Applicable
Refurbishment impacts to terrestrial resources	Not Applicable
Threatened or endangered species	Applicable
Air quality during refurbishment (non-attainment and maintenance areas)	Not Applicable
Microbiological organisms (public health) (plants using lakes or canals, or cooling towers or cooling ponds that discharge to a small river)	Not Applicable
Electromagnetic fields, acute effects	Applicable
Housing impacts	Applicable
Public services: public utilities	Applicable
Public services: education (refurbishment)	Not Applicable
Offsite land use (refurbishment)	Not Applicable
Offsite land use - license renewal term	Applicable
Public services: transportation	Applicable
Historic and archaeological properties	Applicable
Severe accidents	Applicable

4.1 Water Use Conflicts

4.1.1 Description of Issue

Water use conflicts (plants with cooling ponds or cooling towers using make-up water from a small river with low flow).

4.1.2 Findings from Table B-1, Appendix B to Subpart A

SMALL or MODERATE. The issue has been a concern at nuclear power plants with cooling ponds and at plants with cooling towers. Impacts on in-stream and riparian communities near these plants could be of moderate significance in some situations. See 10 CFR 51.53(c)(3)(ii)(A).

4.1.3 Requirement [10 CFR 51.53(c)(3)(ii)(A)]

If the applicant's plant utilizes cooling towers or cooling ponds and withdraws make-up water from a river whose annual flow rate is less than 3.15 x 10^{12} ft^3/year (9 x 10^{10} m^3/year), an assessment of the impact of the proposed action on the flow of the river and related impacts on instream and riparian ecological communities must be provided....

4.1.4 Background

Consultation with regulatory and resource agencies indicates that water use conflicts are already a concern at two closed-cycle nuclear power plants…and may be a problem in the future…. Related to this, the effects of consumptive water use on in-stream and riparian communities could also be small or moderate, depending on the plant….[USNRC 1996, Section 4.3.2.1]

4.1.5 Analysis of Environmental Impact

As discussed in Section 2.2.1.1, 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 x 10^{12} ft^3/year for the 7-day, 10-year low flow, and 6.95 x 10^{13} ft^3/year for the 100-year flood. Thus, even the low flow stage of the Mississippi River is greater than the annual average flow standard for a small river. Therefore since GGNS is located on a large river and withdraws water from the alluvial aquifer, this issue is not applicable to the site and further analysis is not required.

4.2 Entrainment of Fish and Shellfish in Early Life Stages

4.2.1 Description of Issue

Entrainment of fish and shellfish in early life stages (for all plants with once-through and cooling pond heat dissipation systems).

4.2.2 Findings from Table B-1, Appendix B to Subpart A

SMALL, MODERATE, or LARGE. The impacts of entrainment are small at many plants, but may be moderate or even large at a few plants with once-through and cooling-pond cooling systems. Further, ongoing efforts in the vicinity of these plants to restore fish populations may increase the numbers of fish susceptible to intake effects during the license renewal period, such that entrainment studies conducted in support of the original license may no longer be valid. See 10 CFR 51.53(c)(3)(ii)(B).

4.2.3 Requirement [10 CFR 51.53(c)(3)(ii)(B]

If the applicant's plant utilizes once-through cooling or cooling pond heat dissipation systems, the applicant shall provide a copy of current Clean Water Act 316(b) determinations... or equivalent state permits and supporting documentation. If the applicant cannot provide these documents, it shall assess the impact of the proposed action on fish and shellfish resources resulting from... entrainment.

4.2.4 Background

The impacts of fish and shellfish entrainment are small at many plants, but they may be moderate or even large at a few plants with once-through cooling systems. Further, ongoing restoration efforts may increase the numbers of fish susceptible to intake effects during the license renewal period, so that entrainment studies conducted in support of the original license may no longer be valid. [USNRC 1996, Section 4.2.2.1.2]

4.2.5 Analysis of Environmental Impact

GGNS utilizes a closed-cycle cooling system with groundwater utilized as the sole cooling water source. Therefore, this issue is not applicable to the site and further analysis is not required.

4.3 Impingement of Fish and Shellfish

4.3.1 Description of Issue

Impingement of fish and shellfish (for all plants with once-through and cooling pond heat dissipation systems).

4.3.2 Findings from Table B-1, Appendix B to Subpart A

SMALL, MODERATE, or LARGE. The impacts of impingement are small at many plants but may be moderate or even large at a few plants with once-through and cooling-pond cooling systems. See 10 CFR 51.53(c)(3)(ii)(B).

4.3.3 Requirement [10 CFR 51.53(c)(3)(ii)(B)]

If the applicant's plant utilizes once-through cooling or cooling pond heat dissipation systems, the applicant shall provide a copy of current Clean Water Act 316(b) determinations... or equivalent state permits and supporting documentation. If the applicant cannot provide these documents, it shall assess the impact of the proposed action on fish and shellfish resources resulting from... impingement....

4.3.4 Background

Aquatic organisms that are drawn into the intake with the cooling water, but are too large to pass through the debris screens may be impinged against the screens. Mortality of fish that are impinged is high at many plants because impinged organisms are eventually suffocated by being held against the screen mesh, or are abraded, which can result in fatal infection. Impingement can affect large numbers of fish and invertebrates (crabs, shrimp, jellyfish, etc.). As with entrainment, operational monitoring and mitigative measures have allayed concerns about population-level effects at most plants, but impingement mortality continues to be an issue at others. Consultation with resource agencies revealed that impingement is a frequent concern at plants using once-through cooling, particularly where restoration of anadromous fish (fish that migrate from the sea to spawn in fresh water) may be affected. The impacts of impingement are small at many plants but may be moderate or even large at a few plants with once-through cooling systems. [USNRC 1996, Section 4.2.2.1.3]

4.3.5 Analysis of Environmental Impact

GGNS utilizes a closed-cycle cooling system with groundwater utilized as the sole cooling water source. Therefore, this issue is not applicable to the site and further analysis is not required.

4.4 <u>Heat Shock</u>

4.4.1 Description of Issue

Heat Shock (for all plants with once through and cooling pond heat dissipation systems)

4.4.2 Findings from Table B-1, Appendix B to Subpart A

SMALL, MODERATE, OR LARGE. Because of continuing concerns about heat shock and the possible need to modify thermal discharges in response to changing environmental conditions, the impacts may be of moderate or large significance at some plants. See 10 CFR 51.53(c)(3)(ii)(B).

4.4.3 Requirement [10 CFR 51.53(c)(3)(ii)(B)]

If the applicant's plant utilizes once-through cooling or cooling pond heat dissipation systems, the applicant shall provide a copy of current Clean Water Act... 316(a) variance in accordance with 40 CFR Part 125, or equivalent State permits and supporting documentation. If the applicant cannot provide these documents, it shall assess the impact of the proposed action on fish and shellfish resources resulting from heat shock....

4.4.4 Background

Based on the research literature, monitoring reports, and agency consultations, the potential for thermal discharges to cause thermal discharge effect mortalities is considered small for most plants. However, impacts may be moderate or even large at a few plants with once-through cooling systems. For example, thermal discharges at one plant are considered by the agencies to have damaged the benthic invertebrate and seagrass communities in the effluent mixing zone around the discharge canal; as a result, helper cooling towers have been installed to reduce the discharge temperatures. Conversely, at other plants it may become advantageous to increase the temperature of the discharge in order to reduce the volume of water pumped through the plants and thereby reduce entrainment and impingement effects. Because of continuing concerns about thermal discharge effects and the possible need to modify thermal discharges in the future in response to changing environmental conditions, this is a Category 2 issue for plants with once-through cooling systems. [USNRC 1996, Section 4.2.2.1.4]

4.4.5 Analysis of Environmental Impact

GGNS utilizes a closed-cycle cooling heat dissipation system equipped with natural draft and auxiliary cooling towers. Therefore, this issue is not applicable to the site and further analysis is not required.

4.5 Groundwater Use Conflicts (Plants Using > 100 gpm of Groundwater)

4.5.1 Description of Issue

Groundwater use conflicts (potable and service water and dewatering: plants that use more than 100 gpm).

4.5.2 Findings from Table B-1, Appendix B to Subpart A

SMALL, MODERATE, or LARGE. Plants that use more than 100 gpm may cause groundwater use conflicts with nearby groundwater users. See 10 CFR 51.53(c)(3)(ii)(C).

4.5.3 Requirement [10 CFR 51.53(c)(3)(ii)(C)]

If the applicant's plant...pumps more than 100 gallons (total onsite) of groundwater per minute, an assessment of the impact of the proposed action on groundwater use must be provided.

4.5.4 Background

Those nuclear plants that use groundwater may affect the utility of groundwater to neighbors. This impact could occur as a direct effect of pumping groundwater, thereby either lowering the water table and reducing the availability or inducing infiltration of water of lesser quality into the ground. Neighboring groundwater users could also be affected indirectly if construction or operation of the power plant were to disrupt the normal recharge of the groundwater aquifer. The impact to neighboring groundwater users is likely to be most significant at a site where water resources are limited. Groundwater usage impact may be important at those sites where a power plant's usage rate exceeds 0.0063 m^3/s (100 gpm). Lower usage rates are not expected to impact sole source or other aquifers significantly. [USNRC 1996, Section 4.8.1].

4.5.5 Analysis of Environmental Impact

GGNS has eight wells for plant dewatering activities (Figure 2.3-7), although there has not been a need to operate them over previous years. The North Construction Well and the North and South Drinking Water Wells (Construction Wells 1, 3, and 4, respectively listed in Table 9.1-1) shown in Figure 2.3-7 are used for domestic water, once-through cooling for plant air conditioners, and for regenerating the water softeners at the Energy Services Center. As discussed in Section 2.3.4.2, water for these wells is supplied from the Upland Complex, while public water supply wells in Claiborne County are supplied from the Catahoula Formation or Miocene aquifer.

It was determined in the GGNS Unit 3 COLA that even with the additional groundwater required for GGNS Unit 3 construction activities, such as dewatering, concrete batch plant operation, dust suppression, potable water and sanitary needs, the drawdown from withdrawals in the Upland Complex would result in a SMALL impact beyond the GGNS property boundaries [SERI 2008b, Sections 4.2.2.2, 4.2.2.3, and 4.2.2.4]. Since the GGNS dewatering and potable water supply wells have not created a groundwater use conflict during the current operational period, impacts would continue to be SMALL during the license renewal term.

However, as shown in Table 2.3-3, these wells do not collectively utilize more than an annual average of 100 gpm. Since the GGNS workforce is not anticipated to increase during the license renewal term, as discussed in Section 3.5, the annual average usage associated with these wells is not expected to increase. Therefore, this issue is not applicable to the site and further analysis is not required.

Entergy addresses groundwater use conflicts associated with the Ranney Wells in Section 4.7 below.

4.6 Groundwater Use Conflicts (Plants Using Cooling Towers Withdrawing Make-Up Water from a Small River)

4.6.1 Description of Issue

Groundwater use conflicts (plants using cooling towers withdrawing make-up water from a small river).

4.6.2 Findings from Table B-1, Appendix B to Subpart A

SMALL, MODERATE, or LARGE. Water use conflicts may result from surface water withdrawals from small water bodies during low flow conditions which may affect aquifer recharge, especially if other groundwater or upstream surface water users come on line before the time of license renewal. See 10 CFR 51.53(c)(3)(ii)(A).

4.6.3 Requirement [10 CFR 51.53(c)(3)(ii)(A)]

If the applicant's plant utilizes cooling towers or cooling ponds and withdraws make-up water from a river whose annual flow rate is less than 3.15×10^{12} ft^3/year (9×10^{10} m^3/year).... The applicant shall provide an assessment of the impacts of the withdrawal of water from the river on alluvial aquifers during low flow.

4.6.4 Background

Consultation with regulatory and resource agencies indicate that water use conflicts are already a concern at two closed-cycle nuclear power plants … and may be a problem in the future …. [USNRC 1996, Section 4.3.2.1]

4.6.5 Analysis of Environmental Impact

As discussed in Section 2.2.1.1, 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. Thus, even the low flow stage of the Mississippi River is greater than the annual average flow standard for a small river. Therefore since GGNS is located on a large river and withdraws water from the Mississippi River Alluvium aquifer, this issue is not applicable to the site and further analysis is not required.

4.7 <u>Groundwater Use Conflicts (Plants Using Ranney Wells)</u>

4.7.1 Description of Issue

Groundwater use conflicts (plants using Ranney wells).

4.7.2 Findings from Table B-1, Appendix B to Subpart A

SMALL, MODERATE, or LARGE. Ranney wells can result in potential groundwater depression beyond the site boundary. Impacts of large groundwater withdrawal for cooling tower makeup at nuclear power plants using Ranney wells must be evaluated at the time of application for license renewal. See 10 CFR 51.53(c)(3)(ii)(C).

4.7.3 Requirement [10 CFR 51.53(c)(3)(ii)(C)]

If the applicant's plant uses Ranney wells..., an assessment of the impact of the proposed action on groundwater use must be provided.

4.7.4 Background

The impact of cooling water intake on groundwater at … the only plant employing Ranney wells, does not conflict with other groundwater uses in the area. However, conflicts could develop if other uses develop (e.g., additional catfish farms). Because it is not possible to predict whether conflicts will occur … or the significance of impacts associated with Ranney well use at other plants (if they were to adopt their use), it is not possible to determine the significance of Ranney well use at this time. [USNRC 1996, Section 4.8.1.4]

4.7.5 Analysis of Environmental Impact

GGNS is equipped with a closed-cycle circulating cooling water system with natural draft and auxiliary cooling towers. PSW provides cooling tower make-up water by pumping groundwater from the radial collector wells adjacent to and with laterals extending beneath the Mississippi River as discussed in Sections 2.3.4.3 and 3.2.2.2. The high rate of water induced to infiltrate from the Mississippi River into the Holocene Mississippi River 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, with the exception of the suspended solids. Suspended sediment in the river water is trapped in the stream bed, thereby reducing the suspended solids in the make-up cooling water. [USNRC 2006a, Section 2.6.3.2] Groundwater withdrawn for PSW purposes from the current four radial wells collectively has averaged approximately 22,396 gpm in recent years as indicated in Table 2.3-3. In conjunction with an EPU being completed in the current licensing term, a new radial well is being installed to ensure that adequate plant cooling water is maintained. Once the new radial collector well is operational (March 2012 schedule), average combined PSW withdrawal is expected to increase to approximately 27,860 gpm (62 cfs). [GEHNE, Section 3.3.1] It should be noted that GGNS was originally licensed for two units, but only Unit 1 was completed. The original evaluation of groundwater withdrawal impacts in the GGNS FES was for an estimated 42,636 gpm (95 cfs) for make-up cooling water needs [USNRC 1981, Section 4.2.3].

A brief description of the Mississippi River Alluvium, Upland Complex terrace deposits, and the Catahoula Formation aquifers potentially affected by GGNS operations is provided in Section 2.3. A discussion of the regional and vicinity groundwater use is provided in Section 2.3.4. As discussed, there are few population concentrations and little industry located in the region, and most water wells are used for domestic purposes. Use of alluvial 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. [SERI 2005a, Section 2.4.12.2.1]

An inventory of water wells within a two-mile radius of GGNS was developed prior to the startup of GGNS Unit 1 [GGNS 2010a, Table 2.4-23]. A list of registered wells within a 4-mile radius of GGNS was also developed for the GGNS ESP application [SERI 2005b, Table 2.3-26]. MDEQ permit requirements exempt wells used for domestic purposes and providing potable water to only one household, and generally exempt most wells with a surface casing diameter less than six inches. A 2010 inventory of wells registered with MDEQ identified three wells within approximately one mile of the GGNS radial well system that are shown to be located within the Mississippi River Alluvium as discussed below.

- A well registered to the GGMP was included in the 2010 MDEQ database [MDEQ 2010a]. However, the well is not permitted by MDEQ for withdrawal and is not included in the public water supply records. Site reconnaissance and discussion with site personnel (September 2010) indicated that although the well remains in the MDEQ databases, the well is no longer in operation. As previously discussed in Section 2.3.4.2, the GGMP's current sole source of water supply is from CS&I Water Association #1, which withdraws groundwater from the Miocene aquifer approximately six miles to the east-northeast of GGNS [MDEQ 2009a].

- MDEQ well registrations include a well at the Shady Rest Grocery (now closed) for domestic supply located approximately one-half mile east of the radial wells on Grand Gulf Road. [MDEQ 2010a] Based on the depth reported for the well of 240 feet, it is believed that this well would withdraw from the Catahoula Formation, but site reconnaissance (September 2010) indicates the well is inactive.

- A third well potentially located in the Mississippi River Alluvium aquifer is registered as an industrial well to the Claiborne County Port Commission located approximately one mile south of the GGNS radial wells. [MDEQ 2010a] Site reconnaissance (September 2010) was unable to locate the well.

Based on available information, 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. Public water supply wells in Claiborne County (excluding GGNS) are supplied by the Catahoula Formation or Miocene aquifer with well depths ranging from 166 to 960 feet MSL. Active public water supply systems which were located in Claiborne County as of May 2009, not including GGNS, are shown in Table 2.10-1. 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. [MDEQ 2009a; SERI 2005a, Section 2.4.12.2.1]

As shown in Table 2.3-1, GGNS withdraws cooling water via the radial collector wells from the Holocene Mississippi River Alluvium aquifer and potable water from the Pleistocene Upland Complex. Therefore, the water quality of the groundwater in the Catahoula Formation would not be influenced by the operation of the GGNS facility [USNRC 2006a, Section 2.6.3.2].

GGNS' radial wells (Radial Wells 1, 3, 4, and 5) are permitted with the MDEQ for a maximum capacity of 10,000 gpm (two 5,000 gpm pumps per well) each to withdraw groundwater from the Mississippi River Alluvium, or a total of 40,000 gpm combined. However, neither the maximum MDEQ permitted capacity nor the mechanical capacity of the wells ensure sufficient aquifer yield or well yield support withdrawal at 10,000 gpm, since the well yield has declined over previous years due to sediment buildup in the laterals and wells which has deteriorated pump performance. As shown in Table 2.3-3, actual recent withdrawal has been slightly over one-half of the MDEQ permitted capacity. Radial Well 6, scheduled to be operational in 2012, will provide a MDEQ permitted capacity of 50,000 gpm for all five radial wells combined. Therefore, this is used as the worst case withdrawal rate for radial well impact analysis to offsite groundwater users and wetlands, although the actual withdrawal rate is expected to be only approximately 27,860 gpm.

4.7.5.1 Offsite Groundwater Use Impacts

During the preoperational period, estimates of 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. [GGNS 2010a, Section 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 [GGNS 2010a, 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 a "normal" river stage of 61.7 feet MSL [GGNS 2010a, Figure 2.4-44]. As discussed below, the 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, and is not expected to significantly change, even with the addition of Radial Well 6 [Enercon 2010f].

As previously described in Section 2.3.4.3, PSW 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 resulting from the creation of a depression cone in the well field area, with most of the groundwater being withdrawn from the infiltration rather than from groundwater within the floodplain. [GGNS 2010a, Section 2.4.13.1.3.1] Groundwater drawdown levels resulting from the combined pumping of five radial wells (includes Radial Well 6) during the license renewal term under worst case conditions—maximum MDEQ permitted capacity of 50,000 gpm at a river stage of 41.52 feet MSL—would range from approximately 3.3 to 12.1 feet at the GGNS property boundaries. At "nominal" pumping rates averaging between 4,100 to 5,300 gpm, at a river stage of 41.52 feet MSL, the combined pumping drawdown is estimated to range from 1.7 to 5.3 feet at the GGNS property boundaries. These estimates are conservative since it does not include recharge from precipitation, annual inundation of the floodplain during high river stages, nor from the terrace deposits of the Upland Complex. [Enercon 2010f]

Groundwater drawdown, and thus any potential impact to offsite groundwater users from the withdrawal of the radial wells, is limited by the recharge boundary created by the Mississippi River and thus is not expected to extend to the west beyond the river. Additional hydraulic boundaries would be expected due to the Big Black River, approximately 1.25 miles north of the planned Radial Well 6 location, and the Bayou Pierre River, approximately 2.2 miles to the south at its nearest point within the floodplain.

Based on estimates of the radius of anticipated influence of the GGNS radial wells, drawdown at the GGNS property boundaries would have a SMALL 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 2.3-3, and aquifer recharge from sources other than the river (flooding and rainfall events) were not considered. [Enercon 2010f] However, GGNS' 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. As discussed above, there are no known current offsite uses of groundwater from the Mississippi River Alluvium aquifer between the Big Black River to the north and the Bayou Pierre River to the south. Thus, the impact of the radial wells on offsite groundwater users is SMALL.

Groundwater withdrawals are regulated by MDEQ [MDEQ 2009b]. Therefore, all existing GGNS groundwater withdrawals, including those from the radial wells, are regulated by a groundwater permitting program (Table 2.3-3). These permits are granted considering their identified potential impact on other uses in the area.

As discussed in Section 2.3.3.3, the primary recharge for the Catahoula is to the north in Hinds and Warrens Counties. Limited recharge near the GGNS 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% of the low flow conditions of the river.

None of Claiborne County's public water systems sources are from the Mississippi River Alluvium [MDEQ 2009a].

Therefore, there are no groundwater use conflicts and GGNS radial well withdrawal impacts are SMALL.

4.7.5.2 Wetlands

Groundwater drawdown resulting from operation of the radial wells at GGNS, and thus any potential impact on onsite or offsite wetlands, is dependent upon the water level in the Mississippi River. Due to the hydrologic boundary created by the river, any observable drawdown would be limited to the east side of the river. As previously stated, 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, and is not expected to significantly change, even with the addition of Radial Well 6 [Enercon 2010f].

Table 2.4-1 indicates that approximately 40% of the GGNS site is bottomland, including forested, shrub, and emergent marsh wetlands. As stated in Section 2.3.3.1, 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.

4.7.6 Conclusion

Based on the discussion above, the radius of influence from the GGNS radial collector wells is localized within the Mississippi River Alluvium and has no impact on current or foreseeable offsite groundwater use. GGNS' 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 radial wells at GGNS are in direct hydraulic communication with the Mississippi River, which minimizes any potential for overutilization of groundwater in the vicinity. This hydraulic connection and annual inundation during river flooding also minimizes the potential impacts to aquatic, terrestrial, and riparian communities within the floodplain. Therefore, Entergy concludes that impacts of radial well groundwater withdrawal use during the license renewal period would be SMALL and further mitigation measures beyond MDEQ's groundwater withdrawal permitting program are not warranted.

4.8 Degradation of Groundwater Quality

4.8.1 Description of Issue

Groundwater quality degradation (cooling ponds at inland sites).

4.8.2 Findings from Table B-1, Appendix B to Subpart A

SMALL, MODERATE, or LARGE. Sites with closed-cycle cooling ponds may degrade groundwater quality. For plants located inland, the quality of the groundwater in the vicinity of the ponds must be shown to be adequate to allow continuation of current uses. See 10 CFR 51.53(c)(3)(ii)(D).

4.8.3 Requirement [10 CFR 51.53(c)(3)(ii)(D)]

If the applicant's plant is located at an inland site and utilizes cooling ponds, an assessment of the impact of the proposed action on groundwater quality must be provided.

4.8.4 Background

The extent of groundwater contamination by cooling ponds has not been documented at this time. Off-site groundwater monitoring is not standard practice at these sites, and there are no data with which to characterize the significance of potential off-site groundwater contamination. For those plants with cooling ponds located in a salt marsh …, groundwater quality is not a significant concern because groundwater quality beneath salt marshes is too poor for human use. Because continued infiltration into the shallow aquifer will not change its groundwater use category (which is already restricted to industrial uses only) and because potential mitigation measures would be costly, no mitigation measures beyond those implemented during the current term license would be warranted. The impact on groundwater quality for plants with cooling ponds that are not located in salt marshes is a Category 2 issue. [USNRC 1996, Section 4.8.3]

4.8.5 Analysis of Environmental Impact

GGNS uses a closed-cycled cooling system and does not utilize cooling ponds. Therefore, this issue is not applicable to the site and further analysis is not required.

4.9 Impacts of Refurbishment on Terrestrial Resources

4.9.1 Description of Issue

Refurbishment impacts—Terrestrial Resources

4.9.2 Findings from Table B-1, Appendix B to Subpart A

SMALL, MODERATE, or LARGE. Refurbishment impacts are insignificant if no loss of important plant and animal habitat occurs. However, it cannot be known whether important plant and animal communities may be affected until the specific proposal is presented with the license renewal application. See 10 CFR 51.53(c)(3)(ii)(E).

4.9.3 Requirement [10 CFR 51.53(c)(3)(ii)(E)]

All license renewal applicants shall assess the impact of refurbishment and other license renewal related construction activities on important plant and animal habitats.

4.9.4 Background

The significance of lost habitat depends on the importance of the plant or animal community involved. Particularly important habitats are wetlands, riparian habitats, staging or resting areas for large numbers of waterfowl, rookeries, restricted wintering areas for wildlife (e.g., winter deer yards), communal roost sites, strutting or breeding grounds of gallinaceous birds, and areas containing rare plant communities (e.g., Atlantic white cedar swamps). Such habitats are uncommon and are unlikely to occur on most plant sites. However, if such resources do occur on plant sites, refurbishment activities should be planned to avoid them to the extent feasible. If no important resource would be affected, the impacts would be considered minor and of small significance. If important resources could be affected by refurbishment activities, the impacts would be potentially significant…. [USNRC 1996, Section 3.6]

4.9.5 Analysis of Environmental Impact

As discussed in Section 2.4, there are existing management programs in place associated with operational and maintenance activities to ensure that terrestrial resources on the GGNS site and associated in-scope transmission line ROWs are protected. In addition, although the radial wells withdraw groundwater from the alluvial aquifer underlying the floodplain at GGNS, there is minimal impact on wetland terrestrial habitats due to the close hydraulic connection with the river as discussed in Sections 2.3.3.1 and 4.7.5. Further as discussed in Section 4.6.5, GGNS is located on a large river, and thus there is minimal impact on in-stream and terrestrial riparian ecological communities associated with the use of groundwater for cooling tower makeup.

However, as discussed in Section 3.3, there are no refurbishment activities required for renewal of the GGNS OL. Therefore this issue is not applicable to the site and further analysis is not required.

4.10 Threatened or Endangered Species

4.10.1 Description of Issue

Impacts from refurbishment and continued operations on threatened or endangered species.

4.10.2 Finding from Table B-1, Appendix B to Subpart A

SMALL, MODERATE, or LARGE. Generally, plant refurbishment and continued operation are not expected to adversely affect threatened or endangered species. However, consultation with appropriate agencies would be needed at the time of license renewal to determine whether threatened or endangered species are present and whether they would be adversely affected. See 10 CFR 51.53(c)(3)(ii)(E).

4.10.3 Requirement of 10 CFR 51.53(c)(3)(ii)(E)

All license renewal applicants shall assess the impact of refurbishment and other license renewal related construction activities on important plant and animal habitats. Additionally, the applicant shall assess the impact of the proposed action on threatened or endangered species in accordance with the Endangered Species Act.

4.10.4 Background

Potential impacts of refurbishment on federal- or state-listed threatened and endangered species, and species proposed to be listed as threatened or endangered, cannot be assessed generically because the status of many species is being reviewed and it is impossible to know what species that are threatened with extinction may be identified that could be affected by refurbishment activities. [USNRC 1996, Section 3.9]

Because compliance with the Endangered Species Act cannot be assessed without site-specific consideration of potential effects on threatened and endangered species, it is not possible to determine generically the significance of potential impacts to threatened and endangered species. [USNRC 1996, Section 3.9]

4.10.5 Analysis of Environmental Impact

4.10.5.1 Refurbishment

As discussed in Section 3.3, GGNS has no plans to conduct refurbishment or construction activities at the site during the license renewal term. Therefore, there would be no refurbishment-related impacts to special-status species and no further analysis is applicable.

4.10.5.2 License Renewal

Section 2.4 addresses issues related to critical and important habitats, wetlands, and unique natural areas. Section 2.5 identifies and discusses threatened or endangered species that could occur on the GGNS site, the immediate vicinity, and the associated in-scope transmission line ROWs, although none of these species have actually been encountered by Entergy.

GGNS is not aware of any adverse impacts regarding threatened or endangered species which have been attributed to the site or transmission line operations. Maintenance activities necessary to support license renewal would be limited to previously disturbed areas on-site and no additional land disturbance is anticipated in support of license renewal. In addition, there are no plans to alter plant operations during the license renewal term which would affect threatened and endangered species that could potentially exist or pass through GGNS facilities that are considered for license renewal.

As discussed in Section 3.2.2.2, groundwater is the cooling water source for plant operations, which eliminates potential adverse impacts to fish and shellfish due to entrainment or impingement. As indicated in Section 4.7.5.2, the only impacts to aquatic or riparian communities within wetland areas are primarily due to river stage and annual flooding inundations rather than groundwater withdrawals. GGNS is also in compliance with thermal discharge limits that are regulated by the MDEQ to be protective of aquatic biota. In addition, as discussed in Section 2.4, there are existing management programs in place associated with operational and maintenance activities to ensure that state- and federal-listed species on the GGNS site and associated in-scope transmission line corridors are protected during operations and project planning.

In an effort to obtain an independent review, the USFWS, NOAA, MNHP, and LNHP were also consulted for input regarding state- and federal-listed threatened and endangered species and unique natural areas on the GGNS site, vicinity, and in-scope transmission lines (Attachment A). Based on this independent review and GGNS' review, no adverse impacts to state-listed or federal-listed threatened or endangered species were identified as a result of renewing the GGNS OL.

4.10.6 Conclusion

As discussed in Section 2.4, there are no designated critical habitats for threatened, endangered, or species of special concern on the GGNS site, vicinity, or the in-scope transmission line ROWs. However, the continued operation of the site and transmission lines will not adversely impact any federally listed species that may exist on or pass through the GGNS facilities that are considered for license renewal, as discussed above. Therefore, GGNS concludes the impacts to threatened or endangered species from license renewal are SMALL and mitigation measures beyond Entergy's existing management programs discussed in Section 2.4 and state/federal regulatory requirements are not warranted.

4.11 Air Quality During Refurbishment (Nonattainment and Maintenance Areas)

4.11.1 Description of Issue

Air quality during refurbishment (nonattainment and maintenance areas).

4.11.2 Findings from Table B-1, Appendix B to Subpart A

SMALL, MODERATE, or LARGE. Air quality impacts from plant refurbishment associated with license renewal are expected to be small. However, vehicle exhaust emissions could be cause for concern at locations in or near nonattainment or maintenance areas. The significance of the potential impact cannot be determined without considering the compliance status of each site and the number of workers expected to be employed during the outage. See 10 CFR 51.53(c)(3)(ii)(F).

4.11.3 Requirement [10 CFR 51.53(c)(3)(ii)(F)]

If the applicant's plant is located in or near a nonattainment or maintenance area, an assessment of vehicle exhaust emissions anticipated at the time of peak refurbishment workforce must be provided in accordance with the Clean Air Act as amended.

4.11.4 Background

Based on USEPA's interpretation that mobile emissions from workers' vehicles should generally be considered as indirect emissions in a conformity analysis, a screening analysis was performed which indicated that the emissions from 2,300 vehicles may exceed the thresholds for carbon monoxide, oxides of nitrogen, and volatile organic compounds (the latter two contribute to the formation of ozone) in nonattainment and maintenance areas. In addition, the amount of road dust generated by the vehicles traveling to and from work would exceed the threshold for particulate matter less than 10 μm in serious nonattainment areas. However, the assumption of adding 2,300 workers' vehicles to existing traffic forms an upper bound of potential emissions; in reality, some workers would carpool to the refurbishment sites, while others would be driving to other construction sites if the proposed refurbishment activities were not occurring. In addition, USEPA suggests that there may be some flexibility in the rigor of a conformity analysis, particularly with regard to the specific site, the extent of refurbishment, the pollutants which are in nonattainment, the severity of the nonattainment, the state regulatory agency, and the federal agency's control over workers' vehicles. In summary, vehicle exhaust emissions could be cause for some concern, but a general conclusion about the significance of the potential impact cannot be drawn without considering the compliance status of each site and the number of workers expected to be employed during the outage. [USNRC 1996, Section 3.3]

4.11.5 Analysis of Environmental Impact

As discussed in Section 3.2.8.3, the GGNS Air Permit contains conditions established by the MDEQ to be protective of Mississippi's ambient air quality standards to ensure that operational impacts are maintained at minimal levels. These same ambient air quality standards would regulate any future GGNS activities that may involve an increase of air pollutants or change in attainment status.

However, as discussed in Section 3.3, there are no refurbishment activities required for GGNS license renewal. In addition, GGNS is not located near or in a non-attainment or maintenance area. The State of Mississippi is both in attainment with national primary and secondary air quality standards for all criteria air pollutants. As discussed in Section 2.11.2, there are no non-attainment areas within a 100-mile radius of GGNS. Therefore, this issue is not applicable to the site and further analysis is not required.

4.12 Microbiological Organisms—Public Health

4.12.1 Description of Issue

Microbiological organisms (public health) (plants using lakes or canals, or cooling towers, or cooling ponds that discharge to a small river).

4.12.2 Finding from Table B-1, Appendix B to Subpart A

SMALL, MODERATE, or LARGE. These organisms are not expected to be a problem at most operating plants except possibly at plants using cooling ponds, lakes, or canals that discharge to small rivers. Without site-specific data, it is not possible to predict the effects generically. See 10 CFR 51.53(c)(3)(ii)(G).

4.12.3 Requirement [10 CFR 51.53(c)(3)(ii)(G)]

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.

4.12.4 Background

Public health questions require additional consideration for the 25 plants using cooling ponds, lakes, canals, or small rivers because the operation of these plants may significantly enhance the presence of thermophilic organisms. The data for these sites are not now at hand and it is impossible to predict the level of thermophilic organism enhancement at a given site with current knowledge. Thus, the impacts are not known and are site-specific. Therefore, the magnitude of the potential public health impacts associated with thermal enhancement of *N. fowleri* cannot be determined generically. [USNRC 1996, Section 4.3.6]

4.12.5 Analysis of Environmental Impact

As discussed in Section 2.2.1.1, 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. Thus, even the low flow stage of the Mississippi River is greater than the annual average flow standard for a small river. Therefore since GGNS is located on a large river, this issue is not applicable to the site and further analysis is not required.

4.13 Electromagnetic Fields—Acute Effects

4.13.1 Description of Issue

Electromagnetic fields, acute effects (electric shock)

4.13.2 Findings from Table B-1, Subpart A, Appendix A

SMALL, MODERATE, or LARGE. Electric shock resulting from direct access to energized conductors or from induced charges in metallic structures has not been a problem at most operating plants and generally is not expected to be a problem during the license renewal term. However, site-specific review is required to determine the significance of the electrical shock potential at the site. See 10 CFR 51.53(c)(3)(ii)(H).

4.13.3 Requirements [10 CFR 51.53(c)(3)(ii)(H)]

If the applicant's transmission lines that were constructed for the specific purpose of connecting the plant to the transmission system do not meet the recommendations of the National Electric Safety Code (NESC) for preventing electric shock from induced currents, an assessment of the impact of the proposed action on the potential shock hazard from the transmission lines must be provided.

4.13.4 Background

The transmission line of concern is that between the plant switchyard and the intertie to the transmission system. With respect to shock safety issues and license renewal, three points must be made. First, in the licensing process for the earlier licensed nuclear plants, the issue of electrical shock safety was not addressed. Second, some plants that received OLs with a stated transmission line voltage may have chosen to upgrade the line voltage for reasons of efficiency, possibly without reanalysis of induction effects. Third, since the initial NEPA review for those utilities that evaluated potential shock situations under the provision of the NESC, land use may have changed, resulting in the need for reevaluation of this issue. [USNRC 1996, Sections 4.5.4 and 4.5.4.1]

The electrical shock issue, which is generic to all types of electrical generating stations, including nuclear power plants, is of small significance for transmission lines that are operated in adherence with NESC. Without review of each nuclear plant's transmission line conformance with NESC criteria, it is not possible to determine the significance of the electrical shock potential. [USNRC 1996, Section 4.5.4.1]

4.13.5 Analysis of Environmental Impact

4.13.5.1 Background

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.
- Extent to which the object is grounded.

In 1977, the 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 five milliamperes 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 four to six milliamperes.

EMI owns and operates the transmission lines constructed for purposes of connecting GGNS to the transmission system (Figure 2.1-2). The transmission lines that were considered in scope for license renewal (Section 3.2.10.1) are as follows:

- Baxter-Wilson 500 kV transmission line (22 miles in length) that spans from the GGNS 500 kV switchyard to the Baxter Wilson Steam Electric Station EHV switchyard.
- Franklin 500 kV transmission line (43.6 miles in length) that spans from the GGNS 500 kV switchyard to the Franklin EHV Switching Station.
- 500 kV transmission line (~300 feet in length) that spans from the GGNS Turbine Building to the GGNS 500 kV switchyard.

There are no planned changes in the configuration or operation of these lines during the license renewal term.

4.13.5.2 Analysis of Impacts: 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 milliAmp (mA) rule (Rule 232.C.1.c). [Entergy 2009b]

Using line sags corresponding to the final unloaded conductor temperature of 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. [Entergy 2009b]

EPRI's "Applet Gallery," part of 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) 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. [Entergy 2009b]

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 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. [Entergy 2009b]

Based on these calculations, it was determined that the induced current associated with the Bater-Wilson and Franklin transmission lines were 1.32 mA and 2.03 mA, respectively. Therefore, the Baxter-Wilson and Franklin 500 kV transmission lines satisfy the NESC requirements for Rule 232.C.1.c. [Entergy 2009b]

In addition, Entergy's current maintenance practices associated with maintaining transmission line clearances would continue during the license renewal term. All transmission lines 230 kV and above are inspected at least three times each year. 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. [Entergy 2009b]

Potential encroachments identified in aerial patrols are referred to the Entergy's ROW 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 ROW. [Entergy 2009b]

4.13.5.3 Analysis of Impacts: 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). [Entergy 2010d; Entergy 2010f]

4.13.6 Conclusion

Transmission lines that connect GGNS to the transmission grid meet the applicable vertical clearance requirements specified by the NESC for limiting the steady-state induced current to 5 mA. In addition, Entergy's current maintenance practices associated with maintaining transmission line clearances would continue to occur during the license renewal period. Therefore, impacts due to the electrical shock potential for these lines are SMALL and do not warrant additional mitigation measures beyond Entergy's existing transmission line maintenance practices.

4.14 Housing Impacts

4.14.1 Description of Issue

Housing Impacts.

4.14.2 Findings from Table B-1, Appendix B to Subpart A

SMALL, MODERATE, or LARGE. Housing impacts are expected to be of small significance at plants located in a medium or high population area and not in an area where growth control measures that limit housing development are in effect. Moderate or large housing impacts of the workforce associated with refurbishment may be associated with plants located in sparsely populated areas or in areas with growth control measures that limit housing development. See 10 CFR 51.53(c)(3)(ii)(I).

4.14.3 Requirement [10 CFR 51.53(c)(3)(ii)(I)]

An assessment of the impact of the proposed action on housing availability... within the vicinity of the plant must be provided.

4.14.4 Background

The impacts on housing are considered to be of small significance when a small and not easily discernible change in housing availability occurs, generally as a result of a very small demand increase or a very large housing market. Increases in rental rates or housing values in these areas would be expected to equal or slightly exceed the statewide inflation rate. No extraordinary construction or conversion of housing would occur where small impacts are foreseen. [USNRC 1996, Section 3.7.2]

The impacts on housing are considered to be of moderate significance when there is a discernible, but short-lived, reduction in available housing units because of project-induced in-migration. The impacts on housing are considered to be of large significance when project-related demand for housing units would result in very limited housing availability and would increase rental rates and housing values well above normal inflationary increases in the state. [USNRC 1996, Section 3.7.2]

Moderate and large impacts are possible at sites located in rural and remote areas, at sites located in areas that have experienced extremely slow population growth (and thus slow or no growth in housing), or where growth control measures that limit housing development are in existence or have been recently lifted. [USNRC 1996, Section 3.7.2]

Public utility impacts at the case study sites during refurbishment are projected to range from small to moderate. The potentially small to moderate impact …is related to water availability (not processing capacity) and would occur only if a water shortage occurs at refurbishment time. [USNRC 1996, Section 3.7.4.5]

4.14.5 Analysis of Environmental Impact

Supplement 1 to Regulatory Guide 4.2 provides the following guidance.

Section 4.14.1 states: "If there will be no refurbishment or if refurbishment involves no additional workers then there will be no impact on housing and no further analysis is required."

Section 4.14.2 states, "If additional workers are not anticipated there will be no impact on housing and no further analysis is required."

4.14.5.1 Refurbishment

As discussed in Section 3.3, there are no refurbishment activities required for license renewal at the GGNS site. Therefore, housing impacts related to refurbishment are not applicable.

4.14.5.2 License Renewal

As of November 2009, GGNS had a permanent staff of approximately 690 employees (Table 3.5-1). Approximately 81% of GGNS employees reside in Claiborne, Hinds, Jefferson, and Warren counties. Specifically, approximately 35% reside in Warren County, 21% in Claiborne County, 14% in Hinds County, and 12% in Jefferson County. The remaining employees live in outlying counties, including a few who live in Louisiana and other states. As described in Section 2.6, GGNS is located in a low population area, and as discussed in Section 2.9, total housing in the four counties grew between 2000 and 2010, and overall, vacancy rates ranged from 9.2% to 20.3% during this same period. Therefore, adequate housing to accommodate any increase exists in the area. However, as discussed in Section 3.5, Entergy does not anticipate a need for additional full-time workers during the license renewal period. Therefore, housing would be unaffected as a result of license renewal.

4.14.6 Conclusion

Although Hinds County has adopted land use planning regulations such as zoning to manage future growth and development, and Claiborne County recently prepared a comprehensive land use plan (Section 2.8.2), Entergy concludes that the impact on housing from the continued operation of the site would be SMALL and further mitigation is not warranted. This conclusion is based on the following:

- No refurbishment activities are required for license renewal at the site (Section 3.3).
- Number of housing units in the four counties has increased over the years (Section 2.9).
- GGNS is located in a low population area, and there is no anticipated increase in employment during the license renewal period (Sections 2.6.1 and 3.5).
- The number of the site employees would continue to be a small percentage of the population in the adjacent counties during the period of the renewed license (Sections 2.6.1 and 3.5).

4.15 Public Utilities; Public Water Supply Availability

4.15.1 Description of Issue

Public Services (public utilities).

4.15.2 Findings from Table B-1, Appendix B to Subpart A

SMALL or MODERATE. An increased problem with water shortages at some sites may lead to impacts of moderate significance on public water supply availability. See 10 CFR 51.53(c)(3)(ii)(I).

4.15.3 Requirement [10 CFR 51.53(c)(3)(ii)(I)]

The applicant shall provide an assessment of the impact of population increases attributable to the proposed project on the public water supply.

4.15.4 Background

Impacts on public utility services are considered small if little or no change occurs in the utility's ability to respond to the level of demand and thus there is no need to add capital facilities. Impacts are considered moderate if overtaxing of facilities during peak demand periods occurs. Impacts are considered large if existing service levels (such as the quality of water and sewage treatment) are substantially degraded and additional capacity is needed to meet ongoing demands for services. [USNRC 1996, Section 3.7.4.5]

In general, small to moderate impacts to public utilities were observed as a result of the original construction of the case study plants. While most locales experienced an increase in the level of demand for services, they were able to accommodate this demand without significant disruption. Water service seems to have been the most affected public utility. [USNRC 1996, Section 3.7.4.5]

Because the case studies indicate that some public utilities may be overtaxed during peak periods, the impacts to public utilities would be moderate in some cases, although most sites would experience only small impacts. [USNRC 1996, Section 3.7.4.5]

4.15.5 Analysis of Environmental Impact

4.15.5.1 Refurbishment

As discussed in Section 3.3, there are no refurbishment activities required for the renewal of the GGNS OL. Therefore, public water supply availability impacts related to refurbishment are not applicable.

4.15.5.2 License Renewal

GGNS does not anticipate a need for additional workers during the license renewal period (Section 3.5). Therefore, there will be no impact to public water supply utilities from additional plant workers during the license renewal term.

Groundwater comprises the primary water source for both community and non-community water supply systems and serves virtually the entire population in Claiborne County. As shown in Table 2.10-1, public water systems within a 10-mile radius of GGNS have sufficient capacity to respond to additional demands. As discussed in Section 2.3.4.2, GGNS withdraws groundwater for cooling and potable water needs from wells that are located in the Mississippi River Alluvium and Upland Complex aquifers. Since GGNS relies on separate aquifers from that of Claiborne County public utilities for its needs, and only a small portion of potable water from a community water system, water withdrawals and usage at the site would not affect other nearby public water resources (Section 2.10.1). In addition, the State of Mississippi has declared by statute that groundwater is among the basic resources of the state and subject to regulation governing control, development, and use of water for all beneficial purposes. Therefore, all existing GGNS groundwater withdrawals are regulated under MDEQ's permitting program.

4.15.6 Conclusion

Because GGNS obtains the majority of the plant's needed water from onsite groundwater wells located in the Mississippi River Alluvium and Upland Complex aquifers, public water system availability and capacity near the site will remain unaffected. In addition, there are no refurbishment activities required for renewal of the GGNS OL nor a need for additional workers during the license renewal period. Therefore, impacts to public water supplies will continue to be SMALL during the license renewal period, and further consideration of mitigation measures beyond MDEQ's groundwater withdrawal permitting program are not warranted.

4.16 Education Impacts from Refurbishment

4.16.1 Description of Issue

Public Services (effects of refurbishment activities upon local educational system).

4.16.2 Findings from Table B-1, Appendix B to Subpart A

SMALL or MODERATE. Most sites would experience impacts of small significance but larger impacts are possible depending on site- and project-specific factors. See 10 CFR 51.53(c)(3)(ii)(I).

4.16.3 Requirement [10 CFR 51.53(c)(3)(ii)(I)]

An assessment of the impact of the proposed action on … public schools (impacts from refurbishment activities only) within the vicinity of the plant must be provided.

4.16.4 Background

Based on the case-study analysis of the PWR bounding-case work force, refurbishment impacts on education at all plant sites would range from small to large, although most sites will experience only small new impacts to education. Analyses of the work forces associated with the BWR bounding- and typical-case scenarios conclude that moderate impacts to education could be induced by these smaller work forces but only at sites that are remotely located and sparsely populated. Because site-specific and project-specific factors determine the significance of impacts to education and the potential value of mitigation measures… [USNRC 1996, Section 3.7.4.1]

4.16.5 Analysis of Environmental Impact

As discussed in Section 3.3, there are no refurbishment activities required for the renewal of the GGNS OL. Therefore this issue is not applicable to the site and further analysis is not required.

4.17 Offsite Land Use—Refurbishment

4.17.1 Description of Issue

Offsite Land Use (effects of refurbishment activities).

4.17.2 Findings from Table B-1, Appendix B to Subpart A

SMALL or MODERATE. Impacts may be of moderate significance at plants in low population areas. See 10 CFR 51.53(c)(3)(ii)(I).

4.17.3 Requirement [10 CFR 51.53(c)(3)(ii)(I)]

An assessment of the impact of the proposed action on… land-use…(impacts from refurbishment activities only) within the vicinity of the plant must be provided.

4.17.4 Background

Based on predictions for the case study sites, refurbishment at all nuclear plants is expected to induce small or moderate land-use changes. There will be new impacts; but for almost all plants, refurbishment-related population growth would typically represent a much smaller percentage of the local areas' total population than did original construction-related growth. Moderate land use changes are also possible under the BWR conservative scenario, but only small impacts would be associated with the BWR typical scenario. Because future impacts are expected to range from small to moderate, and because land-use changes could be considered beneficial by some community members and adverse by others, this is a Category 2 issue. [USNRC 1996, Section 3.7.5]

4.17.5 Analysis of Environmental Impact

As discussed in Section 3.3, there are no refurbishment activities required for the renewal of GGNS OL. Therefore, this issue is not applicable to the site and further analysis is not required.

4.18 Offsite Land Use—License Renewal Term

4.18.1 Description of Issue

Offsite Land Use (effects of license renewal).

4.18.2 Findings from Table B-1, Appendix B to Subpart A

SMALL, MODERATE, or LARGE. Significant changes in land-use may be associated with population and tax revenue changes resulting from license renewal. See 10 CFR 51.53(c)(3)(ii)(I).

4.18.3 Requirement [10 CFR 51.53(c)(3)(ii)(I)]

An assessment of the impact of the proposed action on … land-use … within the vicinity of the plant must be provided.

4.18.4 Background

During the license renewal term, new land use impacts could result from plant-related population growth or from the use of tax payments from the plant by local government to provide public services that encourage development. [USNRC 1996, Section 4.7.4]

However, as noted in Regulatory Guide 4.2, Section 4.17.2, Table B-1 of 10 CFR Part 51 partially misstates the conclusion reached in Section 4.7.4.2 of NUREG-1437. NUREG-1437, Section

4.7.4.2 concludes that "population-driven land use changes during the license renewal term at all nuclear plants will be small." Regulatory Guide 4.2 further states that "Until Table B-1 is changed, applicants only need cite NUREG-1437 to address population-induced land-use change during the license renewal term." [USNRC 2000, Section 4.17.2]

The assessment of new tax-driven land use impacts in the GEIS considered the following:

(1) the size of the plant's tax payments relative to the community's total revenues,

(2) the nature of the community's existing land use pattern, and

(3) the extent to which the community already has public services in place to support and guide development. [USNRC 1996, Section 4.7.4.1]

In general, if the plant's tax payments are projected to be small relative to the community's total revenue, new tax-driven land use changes during the plant's license renewal term would be small, especially where the community has pre-established patterns of development and has provided adequate public services to support and guide development. If the plant's tax payments were projected to be medium to large relative to the community's total revenue, new tax-driven land use changes would be moderate. If the plant's tax payments are projected to be a dominant source of the community's total revenue, new tax-driven land-use changes would be large. This would be especially true where the community has no pre-established pattern of development or has not provided adequate public services to support and guide development in the past. [USNRC 1996, Section 4.7.4.1]

Based on predictions for the case study plants, it is projected that all new population-driven land use changes during the license renewal term at all nuclear plants will be small, because population growth caused by license renewal will represent a much smaller percentage of the local area's total population than has operations-related growth. In addition, any conflicts between offsite land use and nuclear plant operations are expected to be small. In contrast, it is projected that new tax-driven land use changes may be moderate at a number of sites and large at some others. Because land use changes may be perceived by some community members as adverse and by others as beneficial, the staff is unable to assess generically the potential significance of site-specific off-site land use impacts. [USNRC 1996, Section 4.7.4.2]

4.18.5 Analysis of Environmental Impact

Entergy considered the environmental impacts from this issue as it relates to population-driven land use changes, tax-driven land use changes, and potential effects on land values.

4.18.5.1 Population-Driven Land Use Changes

GGNS agrees with the GEIS conclusion that new population-driven land use changes at the site during the license renewal term will be SMALL [USNRC 1996, Section 4.7.4.2]. GGNS does not anticipate that additional workers will be employed at the site during the license renewal period.

Therefore, there will be no adverse impact resulting from population-driven land use changes associated with license renewal.

4.18.5.2 Tax-Driven Land Use Changes

USNRC has determined that significance levels during license term renewal operations are considered small if new tax payments are less than 10 percent of the taxing jurisdiction's revenue, moderate if payments are 10 to 20 percent of revenue, and large if payments represent greater than 20 percent of revenue. The tax payments used to calculate impacts during the license renewal term are all property taxes paid by the nuclear plant, not just the increment due to refurbishment-related improvements. [USNRC 1996, Section 4.7.2.1]

Because there are no refurbishment activities and no new construction as a result of license renewal, no new sources of plant-related tax payments are expected that could significantly influence land use in Claiborne County or other Mississippi counties. Tax-related impacts from the continued operation of GGNS would consist of the continued effect of direct and indirect tax payments to Claiborne County and the State of Mississippi as discussed in Section 2.7, which began before license renewal. Other than unforeseen changes of the valuation of GGNS during the license renewal term, any new taxes are anticipated to be small relative to the taxes already being paid during the current license term. However, GGNS' tax payments are the dominant source of revenue for Claiborne County, and thus have a large beneficial impact. As discussed in Section 2.7, 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. The $7.8 million represents roughly 83 percent of all Claiborne County revenues. During the license renewal term, new land-use impacts could result from the use by local governments of the tax revenue paid by GGNS for the assessed value of the site.

As discussed in Section 2.6, between 2000 and 2010, the estimated total population for the four counties near the GGNS site has generally decreased (Table 2.6-1) and there have been limited land-use changes (Section 2.8). Although the decline of population is not related to the presence of the site, any new growth could be affected by the economic benefit of the plant on local schools, roads, and community services. Tax receipts from the site are a significant portion of revenue to local government. This revenue likely provides for a higher level of public infrastructure and services than would otherwise be possible. This enhances the county's attractiveness as a place to live and could contribute to future growth of the area. Thus, if GGNS' OL were not renewed, Claiborne County and the other three counties in which GGNS employees primarily reside would be expected to see a negative impact on tax-driven land use initiatives.

As indicated in Section 2.8, Hinds County has local zoning controls in place to support and guide land use and development. While Claiborne County does not currently have zoning controls, it has established a comprehensive land use plan to prevent the overcrowding of land; to avoid undue concentration of population; and to facilitate the adequate provision of transportation, water, sewerage, schools, parks, and other public requirements [Enercon 2010a]. Port Gibson has zoning regulations that control local growth, as do some other communities in the four county area.

As discussed in Section 2.6, Claiborne County's population is experiencing negative growth, and the area around the GGNS site is not expected to experience rapid unexpected future population growth. Because no new construction activities would occur as a result of license renewal, there would be no change in GGNS' tax basis due to renewal of GGNS' OL. However, the taxes paid by the site represent a significant portion of the Claiborne County tax revenues. Thus, GGNS may be considered to create a potential LARGE beneficial impact for tax driven off-site land use.

4.18.5.3 Land Value Land Use Changes

As discussed in the GEIS, land use changes as a result of a nuclear power plant not having its license renewed could result in SMALL to MODERATE impacts on the surrounding community. With the loss of jobs and taxes and an increase of housing vacancies and perhaps even population as the former employees left the area to take employment elsewhere, this would have a noticeable adverse effect on the local economy and in turn on the local land use values. As noted above, this type of effect would be most significant in Claiborne County if GGNS' OL were not renewed.

GGNS has considered the impact of the plant on local property values during the license renewal term. The GEIS concluded that the value of housing units in close proximity to the plants has experienced only SMALL impacts [USNRC 1996, Section 4.7.1.3].

Published literature on this subject comes to varying conclusions. The International Association of Assessing Officers (IAAO) guidelines consider the affect of contamination on nearby property values, including the presence of nuclear plants in valuations of property. Actual contamination may depress offsite property values, but the IAAO discusses the established decommissioning funds required for nuclear plants, notes that the value of the nuclear plant site itself is not decreased, and that property offsite may increase in value due to competing need for land. IAAO also notes that stigma devaluation of property values may be overstated because land value is often not demonstrably affected despite the presence of nearby contaminated sites. [IAOO]

Some studies which have concluded that the presence of nuclear plants have decreased property values are based on information derived from opinion polls rather than evidence of actual property values [Pasqualetti and Pijawka]. Other studies conclude that the negative impact on land value correlate to whether the property is within visual range of the plant, or correlate to the distance from the nuclear plant (up to 60 miles) [Metz et.al.; Folland and Hough]. It should be noted that Folland and Hough based their study of negative externality effects on return on investment, rather than direct property values, and attempted to control various variables over broad geographical areas, while noting that the geographic and market patterns used as the basis for their study did not necessarily control the individualities and idiosyncrasies of the geographical areas, such as terrain, farmland, farmers and wholesalers [Folland and Hough]. In contrast, several studies have found that the impacts of nuclear plants have been largely positive [Bezdek and Wendling; Clark et. al.; Farrell and Hall; Metz et.al.; NEI 2003; NEI 2004a; NEI 2004b; NEI 2006a; NEI 2006b].

As previously discussed in Section 2.9, the USCB has not released 2010 updates for median home values for Claiborne, Hinds, Jefferson, and Warren counties. However, based on 2005–

2009 estimates, the median home values for all four counties grew between 2000 and the 2005–2009 time period. Median home values increased 39.8% in Hinds County to $102,200. Median home values increased by 22.5% to $96,900 in Warren County. Median home values increased by 37.8% and are valued at $67,100 in Jefferson County. The least growth in median home value was in Claiborne County, which only saw an increase of 8.9%, to a median value of $52,500. Overall, the four-county region appears to have experienced a significant increase in property values since the construction of GGNS. The causal factors behind the valuation of land in the four-county area over the different periods of time have not been quantified but are believed to be related to the growth of metropolitan areas due to employment opportunities and the overall general decline of the agricultural economy in the rural areas.

As discussed in Section 4.18.5.2, GGNS has a significant beneficial tax-driven impact on the surrounding counties, especially in Claiborne County. Any potential minor negative impact on land values due to the stigma attached to the presence of a nearby nuclear plant is offset by the large positive financial impact derived from tax revenues, employment, and economic benefits to the region. In 2004, operation of the GGNS increased Mississippi's economic output by $63.9 million, including $12.2 million in Claiborne and Warren counties. If the direct value of plant output is included, state and county output attributable to GGNS was $536.9 million in Mississippi, including $485.2 million in the local area. [NEI 2006a] Therefore, it is concluded that impacts to land values would at most be SMALL as it relates to renewal of the GGNS OL, as there would be no adverse impact from continued operations.

4.18.6 Conclusion

Entergy agrees with the GEIS conclusion that new population-driven land use changes at the site during the license renewal term would be SMALL. Entergy does not anticipate that additional workers will be employed at the site during the license renewal period. Therefore, there will be no adverse impact to the offsite land use from additional plant workers and mitigation measures are not warranted.

Due to GGNS' significant contribution to Claiborne County's tax revenues (83%), tax-driven offsite impacts to land use is considered to be a LARGE beneficial impact. As discussed in the GEIS, land use changes as a result of a nuclear power plant not having its license renewed could result in SMALL to MODERATE adverse impacts on the surrounding community. With the loss of jobs and taxes and an increase of housing vacancies and perhaps even population as the former employees left the area to take employment elsewhere, this would have a noticeable adverse effect on the local economy and in turn on the local land use values. Thus, the impact to land values during the license renewal term is expected to be SMALL, as tax revenue likely provides for a higher level of public infrastructure and services than would otherwise be possible. Overall, GGNS concludes that land use impacts during the license renewal term would be SMALL to LARGE beneficial. Therefore, mitigation measures are not warranted.

4.19 Transportation

4.19.1 Description of Issue

Public services, Transportation

4.19.2 Findings from Table B-1, Appendix B to Subpart A

SMALL, MODERATE, or LARGE. Transportation impacts (level of service) of highway traffic generated during plant refurbishment and during the term of the renewed license are generally expected to be of small significance. However, the increase in traffic associated with additional workers and the local road and traffic control conditions may lead to impacts of moderate or large significance at some sites. See 10 CFR 51.53(c)(3)(ii)(J).

4.19.3 Requirement [10 CFR 51.53(c)(3)(ii)(J)]

All applicants shall assess the impact of highway traffic generated by the proposed project on the level of service of local highways during periods of license renewal refurbishment activities and during the term of the renewed license.

4.19.4 Background

Transportation impacts would continue to be of small significance at all sites during operations and would be of small or moderate significance during scheduled refueling and maintenance outages. Because impacts are determined primarily by road conditions existing at the time of the project and cannot be easily forecasted, a site-specific review will be necessary to determine whether impacts are likely to be small or moderate and whether mitigation measures may be warranted. [USNRC 1996, Section 4.7.3.2]

4.19.5 Analysis of Environmental Impact

4.19.5.1 Refurbishment

As discussed in Section 3.3, there are no refurbishment activities required for the renewal of the GGNS OL. Therefore, transportation impacts related to refurbishment are not applicable.

4.19.5.2 License Renewal

GGNS does not anticipate a need for additional workers during the license renewal period (Section 3.5). Therefore, impacts to transportation during the license renewal term would be similar to those experienced during current operations and would be dictated by the workers currently involved in plant operations. As of November 2009, the site employed 690 full-time GGNS workers during normal plant operations (Section 3.5). An additional 700 to 900 contractor employees may also be present at the facility during refueling outages.

As indicated in Section 2.6.1, GGNS is located in an area of declining population in rural Claiborne County, Mississippi. The site is bounded on the west by the Mississippi River and land not owned by GGNS on the north, east, and south. Public transportation routes are limited within the site vicinity. Traffic volumes for the area were obtained from the MDOT (Table 2.10-2), with the heaviest volumes of traffic recorded on U.S. 61 where area roads converge north and south of Port Gibson.

Section 2.10.2 further discusses the LOS designations for traffic routes serving GGNS for workers and shipments. Section 4.18 of Regulatory Guide 4.2, Supplement 1, "Preparation of Supplemental Environmental Reports for Applications to Renew Nuclear Power Plant Operating Licenses," states, "LOS A and B are associated with small impacts because operation of individual users is not substantially affected by the presence of other users. At this level, no delays occur and no improvements are needed." MDOT estimates that currently much of U.S. 61 has an LOS designation of A. However, traffic becomes dense where the four-lane turns into a two-lane north of Port Gibson, and again where traffic enters Port Gibson from the south. These portions of U.S. 61 have an LOS designation of D. Within the community of Port Gibson, the road sets currently have an LOS designation of A, as do the roads leading to the plant. With plans to expand all of U.S. 61 to four-lane, MDOT projects that by 2020 the entire length of U.S. 61 in Claiborne County would better accommodate traffic loads and attain an LOS designation of A. The LOS designations for Port Gibson road sets and roads leading to the plant would continue to have an A or B designation.

Based on available information, traffic counts did not include temporary traffic increases due to annual outages at the site. The site generally schedules its outages every 18 months and may have an average of approximately 700-900 contractor employees onsite for the duration of the outage (Section 3.5). Peak traffic during outages would be expected to be leaving and entering the site from 5:30 to 7:00 a.m. and from 6:30 to 8:00 p.m. Compensatory measures, such as staggered shift starting and quitting times, are taken to ensure that the increased traffic flow during outages continue to maintain a reasonable LOS.

In summary, license renewal is not expected to increase the volume of traffic or affect the current LOS designations around the site. Therefore, traffic patterns around the site would be unaffected by plant operations or outage activities during the license renewal period.

4.19.6 Conclusion

No refurbishment activities are required for renewal of the GGNS OL and no increases are expected in the total number of employees that will be onsite during this same period. Although LOS road designations in the vicinity of GGNS are adequate (LOS A), compensating measures, such as staggered shift starting and ending times, are taken by the site to account for the increased traffic flow during outages to maintain a reasonable level of service. Therefore, impacts on local traffic will be SMALL and additional mitigation measures beyond staggering shift times are not warranted.

4.20 Historic and Archaeological Resources

4.20.1 Description of Issue

Historic and Archaeological Resources

4.20.2 Finding from Table B-1, Appendix B to Subpart A

SMALL, MODERATE, or LARGE. Generally plant refurbishment and continued operation are expected to have no more than small adverse impacts on historic and archaeological resources. However, the NHPA requires the federal agency to consult with the SHPO to determine whether there are properties present that require protection. See 10 CFR 51.53 (c)(3)(ii)(K).

4.20.3 Requirement [10 CFR 51.53(c)(3)(ii)(K)]

All applicants shall assess whether any historic or archaeological properties will be affected by the proposed project.

4.20.4 Background

It is unlikely that moderate or large impacts to historic resources would occur at any site unless new facilities or service roads are constructed or new transmission lines are established. However, the identification of historic resources and determination of possible impacts to them must be done on a site-specific basis through consultation with the SHPO. The site-specific nature of historic resources and the mandatory NHPA consultation process mean that the significance of impacts to historic resources and the appropriate mitigation measures to address those impacts cannot be determined generically. [USNRC 1996, Section 3.7.7]

4.20.5 Analysis of Environmental Impact

4.20.5.1 Refurbishment

As discussed in Section 3.3, there are no refurbishment activities associated with the renewal of the GGNS OL. Therefore, historic and archaeological impacts related to refurbishment are not applicable.

4.20.5.2 License Renewal

The area within a 6-mile radius of the site consisting of land primarily within Claiborne County, Mississippi, and Tensas Parish, Louisiana, may be archaeologically sensitive, which means that NRHP-eligible and listed archaeological sites (prehistoric and historic) are present. These sites have been catalogued and listed on the state registries or recorded for potential listing (Tables 2.12-1 and 2.12-2). For those yet unidentified archaeological sites, adverse impacts would only occur as a result of soil intrusive activities. GGNS has no plans to conduct such soil intrusive activities at any location outside of the site boundaries under a renewed license. Therefore, renewal of the GGNS OL would result in no adverse impacts to archaeological sites located outside the site property.

There are also many eligible and listed aboveground historic sites in the vicinity (6-mile radius) of the site. Such historic properties are susceptible to any substantial force that could degrade their physical or historical integrity. Physical integrity refers to the structural condition (or soundness) of a historic property such as a house. The physical integrity of a historic site can be affected by the nearby operation of heavy equipment or by vibrations from the detonation of explosives. Historical integrity is the ability of a property to convey its significance to the public by virtue of its location, design, setting, materials, workmanship, feeling, and association (36 CFR 60.4). The historical integrity of a site can be adversely impacted by factors such as noise. GGNS plant operations produce no intense vibrations or other substantial physical forces that would adversely impact historic properties located outside of the site property. In addition, GGNS and the associated facilities produce little noise. As a result, impacts on the physical and historical integrity of such sites would be expected to be SMALL.

Since the original construction and operation of GGNS, historical and archaeological resource reviews have occurred for proposed projects such as the GGNS ESP, GGNS Unit 3 COLA, and the GGNS EPU. In all instances, impacts were determined to be SMALL. For license renewal, Entergy consulted with the Mississippi and Louisiana SHPOs, and no concerns were identified by the agencies regarding adverse impacts (Attachment B).

As previously discussed, there are no current plans for additional construction or plant refurbishments in conjunction with renewal of the GGNS OL. However, Entergy has procedural administrative controls in place to ensure that reviews are conducted prior to engaging in construction or operational activities in previously undisturbed areas that may result in a potential impact to cultural resources at the site. This procedure, which requires reviews, investigations, and consultations as needed, ensures that existing or potentially existing cultural resources are adequately protected and assists Entergy in meeting state and federal expectations [Entergy 2008d].

Therefore, renewal of the GGNS OL would result in no adverse impacts to any historic and archaeological sites.

4.20.6 Conclusion

No refurbishment activities are required for license renewal at GGNS. There are also no plans to alter operations, expand existing facilities, or disturb additional land in support of license renewal. In addition, as discussed in Section 4.20.5.2 above, no historic properties such as NRHP eligible or listed archaeological sites or aboveground historical sites would be affected by operation of the plant during the license renewal period. Therefore, under a renewed license, the potential impacts on historic properties from continued operation of GGNS would be SMALL and additional mitigation measures beyond Entergy's existing procedural administrative controls are not warranted.

4.21 Severe Accident Mitigation Alternatives

4.21.1 Description of Issue

Severe accidents.

4.21.2 Finding from Table B-1, Appendix B to Subpart A

SMALL. The probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to ground water, and societal and economic impacts from severe accidents are small for all plants. However, alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives. See 10 CFR 51.53(c)(3)(ii)(L).

4.21.3 Requirement [10 CFR 51.53(c)(3)(ii)(L)]

If the staff has not previously considered severe accident mitigation alternatives for the applicant's plant in an environmental impact statement or related supplement or in an environmental assessment, a consideration of alternatives to mitigate severe accidents must be provided.

4.21.4 Background

The staff concluded that the generic analysis summarized in the GEIS applies to all plants and that the probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to ground water, and societal and economic impacts of severe accidents are of small significance for all plants. However, not all plants have performed a site-specific analysis of measures that could mitigate severe accidents. Consequently, severe accidents are a Category 2 issue for plants that have not performed a site-specific consideration of severe accident mitigation and submitted that analysis for Commission review [USNRC 1996, Section 5.5.2.5].

4.21.5 Analysis of Environmental Impact

The method used to perform the Severe Accident Mitigation Alternatives (SAMA) analysis was based on the handbook used by the USNRC to analyze benefits and costs of its regulatory activities [USNRC 1997].

Environmental impact statements and environmental reports are prepared using a sliding scale in which impacts of greater concern and mitigation measures of greater potential value receive more detailed analysis than impacts of less concern and mitigation measures of less potential value. Accordingly, Entergy used less detailed feasibility investigation and cost estimation techniques for SAMA candidates having disproportionately high costs and low benefits and more detailed evaluations for the most viable candidates.

The following is a brief outline of the approach taken in the SAMA analysis.

(1) Establish the Baseline Consequences of a Severe Accident

Severe accident consequences were evaluated in four areas.

- Off-site exposure costs: Monetary value of consequences (dose) to off-site population.

  The Probabilistic Safety Assessment (PSA) model was used to determine total accident frequency (core damage frequency [CDF] and containment release frequency). The MELCOR Accident Consequences Code System 2 (MACCS2) was used to convert release input to public dose. Dose was converted to present worth dollars (based on a valuation of $2,000 per person-rem and a present worth discount rate of 7 percent).

- Off-site economic costs: Monetary value of damage to off-site property.

  The PSA model was used to determine total accident frequency (CDF and containment release frequency). MACCS2 was used to convert release input to off-site property damage. Off-site property damage was converted to present worth dollars based on a discount rate of 7 percent.

- On-site exposure costs: Monetary value of dose to workers.

  Best-estimate occupational dose values were used for immediate and long-term dose. Dose was converted to present worth dollars (based on a valuation of $2,000 per person-rem and a present worth discount rate of 7 percent).

- On-site economic costs: Monetary value of damage to on-site property.

  Best-estimate cleanup and decontamination costs were used. On-site property damage estimates were converted to present worth dollars based on a discount rate of 7 percent. It was assumed that, subsequent to a severe accident, the plant would be decommissioned rather than restored. Therefore replacement/refurbishment costs were not included in on-site costs. Replacement power costs were considered.

(2) Identify SAMA Candidates

Potential SAMA candidates were identified from the following sources (see Attachment E for reference details):

- SAMA analyses for other BWR plants.

- USNRC and industry documentation discussing potential plant improvements.

- GGNS Individual Plant Examination of internal and external events reports and their updates.

- GGNS updated PSA model lists of risk-significant contributors.

(3) Phase I – Preliminary Screening

Potential SAMA candidates were screened out if they modified features not applicable to GGNS, if they had already been implemented at GGNS, or if they were similar in nature and could be combined with another SAMA candidate to develop a more comprehensive or plant-specific SAMA candidate.

(4) Phase II – Final Screening and Cost Benefit Evaluation

The remaining SAMA candidates were evaluated individually to determine the benefits and costs of implementation, as follows:

- The total benefit of implementing a SAMA candidate was estimated in terms of averted consequences (benefits estimate).
    - The baseline PSA model was modified to reflect the maximum benefit of the improvement. Generally, the maximum benefit of a SAMA candidate was determined with a bounding modeling assumption. For example, if the objective of the SAMA candidate was to reduce the likelihood of a certain failure mode, then eliminating the failure mode from the PSA would bound the benefit, even though the SAMA candidate would not be expected to be 100 percent effective in eliminating the failure. The modified model was then used to produce a revised accident frequency.
    - Using the revised accident frequency, the method previously described for the four baseline severe accident impact areas was used to estimate the cost associated with each impact area following implementation of the SAMA candidate.
    - The benefit in terms of averted consequences for each SAMA candidate was then estimated by calculating the arithmetic difference between the total estimated cost associated with all four impact areas for the existing plant design and the revised plant design following implementation of the SAMA candidate.
- The cost of implementing a SAMA was estimated by one of the following methods (cost estimate).
    - An estimate for a similar modification considered in a previously performed SAMA analysis was used. These estimates were developed in the past and no credit was taken for inflation when applying them to GGNS.
    - Engineering judgment on the cost associated with procedural changes, engineering analysis, testing, training, and hardware modification was applied to formulate a conclusion regarding the economic viability of the SAMA candidate.

The detail of the cost estimate was commensurate with the benefit. If the benefit was low, it was not necessary to perform a detailed cost estimate to determine if the SAMA was cost beneficial.

(5) Sensitivity Analyses

Two sensitivity analyses were conducted to gauge the impact of key assumptions upon the analysis. One sensitivity analysis was to investigate the sensitivity of assuming a 33-year period for remaining plant life (i.e., thirteen years on the original plant license plus the 20-year license renewal period). The other sensitivity analysis was to investigate the sensitivity of each analysis case to a more conservative discount rate of 3 percent.

The SAMA analysis for GGNS is presented in the following sections. Sections E.1 and E.2 of Attachment E provide a more detailed discussion of the process presented above.

4.21.5.1 Establish the Baseline Consequences of a Severe Accident

A baseline was established to enable estimation of the risk reductions attributable to implementation of potential SAMA candidates. The baseline severe accident risk was estimated using the GGNS PSA model and the MACCS2 consequence analysis software code. The PSA model used for the SAMA analysis is an internal events risk model.

4.21.5.1.1 The PSA Internal Events Model – Level 1 and Level 2 Analysis

The PSA model (Level 1 and Level 2) used for the SAMA analysis was the most recent internal events risk model for GGNS. This model is an updated version of the model used in the Individual Plant Examination (IPE) and reflects the GGNS configuration following the EPU. In the EPU model, the Rev. 3 model, which reflects GGNS design, component failure and unavailability data as of August 2006, was modified to reflect the power uprate configuration. There have been no major plant hardware changes or procedural modifications since August 2006 that would have a significant impact on the results of the SAMA analysis. Thus, the EPU model used for the SAMA analysis is appropriate. The GGNS model adopts the small event tree / large fault tree approach and uses the CAFTA code for quantifying CDF.

The GGNS Level 2 analysis uses a Containment Event Tree (CET) to analyze all core damage sequences identified in the Level 1 analysis. The CET evaluates systems, operator actions, and severe accident phenomena to characterize the magnitude and timing of radionuclide release. The result of the Level 2 analysis is a list of sequences involving radionuclide release, along with the frequency, magnitude and timing of release for each sequence.

4.21.5.1.2 The PSA External Events Model – Individual Plant Examination of External Events (IPEEE) Model

The GGNS IPEEE determined that the plant is adequately designed to protect against the effects of seismic, high wind and external flooding events. The seismic portion of the IPEEE was completed in conjunction with the Seismic Qualification Utility Group (SQUG) program using a seismic margin method following the guidance of NUREG-1407, *Procedural and Submittal Guidance for the Individual Plant Examination of External*

Events (IPEEE) for Severe Accident Vulnerabilities, June 1991. A number of plant improvements were identified as described in NUREG-1742, *Perspectives Gained from the IPEEE Program, Final Report*, April 2002. These improvements were implemented.

The GGNS fire analysis was performed using the EPRI Fire Induced Vulnerability Evaluation (FIVE) method for qualitative and quantitative screening of fire areas. Unscreened fire zones were then analyzed in more detail using a fire Probabilistic Risk Assessment (PRA) approach. The FIVE method is primarily a screening approach used to identify plant vulnerabilities due to fire initiating events. The end result of GGNS IPEEE fire analysis identified the CDF for significant fire areas. Following this analysis, a number of administrative procedures were revised to improve combustible and flammable material control.

The NRC SER for the IPEEE also lists five potential plant modifications related to external flooding events that were not implemented based on the low probability of external flooding. These modifications were considered "N/A" in the Phase I SAMA screening.

4.21.5.1.3 MACCS2 Model – Level 3 Analysis

A Level 3 model was developed using the MACCS2 consequence analysis software code (Version 1.13.1) to estimate the hypothetical impacts of severe accidents on the surrounding environment and members of the public. The principal phenomena analyzed were atmospheric transport of radionuclides; mitigation actions (i.e., evacuation, condemnation of contaminated crops and milk) based on dose projection; dose accumulation by a number of pathways, including food and water ingestion; and economic costs. Input for the Level 3 analysis included the core radionuclide inventory, source terms from the GGNS PSA model, site meteorological data, projected population distribution (within 50-mile radius) for the year 2044, emergency response evacuation modeling, and economic data. The MACCS2 input data are described in Section E.1.5 of Attachment E.

4.21.5.1.4 Evaluation of Baseline Severe Accident Consequences Using the Regulatory Analysis Technical Evaluation Handbook Method

This section describes the method used to estimate the cost associated with each of the four impact areas for the baseline case (i.e., without SAMA implementation). This analysis was used to establish the maximum benefit that a SAMA could achieve if it eliminated all risk due to GGNS at-power internal events.

Off-Site Exposure Costs

The Level 3 baseline analysis resulted in an annual off-site exposure risk of 0.486 person-rem. This value was converted to its monetary equivalent (dollars) via application of the $2,000 per person-rem conversion factor from the *Regulatory Analysis Technical Evaluation Handbook* [USNRC 1997]. This monetary equivalent was then discounted to present value using the formula from the same source:

$$APE = (F_S D_{P_S} - F_A D_{P_A}) R \frac{1 - e^{-rt_f}}{r}$$

where

APE = monetary value of accident risk avoided from population doses, after discounting.

R = monetary equivalent of unit dose, ($/person-rem).

F = accident frequency (events/year).

D_P = population dose factor (person-rem/event).

S = status quo (current conditions).

A = after implementation of proposed action.

r = discount rate (%).

t_f = license renewal period (years).

Using a 20-year period, a 7 percent discount rate, assuming F_A is zero, and the baseline release frequency of 2.05E-06/ry resulted in the monetary equivalent value of $10,462. This value is presented in Table 4.21-1.

Off-Site Economic Costs

The Level 3 baseline analysis resulted in an annual off-site economic risk monetary equivalent of $1,244. This value was discounted in the same manner as the public health risks in accordance with the following equation:

$$AOC = (F_S P_{D_S} - F_A P_{D_A}) \frac{1 - e^{-rt_f}}{r}$$

where

AOC = monetary value of risk avoided from off-site property damage, after discounting.

P_D = off-site property loss factor ($/event).

F = accident frequency (events/year).

S = status quo (current conditions).

A = after implementation of proposed action.

r = discount rate (%).

t_f = license renewal period (years).

Using previously defined values; the resulting monetary equivalent is $13,387. This value is presented in Table 4.21-1.

On-Site Exposure Costs

The values for occupational exposure associated with severe accidents were not derived from the PSA model but from information in the *Regulatory Analysis Technical Evaluation Handbook* [USNRC 1997]. The values for occupational exposure consist of "immediate dose" and "long-term dose." The best-estimate value provided for immediate occupational dose is 3,300 person rem, and long-term occupational dose is 20,000 person-rem (over a 10-year clean-up period). The following equations were used to estimate monetary equivalents:

Immediate Dose

$$W_{IO} = (F_S D_{IO_S} - F_A D_{IO_A}) R \frac{1 - e^{-rt_f}}{r} \quad (1)$$

where

W_{IO} =monetary value of accident risk avoided from immediate doses, after discounting.

IO = immediate occupational dose.

R = monetary equivalent of unit dose ($/person-rem).

F = accident frequency (events/year).

D_{IO} =immediate occupational dose (person-rem/event).

S = status quo (current conditions).

A = after implementation of proposed action.

r = discount rate (%).

t_f = license renewal period (years).

The values used in the analysis were as follows:

R = \$2,000/person rem.

r = 0.07.

D_{IO} = 3,300 person rem /accident.

t_f = 20 years.

For the basis discount rate, assuming F_A is zero, the bounding monetary value of the immediate dose associated with GGNS' accident risk is

$$W_{IO} = (F_S D_{IO_S}) R \frac{1 - e^{-rt_f}}{r}$$

$$W_{IO} = 3300 \times F_S \times \$2000 \times \frac{1 - e^{-(0.07 \times 20)}}{0.07}$$

$$W_{IO} = (\$7.10 \times 10^7) F_S$$

For the baseline release frequency, 2.05 x 10^{-6}/ry,

$$W_{IO} = \$146$$

Long-Term Dose

$$W_{LTO} = (F_S D_{LTO_S} - F_A D_{LTO_A}) R \times \frac{1 - e^{-rt_f}}{r} \times \frac{1 - e^{-rm}}{rm} \quad (2)$$

where

W_{LTO} = monetary value of accident risk avoided long-term doses, after discounting ($).

LTO = long-term occupational dose.

m = years over which long-term doses accrue.

R = monetary equivalent of unit dose ($/person-rem).

F = accident frequency (events/year).

D_{LTO} = long-term occupational dose (person-rem/event).

S = status quo (current conditions).

A = after implementation of proposed action.

r = discount rate (%).

t_f = license renewal period (years).

The values used in the analysis were as follows:

R = $2,000/person rem.

r = 0.07.

D_{LTO} = 20,000 person-rem /accident.

m = 10 years.

t_f = 20 years.

For the basis discount rate, assuming F_A is zero, the bounding monetary value of the long-term dose associated with GGNS's accident risk is

$$W_{LTO} = (F_S D_{LTO_S})R \times \frac{1-e^{-rt_f}}{r} \times \frac{1-e^{-rm}}{rm}$$

$$W_{LTO} = (F_S \times 20{,}000)\$2000 \times \frac{1-e^{-0.07 \times 20}}{0.07} \times \frac{1-e^{-0.07 \times 10}}{0.07 \times 10}$$

$$W_{LTO} = (\$3.10 \times 10^{8})F_S$$

For the release frequency for the baseline, 2.05 x 10^{-6}/ry,

$$W_{LTO} = \$635$$

Total Occupational Exposures

Combining equations (1) and (2) above, using delta (Δ) to signify the difference in accident frequency resulting from the proposed actions, and using the above numerical values, the long-term accident-related on-site (occupational) exposure avoided is

$$AOE = \Delta W_{IO} + \Delta W_{LTO} \text{ (\$)}$$

where

AOE = on-site exposure avoided.

The bounding value for occupational exposure (AOE_B) is

$$AOE_B = W_{IO} + W_{LTO} = \$146 + \$635 = \$781.$$

The resulting monetary equivalent of $781 is presented in Table 4.21-1.

<u>*On-Site Economic Costs*</u>

Clean-Up/Decontamination

The total cost of clean-up/decontamination of a power reactor facility subsequent to a severe accident is estimated in the *Regulatory Analysis Technical Evaluation Handbook* [USNRC 1997] to be $1.5 x 10^9; this same value was adopted for these analyses. Considering a 10-year clean-up period, the present value of this cost is

$$PV_{CD} = \left(\frac{C_{CD}}{m}\right)\left(\frac{1 - e^{-rm}}{r}\right)$$

where

PV_{CD}= present value of the cost of cleanup/decontamination.

CD = clean-up/decontamination.

C_{CD} = total cost of the cleanup/decontamination effort ($).

m = cleanup period (years).

r = discount rate (%).

Based upon the values previously assumed,

$$PV_{CD} = \left(\frac{\$1.5 \times 10^9}{10}\right)\left(\frac{1 - e^{-0.07 \cdot 10}}{0.07}\right)$$

$$PV_{CD} = \$1.08 \times 10^9.$$

This cost is integrated over the term of the proposed license extension as follows:

$$U_{CD} = PV_{CD}\left(\frac{1 - e^{-rt_f}}{r}\right)$$

where

U_{CD} = total cost of clean up/decontamination over the life of the plant.

Based upon the values previously assumed,

$$U_{CD} = \$1.16 \times 10^{10}.$$

Replacement Power Costs

Replacement power costs were estimated in accordance with the *Regulatory Analysis Technical Evaluation Handbook* [USNRC 1997]. Since replacement power will be needed for the time period following a severe accident, for the remainder of the expected generating plant life, long-term power replacement calculations have been used. The present value of replacement power was estimated as follows:

$$PV_{RP} = \left(\frac{B}{r}\right)(1 - e^{-rt_f})^2$$

where

PV_{RP}= present value of the cost of replacement power for a single event.

t_f = license renewal period (years).

r = discount rate (%).

B = a constant representing a string of replacement power costs that occur over the lifetime of a reactor after an event (for a 910MWe "generic" reactor, NUREG/BR-0184 uses a value of $1.2E+8).

$$B = \frac{1475}{910} \times (1.20 \times 10^8) = \$1.95 \times 10^8$$

This cost was scaled to account for the plant specific power after the EPU of 1,475 MWe.

Based upon the values previously assumed:

$$PV_{RP} = \left(\frac{B}{r}\right)(1 - e^{-rt_f})^2 = \left(\frac{\$1.95 \times 10^8}{0.07}\right)(1 - e^{-(0.07)20})^2$$

$$PV_{RP} = \$1.58 \times 10^9$$

To account for the entire lifetime of the facility, U_{RP} was then calculated from PV_{RP}, as follows:

$$U_{RP} = \left[\frac{PV_{RP}}{r}\right](1 - e^{-rt_f})^2$$

where

U_{RP}=present value of the cost of replacement power over the remaining life.

t_f = license renewal period (years).

r = discount rate (%).

Based upon the values previously assumed:

$$U_{RP} = \frac{PV_{RP}}{r}(1 - e^{-rt_f})^2 = \frac{\$1.58 \times 10^9}{0.07}(1 - e^{(-0.07)20})^2 = \$1.28 \times 10^{10}$$

Total On-Site Property Damage Costs

Combining the clean-up/decontamination and replacement power costs, using delta (ΔF) to signify the difference in accident frequency resulting from the proposed actions, and using the above numerical values, the best-estimate value of averted occupational exposure can be expressed as

$$AOSC = \Delta F(U_{CD} + U_{RP}) = \Delta F(\$1.16 \times 10^{10} + \$1.28 \times 10^{10})$$

$$AOSC = \Delta F(\$2.44 \times 10^{10})$$

where

ΔF = difference in annual accident frequency resulting from the proposed action.

For the baseline release frequency, 2.05×10^{-6}/ry,

$$AOSC = \$50{,}043$$

The resulting monetary equivalent of $50,043 is presented in Table 4.21-1.

Table 4.21-1
Estimated Present Dollar Value Equivalent of Internal Events CDF at GGNS

Parameter	Present Dollar Value ($)
Off-site population dose	$10,462
Off-site economic costs	$13,387
On-site dose	$781
On-site economic costs	$50,043
Total	**$74,673**

4.21.5.2 Identify SAMA Candidates

Based on a review of industry documents, an initial list of SAMA candidates was identified. Since GGNS is a BWR, considerable attention was paid to the SAMA candidates from SAMA analyses for other BWR plants. Attachment E lists the specific documents from which SAMA candidates were initially gathered.

In addition to SAMA candidates from review of industry documents, additional SAMA candidates were obtained from plant-specific sources, such as the GGNS IPE and IPEEE. In the IPE and IPEEE, several enhancements related to severe accident insights were recommended. These enhancements were included in the comprehensive list of SAMA candidates and were verified to have been implemented during preliminary screening or were retained for evaluation (see Table E.2-1 of Attachment E).

In addition, the current GGNS PSA Levels 1 and 2 models were also used to identify plant-specific modifications for inclusion in the comprehensive list of SAMA candidates. The risk-significant events from the PSA Level 1 and Level 2 models were reviewed for similar failure modes and effects that could be addressed through a potential enhancement to the plant. The correlation between candidate SAMAs and the risk significant events are listed in Tables E.1-2 and E.1-4 of Attachment E. The comprehensive list contained a total of 249 SAMA candidates. The first step in the analysis of these candidates was to eliminate the non-viable SAMA candidates through preliminary screening.

4.21.5.3 Preliminary Screening (Phase I)

The purpose of the preliminary SAMA screening was to eliminate from further consideration enhancements that were not viable for implementation at GGNS. Potential SAMA candidates were screened out if they modified features not applicable to GGNS or if they had already been implemented at GGNS. In addition, where it was determined those SAMA candidates were potentially viable, but similar in nature, they were combined to develop a more comprehensive or plant-specific SAMA candidate.

During this process, 186 of the 249 initial SAMA candidates were eliminated, leaving 63 SAMA candidates for further analysis. The list of 249 original SAMA candidates and applicable screening criterion is available in on-site documentation.

4.21.5.4 Final Screening and Cost Benefit Evaluation (Phase II)

A cost/benefit analysis was performed on the remaining SAMA candidates. The method for determining if a SAMA candidate was cost beneficial consisted of determining whether the benefit provided by implementation of the SAMA candidate exceeded the expected cost of implementation. The benefit was defined as the sum of the reduction in dollar equivalents for each severe accident impact area (off-site exposure, off-site economic costs, occupational exposure, and on-site economic costs). If the expected implementation cost exceeded the estimated benefit, the SAMA was not considered cost beneficial.

The result of implementation of each SAMA candidate would be a change in the severe accident risk (i.e., a change in frequency or consequence of severe accidents). The method of calculating the magnitude of these changes is straightforward. First, the severe accident risk after implementation of each SAMA candidate was estimated using the same method as for the baseline. The results of the Level 2 model were combined with the Level 3 model to calculate these post-SAMA risks. The results of the benefit analyses for the SAMA candidates are presented in Table E.2-2 of the Attachment E.

Each SAMA evaluation was performed in a bounding fashion. Bounding evaluations were performed to address the generic nature of the initial SAMA concepts. Such bounding calculations overestimate the benefit and thus are conservative calculations. For example, one SAMA dealt with installing digital large break loss of coolant accident (LOCA) protection; the bounding calculation estimated the benefit of this improvement by total elimination of risk due to large break LOCA (see analysis in Phase II SAMA 56 of Table E.2-2). Such a calculation obviously overestimated the benefit, but if the inflated benefit indicated that the SAMA is not cost beneficial, then the purpose of the analysis was satisfied.

As described above for the baseline, values for avoided public and occupational health risk were converted to a monetary equivalent (dollars) via application of the *Regulatory Analysis Technical Evaluation Handbook* [USNRC 1997] conversion factor of $2,000 per person-rem and discounted to present value. Values for avoided off-site economic costs were also discounted to present value. The formula for calculating net value for each SAMA was

Net value = (APE + AOC + AOE + AOSC) - COE

where

APE = value of averted public exposure ($).

AOC = value of averted off-site costs ($).

AOE = value of averted occupational exposure ($).

AOSC= value of averted on-site costs ($).

COE = cost of enhancement ($).

If the net value of a SAMA was negative, the cost of the enhancement was greater than the benefit and the SAMA was not cost beneficial.

The SAMA analysis considered that external events (including fires and seismic events) could lead to potentially significant risk contributions. To account for the risk contribution from external events, the cost of SAMA implementation was compared with a benefit value estimated by applying a multiplier of 11 to the internal events estimated benefit. This value is defined as an "Internal and External Benefit." To account for uncertainties associated with the internal events CDF calculations, the cost of SAMA implementation was also compared with a benefit value estimated by applying an uncertainty multiplier of 3 to the internal and external estimated benefit. This value is defined as the "Internal and External Benefit with Uncertainty." Development of the multipliers for GGNS is described in the following paragraphs.

The GGNS IPEEE concluded for high winds, floods, and other external events that no undue risks are present that might contribute to CDF with a predicted frequency in excess of 1E10-6/ry. As these events are not dominant contributors to external event risk and quantitative analysis of these events is not practical, they are considered negligible in estimation of the external events multiplier.

A seismic margin assessment was performed for the seismic portion of the GGNS IPEEE. Thus, no core damage frequency sequences were quantified as part of the IPEEE seismic risk analysis. The review level earthquake is 0.15g. The conclusion of the seismic analysis was that GGNS is seismically rugged and that all components identified in the safe shutdown path have adequately considered the seismic input. All anchorage to these components was found to be rugged. As seismic events are not dominant contributors to external event risk and quantitative analysis of these events is not practical, they are considered negligible in estimation of the external events multiplier.

The EPRI Fire PRA Implementation Guide was followed for the GGNS IPEEE fire analysis. The EPRI Fire Induced Vulnerability Evaluation method was used for the initial screening, for treatment of transient combustibles, and as the source of fire frequency data. The sum of the unscreened fire zone CDF values is approximately 8.92E-06 per year, while the sum of the screened and unscreened fire zone CDF values (Table E.1-10) is approximately 2.74E-05 per year. However, a more realistic fire CDF may be much less than this value due to conservatisms in the IPEEE fire analysis.

Generic conservatisms in the IPEEE fire analysis methods mentioned in NEI 05-01, "Severe Accident Mitigation Alternatives (SAMA) Analysis Guidance Document," that are applicable to the GGNS fire analysis include the following.

- The frequency and severity of fires were generally conservatively overestimated. A revised fire events database indicates a trend toward lower frequency and less severe fires. This trend reflects improved housekeeping, reduction in transient fire hazards, and other improved fire protection steps at utilities.

- There is little industry experience with crew actions following fires. This led to conservative characterization of crew actions in the IPEEE fire analysis. Because CDF is strongly correlated with crew actions, this conservatism has a profound effect on fire results.

- The peer review process for fire analyses is less well developed than for internal events PSAs. For example, no industry process, such as NEI 00-02, exists for the structured peer review of a fire PSA.

Plant-specific conservative assumptions in the GGNS IPEEE fire analysis include the following.

- Certain specified components whose locations were not determined were assumed failed by any fire.

- Plant trip initiators were assumed to occur in each fire area.

- The damaging effects of a fire were assumed to affect all components in a compartment unless detailed fire modeling was done to demonstrate otherwise.

- No credit was given to human detection except in areas for which a continuous fire watch is required.

- Suppression prior to loss of a cabinet's function was not credited. This assumption was particularly important to the control room.

- The loss of a control room cabinet containing divisional equipment was assumed to affect the entire division.

The IPEEE fire CDF value (for screened and unscreened zones) is approximately ten times the internal events' CDF. This justifies use of a multiplier of 11 on the averted cost estimates (for internal events) to represent the SAMA benefits from both internal and external events.

The internal and external benefit with uncertainty is intended to account for both the internal and external events impacts with uncertainty. CDF uncertainty estimates conservatively resulted in a ratio of the 95th percentile to the mean of 3. Therefore, "Internal and External Benefit" values were multiplied by a factor of 3 to provide the "Internal and External Benefit with Uncertainty."

Use of an internal and external benefit (with uncertainty) is considered appropriate because of the inherent conservatism in the external events modeling approach and conservative assumptions in benefit modeling of individual SAMA candidates. In addition, not all potential enhancements would be impacted by an external event. In some cases an external event would only impose partial failure of systems or trains. Therefore, using 33 times the internal events estimated benefit to account for internal and external events with uncertainty is appropriate.

The expected cost of implementation of each SAMA (COE) was established from existing estimates of similar modifications combined with engineering judgment. Most of the cost estimates were developed from similar modifications considered in previous performed SAMA analyses. In particular, these cost-estimates were derived from the following major sources.

- Pilgrim Nuclear Power Station
- Hope Creek Generating Station
- Columbia Generating Station
- Cooper Nuclear Station
- Duane Arnold Energy Center

Estimates based on modifications that were implemented or estimated in the past were presented in terms of dollar values at the time of implementation and were not adjusted to present-day dollars.

Detailed cost estimates were often not required to make informed decisions regarding the economic viability of a potential plant enhancement when compared to attainable benefit. The implementation costs for several of the SAMA candidates were clearly in excess of the attainable benefit estimated from a particular analysis case. Nonetheless, the cost of SAMA candidates was conceptually estimated to the point where conclusions regarding the economic viability of the proposed modification could be adequately gauged. The cost benefit comparison and disposition of each of the 63 Phase II SAMA candidates is presented in Table E.2-2 of Attachment E.

4.21.5.5 Sensitivity Analyses

Two sensitivity analyses were conducted to gauge the impact of key assumptions upon the analysis. The main factors affecting present worth are the extended plant life and the discount rate. A description of each follows.

Sensitivity Case 1: Years Remaining Until End of Plant Life

The purpose of this sensitivity case was to investigate the sensitivity of assuming a 33-year period for remaining plant life (i.e., 13 years on the original plant license plus the 20-year license renewal period), rather than the 20-year license renewal period used in the base case. Changing this assumption does not cause additional SAMAs to be cost-beneficial.

Sensitivity Case 2: Conservative Discount Rate

The purpose of this sensitivity case was to investigate the sensitivity of each analysis case to the discount rate. The discount rate of 7.0 percent used in the base case analyses is conservative relative to corporate practices. Nonetheless, a lower discount rate of 3.0 percent was assumed in this case to investigate the impact on each analysis case. Changing this assumption does not cause additional SAMAs to be cost-beneficial.

The benefits estimated for each of these sensitivities are presented in Table E.2-3 of Attachment E.

4.21.6 Conclusion

This analysis addressed 249 SAMA candidates for mitigating severe accident impacts. Phase I screening eliminated 186 SAMA candidates from further consideration, based on either inapplicability to GGNS' design or features that had already been incorporated into GGNS' current design, procedures and/or programs. During the Phase II cost-benefit evaluation of the remaining 63 SAMA candidates, an additional 60 SAMA candidates were eliminated because their cost was expected to exceed their benefit.

Three Phase II SAMA candidates presented in Table 4.21-2 were found to be potentially cost-beneficial for mitigating the consequences of a severe accident at GGNS.

<u>SAMA 39</u> Change procedure to cross-tie open cycle cooling system to enhance containment spray system.

GGNS has a residual heat removal/standby service water (RHRSSW) cross-tie that can be aligned for vessel injection flow or containment spray header flow. In the emergency response procedures, the RHRSSW cross-tie is recommended as a way to augment reactor pressure vessel water level. Also, the procedures recommend using containment spray for containment flooding, but do they not mention the option of using SSW as the water source for containment spray. This SAMA recommends altering the emergency response procedures to specify that the SSW system can provide a backup source of water for the containment spray system through the RHRSSW cross-tie.

<u>SAMA 42</u> Enhance procedures to refill CST from demineralized water or service water system.

During SBOs or LOCAs that render the suppression pool unavailable as an injection source, inventory is available in the demineralized water storage tank, the refueling water storage tank, the upper containment pool, and directly from SSW. This SAMA recommends performing engineering analyses to determine appropriate alternate water sources and altering the SBO and LOCA response procedures to include steps to refill the condensate storage tank (CST) from alternate sources when necessary.

<u>SAMA 59</u> Increase operator training for alternating operation of the low pressure emergency core cooling system (ECCS) pumps (low pressure coolant injection [LPCI] and low pressure core spray [LPCS]) for loss of SSW scenarios.

The low pressure ECCS pumps (i.e., LPCI and LPCS) are dependent on SSW. The LPCS pumps are dependent on SSW for pump room cooling. The RHR (LPCI) pumps are dependent on SSW for pump seal cooling. This SAMA recommends altering the loss of SSW response procedures and associated operator training to specify alternating operation of the pumps to significantly extend the time available for recovery actions.

Although the above SAMA candidates do not relate to adequately managing the effects of aging during the period of extended operation, a condition report to implement these potentially cost-beneficial SAMAs has been initiated within the corrective action process. The sensitivity studies indicated that the results of the analysis would not change for the conditions analyzed.

Table 4.21-2
Final SAMAs

Phase II SAMA ID	SAMA Title	Result of Potential Enhancement	CDF Reduction	PDR Reduction	OECR Reduction	Internal and External Benefit	Internal and External Benefit with Uncert.	GGNS Cost Estimate
39	Change procedure to cross-tie open cycle cooling system to enhance containment spray system.	Increased availability of containment heat removal.	26.6%	51.6%	54.7%	$288,437	$865,312	$25,000
	Basis for Conclusion: Eliminate failure of cooled flow from RHR pump A and B. The implementation cost is a generic procedure modification range estimate.							
42	Enhance procedures to refill CST from demineralized water or service water system.	Reduced risk of core damage during station blackouts or LOCAs that render the suppression pool unavailable as an injection source.	11.3%	16.8%	17.4%	$107,899	$323,696	$200,000
	Basis for Conclusion: Eliminate the failure of high pressure core spray and reactor core isolation cooling suction. The implementation cost is a procedure with engineering and training range estimate.							

Table 4.21-2 (Continued)
Final SAMAs

Phase II SAMA ID	SAMA Title	Result of Potential Enhancement	CDF Reduction	PDR Reduction	OECR Reduction	Internal and External Benefit	Internal and External Benefit with Uncert.	GGNS Cost Estimate
59	Increase operator training for alternating operation of the low pressure ECCS pumps (LPCI and LPCS) for loss of SSW scenarios.	Increased time available for recovery actions for low pressure ECCS when a loss of SSW occurs.	4.1%	6.5%	6.8%	$40,452	$121,357	$50,000
	Basis for Conclusion: Eliminate failure of the SSW to the LPCS room cooler. The implementation cost is a procedure with training range estimate.							

4.22 Environmental Justice

4.22.1 Description of Issue

Environmental Justice

4.22.2 Finding from Table B-1, Appendix B to Subpart A

"The need for and the content of an analysis of environmental justice will be addressed in plant-specific reviews."

4.22.3 Requirement

Other than the above referenced finding, there is no requirement concerning environmental justice in 10 CFR Part 51.

4.22.4 Background

The following background information is from Regulatory Guide 4.2.

Environmental justice was not reviewed in NUREG-1437. Executive Order 12898, "Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations," issued on February 11, 1994, is designed to focus the attention of Federal agencies on the human health and environmental conditions in minority and low-income communities. The USNRC Office of Nuclear Reactor Regulation (NRR) is guided in its consideration of environmental justice by Attachment 4, "NRR Procedures for Environmental Justice Reviews," to NRR Office Letter No. 906, Revision 2, "Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues." NRR Office Letter No. 906 is revised periodically. The environmental justice review involves identifying off-site environmental impacts, their geographic locations, minority and low-income populations that may be affected, the significance of such effects, and whether they are disproportionately high and adverse compared to the population at large within the geographic area, and if so, what mitigative measures are available, and which will be implemented. The USNRC staff will perform the environmental justice review to determine whether there will be disproportionately high human health and environmental effects on minority and low-income populations and report the review in its SEIS. The staff's review will be based on information provided in the ER and developed during the staff's site-specific scoping process.

NRR's Office Letter No. 906, Revision 2 contains a procedure for incorporating environmental justice into the licensing process [USNRC 2004, Appendix D]. Entergy used this process in conducting the review and analysis of this issue.

4.22.5 Analysis

The consideration of environmental justice is required to assure that federal programs and activities will not have "disproportionately high and adverse human health or environmental effects…on minority populations and low-income populations…" Entergy's analyses of the

Category 2 issues defined in 10 CFR 51.53(c)(3)(ii) determined that environmental impacts from the continued operation of GGNS during the license renewal period would either be not detectable or so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. NUREG-1817 also determined the following as it relates to the construction and operation of the proposed GGNS Unit 3: [USNRC 2006a, Sections 4.7.1 and 5.7.1]

- No unusual resource dependencies or practices, such as subsistence agriculture, hunting, or fishing exist through which the populations could be disproportionately affected.

- There are no location-dependent disproportionate impacts affecting minority and low-income populations.

In addition, previous radiological environmental sampling at GGNS associated with such media as venison, rabbit, and fish have shown no detectable activity. Thus, no disproportionate impact on minority or low-income populations would occur from the proposed action of renewing the GGNS OL. However, Entergy presents environmental justice demographic information in Section 2.6.2 to assist the USNRC in its independent review.

4.22.6 Conclusion

As part of its environmental assessment of this proposed action, Entergy has determined that no significant offsite environmental impacts will be created by the renewal of the GGNS OL. This conclusion is supported by the review performed of the Category 2 issues defined in 10 CFR 51.53(c)(3)(ii) presented in this ER, NUREG-1817, and previous radiological environmental sampling.

As discussed in Section 4.22.5, no unusual resource dependencies or practices, such as subsistence agriculture, hunting, or fishing, exist through which the populations could be disproportionately affected near counties around the GGNS area. In addition, as concluded in Section 4.18.6, Entergy's evaluation of the offsite land use concluded the impacts of use and land valuation are SMALL. However, tax-driven offsite land use impacts are LARGE beneficial.

As the NRR procedure recognizes, if no significant offsite impacts occur in connection with the proposed action, then no member of the public will be substantially affected. Therefore, there can be no disproportionately high and adverse impacts or effects on members of the public, including minority and low-income populations, resulting from the renewal of the GGNS OL.

4.23 <u>Cumulative Impacts</u>

Entergy considered potential cumulative impacts in its environmental analysis associated with Station operations during the license renewal period. For the purposes of this analysis, past actions are those related to the resources at the time of plant licensing and construction, present actions are those related to the resources at the time of current operation of the power plant, and future actions are considered to be those that are reasonably foreseeable through the end of plant operation, which would include the 20-year license renewal term. The geographic area over which past, present, and future actions would occur is dependent on the type of action considered and is described below for each impact area.

The impacts of the proposed action are combined with other past, present and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. These combined impacts are defined as "cumulative" in 40 CFR 1508.7 and include individually minor, but collectively significant, actions taking place over a period of time. It is possible that an impact that may be SMALL by itself could result in a MODERATE or LARGE impact when considered in combination with the impacts of other actions on the affected resource. Likewise, if a resource is regionally declining or imperiled, even a SMALL individual impact could be important if it contributes to or accelerates the overall resource decline. Since a portion of the GGNS site has been considered for the future construction and operation of GGNS Unit 3, as addressed extensively in the COLA submitted for that project, the potential cumulative impacts of GGNS Unit 3 are considered throughout in this evaluation. It must be noted, however, that SERI requested the USNRC suspend its review of the GGNS Unit 3 COLA. Future construction and operation of any power generation unit other than GGNS Unit 1 is speculative and is discussed in the following solely to be comprehensive in the analysis.

4.23.1 Cumulative Impacts on Aquatic Resources

PSW is supplied from radial collector wells located in the floodplain that parallels the Mississippi River. Although GGNS withdraws groundwater that is hydraulically connected to the river, as described in Section 2.2.5, GGNS does not have an intake structure. This allows GGNS to avoid the impacts to the Mississippi River aquatic biota from entrainment and impingement effects associated with once-through cooling systems. Threatened and endangered aquatic species associated with GGNS and its transmission lines are listed in Table 2.5-1, and associated impacts are discussed in Section 4.10. Based on Entergy's assessment, there are no cumulative impacts to aquatic biota, including threatened and endangered aquatic species, from entrainment or impingement due to the continued operation of GGNS.

Entergy has also considered potential cumulative impacts on aquatic resources should a new nuclear generation unit (GGNS Unit 3) be constructed and operated at GGNS, along with any new associated transmission lines. GGNS Unit 3 would use surface water for cooling, as discussed in the SERI COLA, and would utilize a closed loop cooling system to minimize impacts associated with impingement and entrainment. Potential impacts to aquatic resources associated with construction and operation of GGNS Unit 3 were considered to be SMALL. [SERI 2008b, Sections 4.3.2 and 5.3.2.2] As indicated in Table 2.5-1, federal and state listed aquatic threatened and endangered species and species of concern include the pallid sturgeon, bayou darter, crystal darter, sicklefin chub, chestnut lamprey, black buffalo, paddlefish, blue sucker, fat pocketbook mussel, and the rabbitsfoot mussel. Impacts to threatened and endangered aquatic species related to construction and operation of a potential GGNS Unit 3 and its associated transmission lines are anticipated to be SMALL [SERI 2008b, Sections 4.3.1.5 and 5.3.2.2]. While the construction and operation of GGNS Unit 3 may include a small incremental impact on aquatic resources, the overall cumulative impact of license renewal would be expected to remain SMALL, since PSW for GGNS Unit 1 cooling water does not directly use surface water resources. In addition, any impacts due to thermal discharges would be managed in accordance with GGNS' NPDES permit for a combined site consisting of GGNS Units 1 and 3.

The potential cumulative effects of climate change on the Mississippi River, whether from natural cycles or related to anthropogenic activities, are speculative in nature, and hypothetically could result in a variety of environmental alterations that would affect aquatic resources. The environmental changes that hypothetically could affect these resources include floods, prolonged drought, temperature increases, changes to the river channel, bank and levees, and sediment and contaminant loads. Changes due to floods and bank erosion hypothetically could also result in dramatic effects on wetlands and other shoreline communities. Prolonged drought hypothetically could result in dramatic effects on riparian and riverine habitats due to decreased flows that hypothetically could affect velocity or flood-pulse related spawning triggers, sediment loads and turbidity, and available cover for various species. Water temperature increases hypothetically could affect spawning patterns or success, or influence species distributions when cold-water species move northward while warm-water species become established in new habitats. Changes in turbidity due to sediment loads patterns hypothetically could influence the spawning and distribution of the pallid sturgeon and the ranges of exotic or nuisance species. Changes in precipitation patterns hypothetically could have major effects on water circulation and alter the nature of sediment and nutrient inputs to the system. This hypothetically could result in changes to primary production and influence the aquatic food web on many levels. Thus, the extent and magnitude of climate change impacts may hypothetically make this process an important contributor to cumulative impacts on the aquatic resources of the Mississippi River, and these impacts hypothetically could be substantial over the long term. However as discussed above, GGNS Unit 1 does not directly use surface water for cooling or other water needs, and although the water withdrawn by the radial collector wells is in hydraulic communication with the water in the Mississippi River, the water consumed due to cooling tower evaporative loss is a minute portion of low-water flow. As discussed in Sections 4.23.2.2 and 4.23.2.3, the cumulative impacts directly attributable to the GGNS site on aquatic resources may have a small incremental impact, but these impacts are minimized by Entergy's existing environmental protection procedures, NPDES permitting program compliance, Section 404 permitting, and best management practices.

Therefore, Entergy concludes that although the renewal of the GGNS OL would have SMALL impacts by itself, impacts from climate change would be MODERATE.

4.23.2 Cumulative Impacts on Terrestrial Resources

Entergy evaluated cumulative impacts of past, current, and possible future activities in the vicinity of the GGNS site, its transmission corridors, and the four counties in which the majority of its employees reside: Claiborne, Hinds, Jefferson, and Warren. Terrestrial resource impacts might include those to the designated land use, wetlands, uplands and lowland plains habitats, and threatened and endangered terrestrial species. Entergy has evaluated the incremental impacts associated with the proposed action to renew the GGNS OL.

4.23.2.1 Land Use

The GGNS environmental setting is described in Chapter 2. The description of GGNS facilities and operations are described in Chapter 3, while analyses of impacts to various resources are described in this Chapter 4. The potential impacts of the various alternatives to the proposed action are discussed in Chapter 8.

Past land use changes include the construction of the GGNS facilities and its associated transmission lines. There has been little residential and commercial development in the immediate area since the construction of GGNS. In addition, the four counties in this region have limited controls on future development and land use (Section 2.8). In fact, due to the region's historically declining population, most counties have strategies to encourage economic development, as discussed in Section 2.8.

The USACE and USFWS both regulate some actions involving terrestrial resources along the Mississippi River. However, there are no known future projects that would require the designation of the current land use to change. As described in Sections 2.8 and 4.18, operation of GGNS and its associated transmission lines during the license renewal term would not require any change to the current land use. Even if GGNS Unit 3 were to be built, land use onsite would continue to be limited primarily to portions of the site previously disturbed during construction and the continuing operation of GGNS Unit 1. As discussed in the SERI COLA, construction and operation of GGNS Unit 3 would result in SMALL land use impacts [SERI 2008b, Sections 4.1.1 and 5.1.1]. Therefore, any cumulative impacts from the additional years of GGNS Unit 1 operation would be SMALL.

As the transmission line owner and operator, EMI transmission line ROW management practices are not expected to adversely affect vegetation characteristics of terrestrial habitats within the ROW or other terrestrial habitats in the vicinity of the transmission lines. In addition, none of the transmission line management practices are expected to alter wetland or riverine hydrology or adversely affect vegetation characteristics of these habitats or other habitats. Since there are no planned changes to the transmission lines related to renewal of GGNS' OL, impact to terrestrial resources are expected to remain SMALL.

Should GGNS Unit 3 be built, land use changes associated with constructing new transmission lines to connect the plant to the electrical grid are expected to be MODERATE [SERI 2008b, Section 4.1.2]. Although impacts from renewal of the GGNS OL would be SMALL by itself, when combined with GGNS Unit 3 activities, cumulative impacts could range from SMALL to MODERATE. However, these impacts would be effectively mitigated by Entergy's existing environmental protection procedures related to threatened and endangered species, cultural resources, and stormwater permitting and best management practices.

4.23.2.2 Wetlands

The open water of the Mississippi River and its emergent wetland habitat supports a number of migrant waterfowl and wildlife species. The withdrawal impacts associated with the GGNS radial well system on nearby wetlands is discussed in Section 4.7. As previously discussed, the wells at GGNS are in direct hydraulic communication with the Mississippi River, which minimizes any potential for overutilization of groundwater in the vicinity. This hydraulic connection and annual inundation during river flooding also minimizes the potential impacts to aquatic, terrestrial, and riparian communities within the floodplain. Entergy also considered the potential cumulative impact of license renewal should GGNS Unit 3 be constructed and licensed. The potential impacts of transmission line construction associated with GGNS Unit 3 to wetlands were discussed in the SERI COLA and were described as SMALL to MODERATE [SERI 2008b, Section 4.3.1.2].

It should be noted that any future unit anticipated to be constructed at GGNS would be expected to obtain its cooling water directly from a surface water intake, rather than from expansion of the radial well system. Even the cumulative use of water withdrawn directly or indirectly would remain less than 1 percent of the average annual flow and would not significantly affect the annual inundation during river flooding of the floodplain. Entergy concludes that there would be little incremental cumulative impact to terrestrial, aquatic, and riparian wetland habitat associated with radial well groundwater withdrawal use during the license renewal period. Therefore, although impacts from renewal of GGNS's OL would be SMALL by itself, when combined with GGNS Unit 3 activities, cumulative impacts could range from SMALL to MODERATE. However, these impacts would be effectively mitigated by Entergy's existing environmental protection procedures related to stormwater and Section 404 permitting and best management practices.

4.23.2.3 Threatened and Endangered Terrestrial Species

State and federally listed threatened or endangered terrestrial species and species of concern in Claiborne County and those along the transmission line ROW are identified in Table 2.5-1. There are no critical habitats designated in any of the counties associated with the GGNS site, site vicinity, or its transmission line ROW. Federal and state listed terrestrial threatened or endangered species and species of concern that could potentially be present on the GGNS site, in the vicinity of GGNS, or along the ROW of the in-scope transmission lines include the Louisiana black bear, American black bear, bald eagle, wood stork, interior least tern, red-cockaded woodpecker, white ibis, Webster's salamander, and robust baskettail. The impacts to threatened and endangered species related to renewal of the GGNS OL are discussed in Section 4.10, and were found to be SMALL.

In addition to impacts associated with renewal of the GGNS OL, Entergy included impacts with the potential construction and operation of GGNS Unit 3 and its associated transmission lines. As discussed in the GGNS Unit 3 COLA, anticipated impacts to threatened, endangered species of special concern were expected to be SMALL. [SERI 2008b, Sections 4.3.1.5 and 5.3.2.2] While there might be a small incremental change in impacts due to GGNS Unit 3, the overall cumulative impacts would be minimized during construction, and operational procedures associated with vegetative management and environmental protection practices would assure that cumulative potential impacts remain SMALL.

4.23.3 Cumulative Radiological Impacts

GGNS has conducted a REMP around the site since 1978. On the basis of an evaluation of REMP results, GGNS concludes that impacts of radiation exposure on the public and workers (occupational) from operation of GGNS during the license renewal term would be SMALL. With respect to the future, the REMP sampling locations as shown in the GGNS ODCM have not identified increasing levels or the accumulation of radioactivity in the environment over time. The results of the operational REMP are reported annually to the USNRC in the GGNS Annual Radiological Environmental Operating Report. The REMP measures radiation and radioactive materials in the environment from all sources, including, but not limited to, GGNS radioactive emissions discussed in Section 3.2.3, and thus considers cumulative radiological impacts.

The radiological dose limits for protection of the public and workers have been developed by the USEPA and USNRC to address the cumulative impact of acute and long-term exposure to radiation and radioactive material. These dose limits are codified in 40 CFR Part 190 and 10 CFR Part 20. For the purpose of this analysis, the area within a 50-mile radius region of interest (ROI) around GGNS was included. There are no other nuclear facilities within the 50-mile ROI. RBS is located approximately 88 miles south of GGNS on the Mississippi River between RM 262 and 265. A portion of the population within the GGNS ROI is also within the 50-mile ROI for RBS. Any cumulative radiological impact from the routine operation of RBS and GGNS, even when considered together, would be expected to be SMALL.

The USNRC and the State of Mississippi would regulate any future actions in the vicinity of the site (including the operation of GGNS Unit 3 or RBS Unit 3) that could contribute to cumulative radiological impacts. Therefore, GGNS concludes that future cumulative radiological impacts would be SMALL and further mitigation measures beyond station procedures and USNRC regulatory requirements that limit radiological doses are not warranted.

4.23.4 Cumulative Socioeconomic Impacts

The socioeconomic conditions involving population, taxes, housing, local public services, utilities, education, employment, offsite land use, and transportation were presented in Chapter 2. The impacts to housing, local public services/utilities, education, and transportation as measures of socioeconomic indicators were evaluated separately in Sections 4.14, 4.15, 4.16, and 4.19.

As noted in Section 2.7, GGNS makes a significant contribution to the local and state tax base. Taxes paid by the site go directly to the State of Mississippi but have a positive impact on the fiscal condition of the four-county region (Claiborne, Hinds, Jefferson, and Warren). GGNS is the second largest employer in the area and largest contributor to the local tax base. Besides the direct payment of tax revenue to Claiborne County and the Town of Port Gibson, 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. Continued operation of the plant through the license renewal term would provide a LARGE beneficial impact of economic support and tax revenues to the surrounding counties and communities. The tax benefit due to license renewal is expected to remain approximately the same as it is currently since no refurbishment is planned for GGNS. Should GGNS Unit 3 be licensed and constructed, additional tax revenue for the local and state government would be generated, with increasing tax-related beneficial impacts within the four-county area.

The continued operation of GGNS Unit 1 would not be expected to have an impact on housing in the local area. As discussed in Section 3.3, there are no plans for refurbishment during the license renewal term, and thus no new impacts on housing in the four-county area as discussed in Section 4.14. There would be a potential for incremental cumulative impacts to housing in the four-county area if GGNS Unit 3 were to be constructed and operated at the existing GGNS site. However, as discussed in Section 2.9, the available housing in the four-county area has continued to increase and vacancy rates have increased. Therefore, Entergy concludes that the cumulative impact on housing due to renewal of the GGNS OL would be SMALL.

As discussed in Section 2.10.2, the USDOT LOS assigned to the roads in the vicinity of GGNS are generally rated "A", and while the construction of GGNS Unit 3 may result in an incremental increase in the number of workers at the site, the likely cumulative impact on transportation in the vicinity would be expected to be SMALL. It is likely that staggered shift-changes would minimize any transportation congestion.

In conclusion, the cumulative socioeconomic impact from renewing the GGNS OL is expected to be SMALL to LARGE beneficial.

4.23.5 Cumulative Impacts on Groundwater Use and Quality

The area of analysis for cumulative impacts on groundwater encompasses the area within Claiborne, Hinds, Jefferson, and Warren Counties in Mississippi. With the exception of the four onsite areas served by the CS&I Water Association #1 as discussed in Section 2.3.4.3, GGNS' cooling and potable water needs are supplied by onsite groundwater wells.

As discussed in Section 2.3.4.2, GGNS groundwater is supplied from the Mississippi River Alluvium (radial wells) and the Upland Complex (potable wells) aquifers. Also, as discussed in Sections 2.3.4.2 and 2.10.1, public water supplies in the four-county area where the majority of GGNS employees reside are primarily derived from the Catahoula Formation or Miocene aquifers. Residents within the vicinity of GGNS are served by CS&I Water Association #1, which withdraws water from the Miocene aquifer, and the Town of Port Gibson, which is reported as withdrawing from the Catahoula [MDEQ 2009a]. As previously discussed, the Miocene series consists of three stratigraphic units: Pascagoula, Hattiesburg, and Catahoula Formations. Since GGNS withdraws groundwater from the Mississippi River Alluvium and Upland Complex, the Miocene aquifers including the Catahoula are unaffected. As discussed in Section 4.7, impacts to offsite groundwater users due to current operations and anticipated future uses during the license renewal period are expected to be SMALL. Impacts to public water supplies are also expected to be SMALL during the license renewal period.

Even if GGNS Unit 3 were to be built at the GGNS site, it is likely that potable water for onsite workers would continue to be provided by water wells in the Upland Complex or Mississippi River Alluvium aquifers [SERI 2008b, Section 4.2.2.4]. Cumulative impacts to groundwater would involve only those impacts resulting from additional workers during construction and operation of

GGNS Unit 3. Based on the available capacity and demand discussed in Section 2.10.1, cumulative impacts to public water systems would still be anticipated to be SMALL.

4.23.6 Cumulative Impacts on Air Quality

Operational activities at GGNS may release GHGs, including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). As discussed in Section 9.1.3.6, GGNS is in compliance with the various programs associated with the Clean Air Act (CAA).

Carbon dioxide emissions are a major contributor to anthropogenic greenhouse gas emissions, which many scientists believe contribute to climate change. These emissions result from the efficiency of the technologies utilized to produce and deliver energy and the carbon content of the fuel being utilized. As shown in Table 8.3-1, which demonstrates the differences of CO_2 emissions for various fuels used for electricity generation, GHG emissions associated with renewal of the GGNS OL would be similar to the lifecycle GHG emissions from renewable energy sources and lower than those associated with fossil fuel-based energy sources.

To estimate the amount of GHG releases avoided by continued operation of GGNS, its electricity generation can be compared to an equivalent amount of electricity generation in fossil-fuel power plant(s). For 2009, NEI estimates emissions avoided by the nuclear industry for Mississippi amounted to 7.95 metric tons of CO_2 emissions, 13,382 short tons of sulfur dioxide (SO_2), and 7,521 short tons of nitrogen oxide (NO_x) [NEI 2010]. Thus, if cumulative emissions of these pollutants are considered from all sources, the emissions avoided by continued operation of GGNS during the 20-year term of license renewal would result in a MODERATE beneficial impact.

A discussion of GHG emissions is presented in Section 2.11.3. Similar to the emissions avoided by the continued operation of GGNS, significant beneficial impacts would be achieved if a new GGNS Unit 3 were constructed and operated at GGNS. As noted in Section 2.11.3, studies indicate a consensus that nuclear power produces fewer GHG emissions than fossil-fuel-based electricity-generating technologies. Based on the literature review, lifecycle GHG emissions from the complete nuclear fuel cycle currently range from 2.5 to 55 g of Ceq/kWh. The comparable lifecycle GHG emissions from the use of coal range from 264 to 1,250 g Ceq/kWh, and GHG emissions from the use of natural gas range from 120 to 780 g Ceq/kWh. The studies also provided estimates of GHG emissions from five renewable energy sources, based on current technology. These estimates included solar-photovoltaic (17 to 125 g Ceq/kWh), hydroelectric (1 to 64.6 g Ceq/kWh), biomass (8.4 to 99 g Ceq/kWh), wind (2.5 to 30 g Ceq/kWh), and tidal (25 to 50 g Ceq/kWh). The range of these estimates is wide, but the general conclusion is that the GHG emissions from the nuclear fuel cycle are of the same order of magnitude as those for renewable energy sources.

Combustion-related GHG emissions (such as CO_2, CH_4, and N_2O) at GGNS are minor, since GGNS does not burn fossil fuels to generate electricity. GHG stationary emission sources at GGNS include minor emissions from emergency diesel generators, diesel fire pumps, and miscellaneous portable equipment. These combustion sources are designed for efficiency and operated using good combustion practices on a limited basis throughout the year (often only for testing). Other combustion-related GHG emission sources at GGNS include vehicular traffic within, to, and from GGNS. These are considered insignificant when compared to the beneficial impacts from avoided GHG emissions associated with nuclear power.

Thus, although there would be a small incremental increase of GHG emissions if GGNS Unit 3 were added to the generation at GGNS, the increased emissions would be offset by the emissions avoided if any type of fossil fuel were to be used. Based on the above, release of GHGs should be minor, and the potential impacts of continued operation of GGNS on climate change are anticipated to be SMALL and beneficial to climate change.

4.23.7 Conclusion

GGNS considered the potential impacts from GGNS continued operation during the license renewal term and other past, present, and future actions in the vicinity of the site. Based on the various impacts discussed above, GGNS' conclusion is that the potential cumulative impacts resulting from GGNS continued operation during the license renewal term would be SMALL to MODERATE for land use and ecological resources, which would be effectively mitigated; SMALL to MODERATE for aquatic resources due to climate change; SMALL to MODERATE beneficial for air quality due to emissions avoided; SMALL to LARGE beneficial for socioeconomics; and SMALL for remaining resources.

5.0 ASSESSMENT OF NEW AND SIGNIFICANT INFORMATION

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware. [10 CFR 51.53(c)(3)(iv)]

The USNRC has resolved most license renewal environmental issues generically and only requires an applicant to analyze those issues the USNRC has not resolved generically. While USNRC regulations do not require an applicant's environmental report to contain analyses of the impacts of those environmental issues that have been generically resolved [10 CFR 51.53(c)(3)(i)], the regulations do require that an applicant identify any new and significant information of which the applicant is aware. [10 CFR 51.53(c)(3)(iv)]

Entergy performed an analysis to identify the following:

- Information that identifies a significant environmental issue not covered in the USNRC's GEIS and codified in the regulation.

- Information not covered in the GEIS analyses that leads to an impact finding different from that codified in the regulation.

USNRC does not specifically define the term "significant." For its review, Entergy used guidance available in Council on Environmental Quality (CEQ) regulations. The NEPA authorizes CEQ to establish implementing regulations for federal agency use. The USNRC requires license renewal applicants to provide input, in the form of an environmental report, that the USNRC will use to meet NEPA requirements as they apply to license renewal [10 CFR 51.10].

CEQ guidance provides that federal agencies should prepare environmental impact statements for actions that would significantly affect the environment [40 CFR 1502.3], focus on significant environmental issues [40 CFR 1502.1], and eliminate from detailed study issues that are not significant [40 CFR 1501.7(a)(3)]. The CEQ guidance includes a lengthy definition of "significantly" that requires consideration of the context of the action and the intensity or severity of the impact(s) [40 CFR 1508.27]. Entergy expects that MODERATE or LARGE impacts, as defined by USNRC, would be significant. Chapter 4 presents the USNRC definitions of SMALL, MODERATE, and LARGE impacts.

During preparation of the GGNS ER, Entergy reviewed the analyses of the Category 1 issues discussed in the GEIS that were applicable to GGNS, and the permits and reference materials listed in Table 9.1-1 and Section 10.0, respectively. Entergy also conducted meetings and consultations with those state and federal agencies having regulatory oversight of GGNS requesting their input on issues that should be considered in the ER.

Entergy also utilized its existing in-house process for reviewing and evaluating environmental issues which could potentially be new and significant information. This process provided an additional means for Entergy to ensure that any potential new and significant environmental information related to renewal of the GGNS OL was identified, reviewed and addressed as appropriate.

This process is collectively conducted by departments within Entergy Nuclear's corporate group and environmental peer group members composed of technical personnel from all Entergy nuclear sites involved in environmental compliance, environmental monitoring, environmental planning, natural resource management, and health and safety issues. A summary of this process follows.

- Issues relevant to environmental matters are identified as follows:
  - → Participation in industry utility groups such as EEI, EPRI, NEI, and USWAG.
  - → Participation in non-utility groups such as Institute of Hazardous Materials Management and National Registry of Environmental Professionals.
  - → Routine interface with regulatory agencies having oversight of GGNS and other non-nuclear Entergy business units such as Fossil, Transmission, Distribution, and Corporate.
  - → Periodic reviews of proposed regulatory and legislative changes.
  - → Review of changes to the plant that are evaluated by Entergy fleet procedures EN-LI-100 (Process Applicability Determinations), EN-LI-101 (10CFR50.59 Review Program), and EN-EV-115 (Environmental Reviews and Evaluations).
- If the issue is applicable to the nuclear sites, it is then further evaluated, and if necessary, changes are made to the program and implemented in accordance with site and/or corporate fleet procedures.
- Additional actions conducted by Entergy when developing the GGNS ER included the following:
  - → Review of current site activities and discussions with site personnel.
  - → Review of internal procedures for reporting to the USNRC events that could have environmental impacts.
  - → Credit for the oversight provided by inspections of plant facilities by state and federal regulatory agencies and associated inspection results.
  - → Review of environmental issues associated with other license renewal activities.

As a result of this assessment, Entergy is aware of no new and significant information regarding the environmental impacts of license renewal associated with GGNS. Entergy is providing a brief discussion in Section 5.1 below regarding the 2011 flood associated with the Mississippi River, since previously recorded estimates of maximum streamflow discharges were exceeded. However, Entergy does not consider this new and significant information in the context of 10 CFR 51.53(c)(3)(iv) as discussed below. Entergy is also providing a brief discussion in Section 5.2 of the proposed Phase II/III §316(b) Rule regulating cooling water intake structures, although GGNS will be unaffected by the Rule.

5.1 Mississippi River Flood of 2011

The Mississippi River floods in April and May 2011 were among the largest and most damaging recorded along the U.S waterway in the past century. In April 2011 two major storm systems deposited record levels of rainfall on the Mississippi River watershed. Rising from springtime snowmelt, the river and many of its tributaries began to swell to record levels by the beginning of May. Specifically, the flood of 2011 likely set a new maximum peak streamflow record at Vicksburg during the month of May as shown in Table 5.1-1 below based on USGS provisional data.

Table 5.1-1
Mississippi River Highest Flood Discharge Events at Vicksburg, MS

Year	Maximum Discharge (cfs)
1913[a]	1,783,000
1927[a]	2,278,000
1937[a]	2,080,000
1945[a]	1,922,000
1950[a]	1,876,000
1973[a]	1,962,000
2011[b]	2,330,000

a. GGNS 2010a, Table 2.4-4
b. USGS 2011

Estimates of the maximum peak streamflow discharges exceeded previous records. However, this is only new information in the context of a new streamflow record. The 2011 flood does not change the Mississippi River's classification as a large river (Section 4.1.5). Thermal discharges and water quality impacts due to GGNS operations would still be SMALL due to the massive nature of the Mississippi River (Section 3.2.2.1), radial well groundwater withdrawal effects would still be SMALL (Section 4.7.5), and groundwater water characteristics such as hydraulic conductivity, flow gradient, and use remain unchanged (Section 2.3.3.4). None of the 2011 flood conditions would affect the information that has been included in this ER.

Annual flooding events associated with the Mississippi River are a common occurrence. During these flood events, terrestrial, aquatic, hydrology, and threatened and endangered species resources are typically impacted until flood waters recede. Even though the 2011 flood event likely set a new maximum peak streamflow discharge record, impact to these same resources would be either identical or similar in nature to previous flood events. As discussed in Chapter 4.0, GGNS has SMALL impacts on terrestrial, aquatic, hydrology, and threatened and endangered species resources. Therefore, Entergy concludes that this issue is neither new nor significant, either indirectly or from a cumulative standpoint.

5.2 Clean Water Act Section 316(b)

On April 20, 2011, the USEPA released its revised, proposed Phase II/III §316(b) Rule regulating cooling water intake structures at existing facilities and new units at existing facilities. USEPA's revised Rule directs permitting authorities to make separate best technology available determinations for impingement mortality and entrainment mortality. For both impingement mortality and entrainment mortality, the revised Rule provides options for compliance with best technology available standards.

Existing facilities with a design intake flow greater than 2 mgd have two options for complying with best technology available standards for impingement mortality:

(1) Demonstrating that its cooling water intake system has a maximum velocity of 0.5 feet per second; or

(2) Demonstrating that impingement mortality limitations are not exceeded.

Existing facilities with a design intake flow greater than 2 mgd have two options for compliance with best technology available standards for entrainment mortality:

(1) Compliance with the entrainment mortality requirements applicable to new units at existing facilities—closed cycle cooling or demonstrating specific entrainment mortality reductions; or

(2) Compliance with best technology available standards for entrainment mortality as determined by the permitting authority on a site-specific basis.

The Rule as currently written not only affects plants with once-through cooling systems but also has the potential to affect plants with closed-cycle cooling systems. Although GGNS utilizes a closed-cycle cooling system, there is no intake structure associated with the plant. As previously discussed in Section 2.2.5, radial wells provide groundwater for cooling water purposes, thereby eliminating entrainment or impingement impacts. Therefore, this Rule does not constitute new and significant information as it relates to GGNS.

6.0 SUMMARY OF LICENSE RENEWAL IMPACTS AND MITIGATING ACTIONS

6.1 License Renewal Impacts

Entergy has reviewed the environmental impacts of renewing the GGNS OL and has concluded that all impacts would be SMALL and further mitigation measures beyond those currently existing are not warranted. This ER documents the basis for Entergy's conclusion. Chapter 4 incorporates by reference USNRC findings for the 51 Category 1 issues that apply to GGNS (and for the two "NA" issues for which USNRC came to no generic conclusion), all of which have environmental impacts that are SMALL. The remainder of Chapter 4 analyzes the 21 Category 2 issues that are either not applicable or have impacts that would be SMALL or, in the case of socioeconomics, SMALL to LARGE beneficial. Entergy identified minority and low-income populations, evaluated potential impacts to these populations alone, and determined that there are no issues that would have disproportionately high adverse impacts. Table 6.1-1 summarizes the environmental impacts that GGNS license renewal would have on resources associated with Category 2 issues.

Table 6.1-1
Environmental Impacts Related to License Renewal at GGNS

Issue	ER Section	Environmental Impact
Surface Water Quality, Hydrology and Use (for all plants)		
Water use conflicts (plants with cooling ponds or cooling towers using make-up water from a small river with low flow) [10 CFR 51.53(c)(3)(ii)(A)]	4.1.5	**NONE. Issue is not applicable.** GGNS is not located on a small river. Mississippi River flow at GGNS is 3.78 x 10^{12} ft^3/year for the 7-day, 10-year low flow, and 6.95 x 10^{13} ft^3/year for the 100-year flood.
Aquatic Ecology (for all plants with once-through and cooling pond heat dissipation systems)		
Entrainment of fish and shellfish [10 CFR 51.53(c)(3)(ii)(B)]	4.2.5	**NONE. Issue is not applicable.** GGNS is equipped with a closed-cycle cooling system that utilizes make-up water from the Mississippi River Alluvium groundwater aquifer.
Impingement of fish and shellfish [10 CFR 51.53(c)(3)(ii)(B)]	4.3.5	**NONE. Issue is not applicable.** GGNS is equipped with a closed-cycle cooling system that utilizes make-up water from the Mississippi River Alluvium groundwater aquifer.
Heat shock [10 CFR 51.53(c)(3)(ii)(B)]	4.4.5	**NONE. Issue is not applicable.** GGNS is equipped with a closed-cycle cooling system with natural draft and auxiliary cooling towers.

**Table 6.1-1 (Continued)
Environmental Impacts Related to License Renewal at GGNS**

Issue	ER Section	Environmental Impact
Groundwater Use and Quality		
Groundwater use conflicts (plants using > 100 gpm of groundwater) [10 CFR 51.53(c)(3)(ii)(C)]	4.5.5	**NONE. Issue is not applicable.** Groundwater withdrawals associated with the North Construction Well, and the North and South Drinking Water Wells do not collectively pump more than an annual average of 100 gpm.
Groundwater use conflicts (plants using cooling towers withdrawing make-up water from a small river) [10 CFR 51.53(c)(3)(ii)(A)]	4.6.5	**NONE. Issue is not applicable.** GGNS is not located on a small river. Mississippi River flow at GGNS is 3.78 x 10^{12} ft^3/year for the 7-day, 10-year low flow, and 6.95 x 10^{13} ft^3/year for the 100-year flood.
Groundwater use conflicts (Ranney Wells) [10 CFR 51.53(c)(3)(ii)(C)]	4.7.5	**SMALL.** Based on estimates of the radius of anticipated drawdown of the GGNS radial wells, there would be limited impact on potential offsite groundwater users or wetland areas.
Degradation of groundwater quality [10 CFR 51.53(c)(3)(ii)(D)]	4.8.5	**NONE. Issue is not applicable.** GGNS does not have or utilize cooling ponds. The Station is equipped with a closed-cycle cooling system that utilizes make-up water from the Mississippi River Alluvium groundwater aquifer.
Terrestrial Resources		
Refurbishment impacts on terrestrial resources [10 CFR 51.53(c)(3)(ii)(E)]	4.9.5	**NONE. Issue is not applicable.** No refurbishment activities have been identified.
Threatened or Endangered Species (for all plants)		
Threatened or endangered species [10 CFR 51.53(c)(3)(ii)(E)]	4.10.5	**SMALL.** No refurbishment activities have been identified, no critical habitats designated on the GGNS site or transmission line ROWs, and no species encountered by Entergy. No adverse impacts to threatened or endangered species are expected due to continued operation of GGNS.
Air Quality		
Air quality during refurbishment [10 CFR 51.53(c)(3)(ii)(F)]	4.11.5	**NONE. Issue is not applicable.** No refurbishment activities have been identified.

Table 6.1-1 (Continued)
Environmental Impacts Related to License Renewal at GGNS

Issue	ER Section	Environmental Impact
Human Health		
Microbiological (Thermophilic) Organisms [10 CFR 51.53(c)(3)(ii)(G)]	4.12.5	**NONE. Issue is not applicable.** GGNS is not located on a small river. Mississippi River flow at GGNS is 3.78 x 10^{12} ft^3/year for the 7-day, 10-year low flow, and 6.95 x 10^{13} ft^3/year for the 100-year flood.
Electromagnetic fields—Acute effects [10 CFR 51.53(c)(3)(ii)(H)]	4.13.5	**SMALL.** Transmission lines constructed to connect the plant to the transmission system grid meet the NESC® recommendations for preventing electric shock from induced currents.
Socioeconomics		
Housing impacts [10 CFR 51.53(c)(3)(ii)(I)]	4.14.5	**SMALL.** No major refurbishment activities identified and no additional workers anticipated during the period of extended operation. Therefore, no additional impacts to housing are expected due to continued operation of GGNS.
Public utilities: public water supply availability [10 CFR 51.53(c)(3)(ii)(I)]	4.15.5	**SMALL.** No major refurbishment activities identified and no additional workers anticipated during the period of extended operation. Community water systems near GGNS currently have adequate system capacity to meet demand of residential and industrial customers in the area.
Education impacts from refurbishment [10 CFR 51.53(c)(3)(ii)(I)]	4.16.5	**NONE. Issue is not applicable.** No refurbishment activities have been identified.
Offsite land use (effects of refurbishment activities) [10 CFR 51.53(c)(3)(ii)(I)]	4.17.5	**NONE. Issue is not applicable.** No refurbishment activities have been identified.
Offsite land use (effects of license renewal) [10 CFR 51.53(c)(3)(ii)(I)]	4.18.5	**SMALL to LARGE - Beneficial.** Area around GGNS will continue to be sparsely populated, with minimal population growth and resulting development unanticipated during the license renewal term. No additional workers are anticipated during the period of extended operation. Taxes paid by GGNS represent significant portion of Claiborne County tax revenues.

Table 6.1-1 (Continued)
Environmental Impacts Related to License Renewal at GGNS

Issue	ER Section	Environmental Impact
Local transportation impacts [10 CFR 51.53(c)(3)(ii)(J)]	4.19.5	**SMALL.** No refurbishment activities have been identified, no increases in total number of employees during the period of extended operation are expected, and LOS road designations in the vicinity of GGNS are adequate.
Historic and archaeological properties [10 CFR 51.53(c)(3)(ii)(K)]	4.20.5	**SMALL.** No refurbishment activities have been identified. Although potential unidentified archaeologically and historically sensitive areas may be present onsite, administrative procedures ensure protection of these type resources in the event of excavation activities.
Postulated Accidents		
Severe accident mitigation alternatives [10 CFR 51.53(c)(3)(ii)(L)]	4.21.5	**SMALL.** No impact from continued operation. Potentially cost-effective SAMAs are not related to adequately managing the effects of aging during period of extended operation.

6.2 Mitigation

6.2.1 Requirement [10 CFR 51.45(c)]

The report must contain a consideration of alternatives for reducing adverse impacts, as required by §51.45(c), for all Category 2 license renewal issues in Appendix B to subpart A of this part. No such consideration is required for Category 1 issues in Appendix B to subpart A of this part. [10 CFR 51.53(c)(3)(iii)]

6.2.2 Entergy Response

As discussed in Supplement 1 to Regulatory Guide 4.2, "Preparation of Supplemental Environmental Reports for Applications to Renew Nuclear Power Plant Operating Licenses," when adverse environmental effects are identified, 10 CFR 51.45(c) requires consideration of alternatives available to reduce or avoid these adverse effects. Furthermore, Supplement 1 states, "Mitigation alternatives are to be considered no matter how small the adverse impact; however, the extent of the consideration should be proportional to the significance of the impact." [USNRC 2000, Introduction]

As discussed in Section 6.1 and shown in Table 6.1-1, analysis of the Category 2 issues found the impacts to be SMALL for issues applicable to GGNS. For these issues, the various permits and programs discussed in Chapter 9 (e.g., NPDES Permit, Air Permit, groundwater well permits, radioactive effluents monitoring program, REMP, cultural resource protection plan, and environmental review programs) that currently mitigate the environmental impacts of plant operations are adequate. Therefore, no additional mitigation measures were found to be sufficiently beneficial as to be warranted.

6.3 Unavoidable Adverse Impacts

6.3.1 Requirement [10 CFR 51.45(b)(2)]

The applicant's report shall discuss any adverse environmental effects which cannot be avoided upon implementation of the proposed project.

6.3.2 Entergy Response

Entergy adopts by reference USNRC findings for applicable Category 1 issues, including discussions of any unavoidable adverse impacts. Chapter 4 contains the results of Entergy's review and analyses of the Category 2 issues as required by 10 CFR 51.53(c)(3)(ii). These reviews take into account the information that has been provided in the GEIS, Appendix B to Subpart A of 10 CFR Part 51, and information specific to GGNS.

An environmental review conducted at the license renewal stage differs from the review conducted in support of a construction permit because the facility is in existence at the license renewal stage and has operated for a number of years. As a result, adverse impacts associated with the initial construction have been avoided, have been mitigated, or have already occurred.

As discussed in Section 3.3, there are no refurbishment activities required for the renewal of the GGNS OL. Therefore, the environmental impacts to be evaluated for license renewal are those associated with continued operation during the renewal term. The review and analysis of the 21 Category 2 issues associated with continued operation of GGNS identified the following unavoidable adverse impact:

- Operation of GGNS results in consumptive use of groundwater from the Mississippi River Alluvium and Upland Complex aquifers. These groundwater withdrawals are mitigated through MDEQ's permitting program.

6.4 Irreversible or Irretrievable Resource Commitments

6.4.1 Requirement [10 CFR 51.45(b)(5)]

The applicant's report shall discuss any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

6.4.2 Entergy Response

The continued operation of GGNS for the period of extended operation will result in irreversible and irretrievable resource commitments, including the following:

- Nuclear fuel, which is consumed in the reactor and converted to radioactive waste.
- Land required to permanently store or dispose of spent nuclear fuel, low-level radioactive wastes generated as a result of plant operations, and sanitary wastes generated from normal industrial operations.
- Elemental materials that will become radioactive.
- Materials used for the normal industrial operations of GGNS that cannot be recovered or recycled or that are consumed or reduced to unrecoverable forms.

Other than the above, there are no refurbishment activities or changes in operation of GGNS during the period of extended operation that would irreversibly or irretrievably commit environmental components of land, water, and air.

However, the likely power generation alternatives if GGNS ceases operations on or before the expiration of the current OL would require a commitment of resources for construction of the replacement plants as well as for fuel to run the plants.

6.5 Short-Term Use Versus Long-Term Productivity

6.5.1 Requirement [10 CFR 51.45(b)(4)]

The applicant's report shall discuss the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity.

6.5.2 Entergy Response

The current balance between short-term use and long-term productivity of the environment at the site has remained relatively constant since GGNS began operating in 1985. The GGNS FES evaluated the relationship between the short-term uses of the environment and the maintenance and enhancement of the long-term productivity associated with the construction and operation of GGNS [USNRC 1981, Section 6.3]. The period of extended operation will not alter the short-term uses of the environment from the uses previously evaluated in the GGNS FES. The period of extended operation will postpone the availability of the site resources (land, air, water). Denial of the application to renew the GGNS OL would lead to the shutdown of the plant and would alter the balance in a manner that depends on the subsequent uses of the site. For example, the environmental consequences of turning the GGNS site into a park or an industrial facility are quite different. However, extending operations will not adversely affect the long-term uses of the site.

In summary, there are no refurbishment activities or changes in operation of GGNS planned for the period of extended operation that would alter the evaluation of the GGNS FES for the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity of these resources.

7.0 ALTERNATIVES CONSIDERED

7.1 Introduction

USNRC regulations require that an applicant's environmental report discuss alternatives to a proposed action [10 CFR 51.45(b)(3)]. The intent of this review is to enable the Commission to consider the relative environmental consequences of the proposed action as compared to the environmental consequences of other activities that also meet the purpose of the proposed action and meet system generation needs. In addition, this review addresses the environmental consequences of taking no action. The alternatives considered in this ER are summarized below with Chapter 8 providing a more detailed discussion.

7.2 Proposed Action

The proposed action is to renew the GGNS OL, which would preserve the option for Entergy to continue to operate GGNS to provide base-load power throughout the 20-year license renewal period. GGNS uses a BWR that is currently licensed for 3,898 MWt. As a result of an EPU that is scheduled to occur in 2012, the licensed thermal power level will increase to 4,408 MWt, with a maximum net power output of approximately 1,475 net MWe.

The review of the environmental impacts required by 10 CFR 51.53(c)(3)(ii) is provided in Chapter 4. Based on this review, Entergy concludes that the environmental impacts of renewing the GGNS OL would be SMALL, and in the case of socioeconomics, SMALL to LARGE beneficial.

7.3 No-Action Alternative

The "no-action alternative" to the proposed action is not to renew the GGNS OL. In this alternative, it is expected that GGNS would continue to operate up through the end of the existing OL, at which time plant operations would cease and decommissioning would begin, or the Unit could be placed in safe storage (SAFSTOR). Because GGNS constitutes a significant block of long-term base-load capacity, it is reasonable to assume that a decision not to renew the GGNS OL would necessitate the replacement of its approximately 1,475 net MWe capacity with another generation source. The environmental impacts of the no-action alternative would be from decommissioning GGNS and providing a replacement power source or sources.

Environmental impacts associated with decommissioning are discussed in Section 7.4. The environmental impacts associated with the construction and operation of a replacement power source or sources are discussed in Chapter 8. The no-action alternative is further discussed in Section 8.3.

7.4 Decommissioning Impacts

The GEIS defines decommissioning as the safe removal of a nuclear facility from service and the reduction of residual radioactivity to a level that permits release of the property for unrestricted use and termination of the license [USNRC 1996, Section 7.1]. USNRC-evaluated decommissioning options include immediate decontamination and dismantlement (DECON) and safe storage of the stabilized and defueled facility (SAFSTOR) followed by decontamination and dismantlement.

Regardless of the option chosen, decommissioning must be completed "within 60 years of permanent cessation of operations." (See 10 CFR 50.82(a)(3).) Under the no-action alternative, Entergy would continue operating GGNS until the current license expires, then initiate decommissioning activities in accordance with USNRC requirements. The GEIS describes decommissioning activities based on an evaluation of an example reactor (the "reference" reactor is the 1,155 MWe Washington Public Power Supply System's Columbia Nuclear Power Plant) [USNRC 1996, Section 7.1]. Entergy considers the reference reactor to be representative of GGNS Unit 1 and considers the decommissioning activities described in the GEIS to be reasonably representative of actions that Entergy would perform for decommissioning at GGNS.

As the GEIS notes, USNRC has evaluated environmental impacts from decommissioning. USNRC-evaluated impacts include occupational and public radiation dose; impacts of waste management; impacts to air and water quality; and ecological, economic, and socioeconomic impacts. USNRC indicated in Section 4.3.8 of the Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities that the environmental effects of greatest concern (i.e., radiation dose and releases to the environment) are substantially less than the same effects resulting from reactor operations [USNRC 1996, Section 8.4.5]. Therefore, Entergy adopts by reference the USNRC conclusions regarding environmental impacts of decommissioning.

Entergy also notes that decommissioning activities and their impacts are not discriminators between the proposed action and the no-action alternative. Entergy will eventually have to decommission GGNS; license renewal would only postpone the beginning of decommissioning activities. USNRC has established in the GEIS that the timing of decommissioning activities does not substantially influence their environmental impacts. Therefore, Entergy adopts by reference the USNRC findings (10 CFR Part 51, Subpart A, Appendix B, Table B-1, Decommissioning) to the effect that delaying decommissioning until after the renewal term would have SMALL environmental impacts.

Entergy concludes that the decommissioning impacts under the no-action alternative would not be substantially different from those that occur following license renewal, as identified in the GEIS and in the decommissioning generic environmental impact statement [USNRC 1996, Section 8.2]. These impacts would be temporary and would occur at the same time as the impacts from meeting system generating needs.

7.5 Alternative Energy Sources

GGNS is used for base-load generation. The GEIS states that coal-fired and gas-fired generation capacity are the feasible alternatives to nuclear power generating capacity, based on current (and expected) technological and cost factors. In addition, several COL and ESP applications have been submitted to the USNRC, indicating industry and government interest in development of new nuclear. Wind and solar energy are not currently capable of providing base-load generation (due to intermittency), and interstate transmission infrastructure is not currently sufficient to take advantage of large-scale interconnection between generation sites and demand centers. These conditions are not likely to change significantly in time to replace GGNS' base-load power by the end of its current operating license. However, due to the considerable interest in renewable energy, Entergy has opted to consider interconnected wind energy combined with compressed air energy storage (CAES) as a reasonable alternative to GGNS license renewal. Therefore, the generation alternatives identified below were considered in detail in this ER. For the purposes of this ER, generation alternatives are based on replacement of approximately 1,475 net MWe, which would include the anticipated GGNS EPU scheduled for 2012 as discussed in Section 7.2.

- Super-critical coal-fired generation at an alternate site (Section 8.1.1).

  Based on Table 8.1 of the GEIS, it would take approximately 1.7 acres of land per MWe to construct a coal-fired plant. For the 1,614 gross MWe plant described in Section 8.1.1, a super-critical coal-fired plant would require approximately 2,744 acres of land. The GGNS site is situated on approximately 2,100 acres, of which a considerable portion, estimated to be approximately 1,000 acres, is in a floodplain and not suitable for a plant or for coal storage. Without the purchase of additional land, coupled with the utilization of currently existing site support structures, the GGNS site would be unable to support the land requirement needed for onsite super-critical coal-fired generation.

- Natural gas-fired generation at the GGNS site (brownfield) as evaluated in Section 8.2.2 of NUREG-1817.

  The site is situated on approximately 2,100 acres, of which a considerable portion, estimated to be approximately 1,000 acres, is in a floodplain and not suitable for a plant. For the power block area only, the GEIS estimated that 110 acres are needed for a 1,000 MWe natural gas-fired facility [USNRC 1996, Section 8.3.10]. This would indicate a land requirement of approximately 174 acres for a 1,584 gross MWe gas-fired unit and would not be inclusive of support facilities.

- Nuclear generation at the GGNS site or an alternate site as evaluated in NUREG-1817 and the GGNS Unit 3 COLA as discussed in Section 8.1.3.

- Interconnected onshore and/or offshore wind with CAES at an alternate site as discussed in Section 8.1.4.

Generation alternatives to GGNS (Sections 8.1.1, 8.1.2, and 8.1.3) are presented as if such plants were constructed at the GGNS site, using the existing switchyard, transmission lines, and support facilities as allowable, or at an alternate location that could be either a current industrial site or an undisturbed, pristine site (greenfield) requiring a new generating building, facilities, and switchyard, and new transmission lines. The wind energy generation, interconnection transmission grid modifications, and the CAES facility discussed as an alternative to GGNS in Section 8.1.4 are assumed to be constructed on greenfield sites.

The potential for using imported power is discussed in Section 8.1.5. Imported power would result in the transfer of environmental impacts from the current region in Mississippi to some other location in Mississippi, another state, or another country. In addition, there is no assurance that the capacity or energy would be available during the required time frame.

As stated in NUREG-1437, Vol.1, Section 8.1, the "USNRC has determined that a reasonable set of alternatives should be limited to analysis of single, discrete electric generation sources and only electric generation sources that are technically feasible and commercially viable" [USNRC 1996, Section 8.1]. Accordingly, the following alternatives were not considered as reasonable replacement base-load power generation. Although several of these alternatives could be considered in combination for replacement power generation at multiple sites, they do not generally provide base-load generation and would entail greater environmental impacts. Additional details on the evaluation of these alternatives are provided in Section 8.2.

- Wind
- Solar
- Hydropower
- Geothermal
- Wood energy
- Municipal solid waste
- Other biomass-derived fuels
- Oil
- Fuel cells
- Tidal, ocean thermal, and wave
- Delayed retirement of other existing units
- Utility-sponsored conservation
- Purchased/imported power
- Combination of alternatives

These technologies were eliminated during Entergy's review as possible replacement power alternatives for one or more of the following reasons.

- High land-use impacts. Some of the technologies listed above (wind, solar, and hydroelectric) would require a large area of land and would thus require a greenfield siting plan. This would result in a greater environmental impact than continued operation of GGNS.
- Low capacity factors. Some of the technologies identified above (wind and solar) are not capable of replacing the 1,475 net MWe of power at high capacity factors. These generation technologies are used as supplemental power sources, as opposed to base-load power sources, and for this reason are not reasonable alternatives.
- Geographic availability of the resource. Some of the technologies are not feasible because there is no feasible location in the area served by the site (geothermal, hydroelectric, and wind).

- Emerging technology. Some of the technologies have not been proven as reliable and cost-effective replacements for a large generation facility (fuel cells, biomass derived fuels, and municipal solid waste). Therefore, these technologies are typically used with smaller (lower MWe) generation facilities.
- Availability. There is no assurance of the availability of imported power, of power saved as the result of utility sponsored conservation, or that retirement of other existing units can be delayed.
- Cost. Some of the technologies above are very expensive and are not a cost-effective way to produce base-load power (solar, fuel cells, and oil).

8.0 COMPARISON OF IMPACTS

GGNS is a base-load generator of electric power, with a net generating capability of approximately 1,475 MWe. All power produced by GGNS is supplied to customers in EMI's service territory in western Mississippi. Accordingly, the ROI for replacement power is western Mississippi because if the USNRC does not renew the operating license for GGNS, EMI will have to provide replacement power for its customers in this area. When discussing reasonable energy alternatives to GGNS license renewal, however, Entergy assumes that replacement energy sources can be located in states other than western Mississippi if the electricity generated by those out-of-state sources can be efficiently routed into the GGNS ROI. For example, GGNS is located within the Southeast Electric Reliability Corporation (SERC) transmission grid. SERC is a nonprofit corporation responsible for promoting and improving the reliability, adequacy, and critical infrastructure of the bulk power supply systems in all or portions of 16 central and southeastern states. Owners, operators, and users of the bulk power system in these states cover an area of approximately 560,000 square miles and comprise what is known as the SERC Region.

Entergy has made following assumptions in the review of alternative energy sources and are intended to simplify the evaluation, yet still allow the no-action alternative review to meet the intent of NEPA requirements and USNRC environmental regulations.

- The purpose of the proposed action (license renewal) is the continued production of approximately 1,475 net MWe of base-load generation, which includes the anticipated EPU scheduled for 2012. Alternatives that do not meet this goal are not considered in detail.
- The time frame for the needed generation is 2024–2044.
- Alternatives considered must be available (constructed, permitted, and connected to the grid) by the time the current GGNS OL expires in 2024.
- For the natural gas-fired facility at the GGNS site, it is assumed that the plant would utilize the site's existing transmission lines, construction and drinking water wells, and radial wells.
- For the new nuclear alternative, sites considered were at GGNS and RBS (alternate site) based on NUREG-1817 and the GGNS Unit 3 COLA. It is also assumed that the new nuclear plant at GGNS would utilize the site’s existing transmission lines.
- Based on the Phase I 316(b) regulations issued on December 18, 2001, for new facilities that use water withdrawn from rivers, streams, lakes, reservoirs, estuaries, oceans, or other waters of the U.S. for cooling purposes, Entergy did not include once-through cooling as an option for the super-critical coal-fired and nuclear generation alternatives considered in this chapter.

- The annual capacity factor of GGNS based on a three-year average of 2007–2009 is 89%. The capacity factor is targeted to remain near or above this value throughout the plant's operating life.

- All necessary Federal permits, licenses, approvals, and other entitlements would be obtained.

8.1 Comparison of Environmental Impacts for Reasonable Alternatives

Each year the Energy Information Administration (EIA), a component of the USDOE, issues an Annual Energy Outlook. In its Annual Energy Outlook 2010 with Projections to 2035, EIA projects that coal-fired plants will continue to provide the majority of the U.S. electric power, providing 43% in 2035 [USDOE 2011d, Table A8]. Combined-cycle or combustion turbine technology fueled by natural gas will also continue to play an important role in electricity generation in the U.S. at approximately 25% of generation in 2035 [USDOE 2011d, Table A8]. Both natural gas technologies are designed primarily to supply peak and intermediate capacity, but combined-cycle technology can also be used to meet base-load requirements. Coal-fired plants are generally used to meet base-load requirements. Renewable energy sources (excluding hydropower), such as wind, biomass gasification, and municipal solid waste units, are projected by EIA to increase approximately 42% as compared to 2009, but are generally not considered for baseload generation [USDOE 2011d, Table A8]. EIA's projections are based on the assumption that providers of new generating capacity will seek to minimize cost while meeting applicable environmental requirements.

Wind energy as replacement power is discussed in Section 8.2.1, and as noted is not considered to be a reasonable replacement of the 1,475 MWe base-load power generated by GGNS. Compared with other regions of the country, the region served by GGNS is not climatically well-situated for wind power [USDOE 2009a]. Mississippi is in a wind power Class 1 region (average wind speeds lower than 5.6 m/s), having the lowest potential for wind energy generation. Wind has a high degree of intermittency and average annual capacity factors for wind plants are relatively low (typically 25–35%) as compared to the 89% capacity factor for GGNS. Wind energy proponents, however, have suggested that interconnected wind farms may provide for higher capacity factors that might provide more reliable power. However, even interconnected wind farms will still require reserve power when there is little wind to provide design capacities. Therefore, with all factors considered for GGNS' ROI, even interconnected wind farms would not be a reasonable alternative to renewing the GGNS operating license.

Proponents have also suggested that wind power in conjunction with energy storage mechanisms might serve as a means of providing base-load power. Current energy storage technologies are considered too expensive for wind power to serve as a large base-load generator [USNRC 2006a, Section 8.2.3.2; USNRC 2006c, Section 8.2.5.2]. However, due to the considerable interest in renewable energy, Entergy has opted to consider wind energy combined with CAES as a reasonable alternative for NEPA review to GGNS license renewal.

As a result of federal tax breaks and incentives, as well as concerns about climate change and economic analysis, additional base-load generating capacity from nuclear power is expected in the U.S. Even with new and additional power (power uprates) generated by nuclear power plants during the 2010 to 2035 time period, the nuclear share of the electricity market in the U.S. is expected to fall from 8.8% in 2009 to 8.0% in 2035 as the demand for electricity increases throughout the U.S. [USDOE 2011d, Table A8] Since 1997, the USNRC has certified four new standard designs for nuclear power plants under the procedures in 10 CFR Part 52, Subpart B, additional designs are currently under review, and additional designs are in pre-application review. A new nuclear plant alternative for replacing power generated by GGNS is considered in Section 8.1.3. As of May 2011, the USNRC has received 18 applications, for a total of 28 units, for COLs and six applications for ESPs for new nuclear plants. Four ESPs have been issued.

As stated in the GEIS, the "USNRC has determined that a reasonable set of alternatives should be limited to analysis of single, discrete electric generation sources and only electric generation sources that are technically feasible and commercially viable." [USNRC 1996, Section 8.1] Below is a discussion of the supply side alternative energy technologies that Entergy could utilize if the operating license for GGNS is not renewed. These alternatives are within the range of alternatives capable of meeting the goal of approximately 1,475 net MWe as base-load generation (replacement power for GGNS).

Based on the discussion above, conventional coal-fired, natural gas-fired combined cycle, and advanced light water reactors are currently available conventional base-load technologies considered to replace GGNS generation upon its termination of operation. Wind energy combined with CAES is also evaluated for replacement power due to current concerns of climate change and renewable energy. However, as described below, the continued operation of GGNS for the period of extended operation would result in less environmental impact than that of the replacement power that could be obtained from other reasonable generating sources.

As noted in previous sections, the impacts of new power generation at the GGNS site have recently been considered for a new nuclear unit in a 2006 ESP (NUREG-1817) and a 2008 COLA. In NUREG-1817 and the SERI COLA, impacts of similar replacement power were considered, both at the site, and at other brownfield and greenfield sites. The USNRC's conclusions in NUREG-1817 regarding the impacts of alternatives to onsite new nuclear baseload power generation are similar to those discussed for alternatives to extended operation of GGNS Unit 1 [USNRC 2006a, Section 8.2].

8.1.1 Super-Critical Coal-Fired Generation

Entergy has chosen to evaluate the construction of three 538 gross MWe super-critical coal-fired plants using a closed-cycle cooling system with cooling towers at an alternate site in Mississippi with an operating life of 40 years. Entergy has assumed a plant design that would minimize air emissions through a combination of boiler technology and post-combustion pollutant removal. The environmental impacts associated with constructing and operating a super-critical coal-fired plant at an alternate site using a closed-cycle cooling system with cooling towers are discussed below and summarized in Table 8.1-4.

8.1.1.1 Land Use

Based on Table 8.1 of the GEIS, approximately 1.7 acres of land per MWe would be required to construct a coal-fired plant. Therefore, for the 1,614 gross MWe plant utilized in this analysis, approximately 2,744 acres of land would be needed. This could amount to a considerable loss of natural habitat or agricultural land for the plant site alone, dependant upon if a greenfield or brownfield site was used, excluding that required for mining and other fuel-cycle impacts.

Additional land might also be needed for transmission lines and rail lines, depending on the location of the site relative to the nearest inter-tie connection and rail spur. Depending on the transmission line routing and nearest rail line, these alternatives could result in noticeable but not destabilizing land use impacts.

Land-use changes would also occur offsite in an undetermined coal-mining area to supply coal for the plant. In the GEIS, it was estimated that approximately 22 acres of land per MWe would be affected for mining the coal and disposing of the waste to support a coal-fired plant during its operational life [USNRC 1996, Section 8.3.9]. Therefore, for the 1,614 gross MWe plant utilized in this analysis, approximately 35,508 acres of land would be needed. Partially offsetting this offsite land use would be the elimination of the need for uranium mining and processing to supply fuel for GGNS. In the GEIS, it was estimated that approximately one acre per MWe would be affected for mining and processing the uranium during the operating life of a nuclear power plant [USNRC 1996, Section 8.3.12].

Overall, the construction and operational impacts on land use are considered MODERATE.

8.1.1.2 Ecology

Constructing a super-critical coal-fired plant at an alternate site could alter ecological resources because of the need to convert roughly 2,744 acres of land at the site to industrial use for the plant, coal storage, and ash and scrubber sludge disposal. However, some of this land might have been previously disturbed if a brownfield site was chosen for the plant siting.

Super-critical coal-fired generation at an alternative site would introduce construction impacts and new incremental operational impacts. Even assuming siting at a previously disturbed area, the impacts could include wildlife habitat loss, reduced productivity, habitat fragmentation, and a local reduction in biological diversity.

Use of cooling system makeup water from a nearby surface water body could have adverse impacts on aquatic resources. The construction and maintenance of a transmission line and rail spur, if needed, would also have ecological impacts. There would be some impact on terrestrial resources associated with the cooling tower drift and on the body of water from the chemicals used on-site, as well as the chemical constituents in the emissions. Overall, the construction and operational impacts on ecology could range from MODERATE to LARGE.

8.1.1.3 Water Use and Quality

8.1.1.3.1 Surface Water

Cooling water at an alternate site would likely be withdrawn from a surface water body. Water would also be consumed because of evaporation from the cooling towers, which could add to cumulative impacts of water use if a plant were to be constructed on a small river. Cumulative impacts of consumptive surface water use could be MODERATE, unless controlled by state or federal surface water withdrawal permit programs. Plant discharges would consist mostly of cooling tower blowdown, characterized primarily by an increased temperature and concentration of dissolved solids relative to the receiving water body and intermittent low concentrations of biocides (for example, chlorine). Treated process waste streams and sanitary wastewater may also be discharged. Runoff from coal storage and waste disposal would be controlled, but some runoff would occur with the potential for water quality impacts. All discharges would be regulated by an NPDES permit. Indirectly, water quality could be affected by acids and mercury from air emissions. Some erosion and sedimentation may also occur during construction but would be mitigated by best management practices pursuant to the site's stormwater permit. Overall, the construction and operational impacts to surface water use and quality would be SMALL to MODERATE.

8.1.1.3.2 Groundwater

Except for potable water uses, groundwater resources would most likely not be utilized to support operation of the super-critical coal-fired plant. Due to a typically smaller operating workforce, total potable water usage would likely be less under the super-critical coal-fired alternative than for continued GGNS operation. The impact on groundwater use would depend on the location selected for the plant, whether groundwater is needed to supply potable water to the plant, and local groundwater use.

If the plant were to be built in Mississippi, groundwater withdrawals would be regulated by MDEQ [MDEQ 2009b]. Thus, impacts to groundwater use and quality would be considered prior to the issuance of a groundwater withdrawal permit. Most other states have similar regulations that effectively minimize the impacts of groundwater use. Construction of a super-critical coal-fired plant may have a limited and minor impact on groundwater due to changes to surface drainage patterns during construction and thereafter. Overall, the construction and operational impacts to groundwater use and quality would be SMALL.

8.1.1.4 Air Quality

Air quality impacts of super-critical coal-fired generation are considerably different from those of nuclear power. A super-critical coal-fired plant emits SO_x, NO_x, particulate matter (PM), and carbon monoxide (CO), all of which are regulated pollutants. However, Entergy has assumed a plant design that would minimize air emissions through a combination of boiler technology and post-combustion pollutant removal.

Tables 8.1-1 and 8.1-2 present the basic super-critical coal-fired alternative emission control characteristics and emission estimates. Emission control technology and percent control assumptions were based on alternatives that the USEPA has identified as being available for minimizing emissions [USEPA 1998].

Entergy estimates the super-critical coal-fired alternative emissions to be as follows (from Table 8.1-2).

- Oxides of sulfur = 3,689 tons per year
- Oxides of nitrogen = 1,832 tons per year
- Carbon monoxide = 1,832 tons per year
- Particulates:
    - PM_f (total filterable particulates) = 826 tons per year
    - PM_{10} (particulates having a diameter of less than 10 microns) = 190 tons per year
- Carbon dioxide = 13.1 million tons per year

It should be noted that the particulate emissions from the cooling towers are not included in the above estimates. Although the amount of particulate emissions would be water-body specific along with other factors, for comparison purposes the cooling towers at GGNS could potentially emit approximately 65 tons/year of PM_{10} (worst case) [GGNS 2008g].

The impacts on air quality from super-critical coal-fired generation would vary considerably from those of nuclear generation because of emissions of SO_x, NO_x, CO, PM, and hazardous air pollutants (HAP) such as mercury. A super-critical coal-fired plant would also have CO_2 emissions that could contribute to global warming. [USNRC 2006a, Section 8.2.2.1]

The acid rain requirements of the CAA capped the nation's SO_2 emissions from power plants. Entergy would have to obtain sufficient pollution credits either from a set-aside pool or purchases on the open market to cover annual emissions from the plant. The market-based allowance system used for SO_2 emissions is not used for NO_x emissions. A new super-critical coal-fired power plant would be subject to the new source performance standard for such plants (40 CFR 60.44Da(d)(1)), which limits the discharge of any gases that contain NO_x (expressed as nitrogen dioxide) to 1.6 lb/MWh of gross energy output, based on a 30-day rolling average. [USNRC 2006a, Section 8.2.2.1]

A new super-critical coal-fired generation plant would also likely need a prevention of significant deterioration permit and an operating permit under the CAA. The plant would need to comply with the new source performance standards for such plants in 40 CFR Part 60 Subpart Da. The standards establish emission limits for particulate matter and opacity (40 CFR 60.42Da), SO_2 (40 CFR 60.43Da), and NO_x (40 CFR 60.44Da). [USNRC 2006a, Section 8.2.2.1]

The USEPA has various regulatory requirements for visibility protection in 40 CFR Part 51, Subpart P, including a specific requirement for review of any new major stationary source in an area designated as attainment or unclassified for criteria pollutants under the CAA (40 CFR 51.307(a)). Criteria pollutants under the CAA are lead, ozone, particulates, CO, NO_x, and SO_2. Ambient air quality standards for criteria pollutants are in 40 CFR Part 50. [USNRC 2006a, Section 8.2.2.1]

Section 169A of the CAA (42 USC 7491) establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when impairment occurs because of air pollution resulting from human activities. In addition, USEPA regulations provide that, for each mandatory Class I Federal area located within a State, the State must establish goals that provide for reasonable progress toward achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for those days on which visibility is most impaired over the period of the implementation plan and ensure no degradation in visibility for the least visibility-impaired days over the same period (40 CFR 51.308(d)(1)). If a new super-critical coal-fired power station were located close to a mandatory Class I area, additional air pollution control requirements could be imposed. [USNRC 2006a, Section 8.2.2.1]

Carbon dioxide emissions are a major contributor to anthropogenic greenhouse gas emissions, which has been suggested to contribute to climate change. These emissions result from the efficiency of the technologies utilized to produce and deliver the energy and carbon content of the fuel being utilized. Super critical coal-fired electricity generation has the highest emissions rate of CO_2 of the fossil fuel sources, and significantly higher emissions compared to nuclear power generation. As shown in Table 8.1-2, CO_2 emissions is estimated at 210 pounds per MMBtu or 13.1 million tons per year for the super-critical coal-fired plant assuming current emissions controls.

USNRC did not quantify coal-fired emissions in the GEIS, but implied that air impacts would be substantial. USNRC noted that adverse human health effects from coal combustion have led to important federal legislation in recent years and that public health risks, such as cancer and emphysema, have been associated with coal combustion. The GEIS also mentioned global warming and acid rain as potential impacts. Entergy concludes that federal legislation and large-scale concerns, such as global warming and acid rain, are indications of concerns about destabilizing important attributes of air resources. However, SO_x emission allowances, NO_x emission offsets, low NO_x burners with overfire air and selective catalytic reduction, fabric filters or electrostatic precipitators, and scrubbers are provided as mitigation measures. As such, Entergy concludes that the construction and operation impacts on air quality would be MODERATE.

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Table 8.1-1
Super-Critical Coal-Fired Alternative Emission Control Characteristics

Characteristic	Basis
Total unit size = 1,614 MW ISO rating net/ 1,524 MWe ISO rating net[a]	Size set to gas-fired alternative. Chosen as comparable to GGNS unit
Individual unit size = 538 MWe ISO rating gross / 508 MWe ISO rating net[a]	Based on approximately 6% onsite power usage
Number of units = 3	
Boiler type = pulverized coal, tangentially fired, dry-bottom, NSPS	Minimizes nitrogen oxide emissions [USEPA 1998, Table 1.1-3]
Fuel type = combination bituminous coal, subbituminous, lignite	Typical for coal used in Mississippi [USDOE 2010b, Table 4]
Fuel heating value = 8,541 Btu/lb	2009 value for coal used in Mississippi [USDOE 2010b, Table 15]
Fuel ash content by weight = 11.27%	2009 value for coal used in Mississippi [USDOE 2010b, Table 15]
Fuel sulfur content by weight = 0.53%	2009 value for coal used in Mississippi [USDOE 2010b, Table 15]
Uncontrolled SO_x emission = 38S lb/ton Uncontrolled NO_x emission = 10 lb/ton Uncontrolled CO emission = 0.5 lb/ton	Typical for pulverized coal, tangentially fired, dry-bottom, NSPS [USEPA 1998, Table 1.1-3]
Heat rate = 10,414 Btu/kWh	Average operating heat rate for coal [USDOE 2011a, Table 5.3]
Capacity factor = 0.85	Typical for newer large coal-fired units
NO_x control = low NO_x burners, overfire air and selective catalytic reduction (95% reduction)	Best available and widely demonstrated for minimizing NO_x emissions [USEPA 1998, Table 1.1-2]
Particulate Material, filterable (PM_f) = 10 lb/ ton of ash Particulate Material (less than 10 microns) PM_{10} = 2.3 lb/ton of ash	Typical for pulverized coal, tangentially fired, dry bottom [USEPA 1998, Table 1.1-4]
Particulate control = fabric filters (baghouse - 99.8% removal efficiency)	Best available for minimizing particulate emissions [USEPA 1998, pgs.1.1-6 and 1.1-7, Table 1.1-6]
SO_x control = Wet scrubber – lime (95% removal efficiency)	Best available for minimizing SO_x emissions [USEPA 1998, Table 1.1-1]

Table 8.1-1 (Continued)
Super-Critical Coal-Fired Alternative Emission Control Characteristics

Characteristic	Basis
CO_2 emission = average of bituminous and lignite coal = 210 lb/MMBtu	Based on USDOE 2010c

Btu/kWh = British thermal unit per kilowatt hour
Btu/lb = British thermal unit per pound
CO = carbon monoxide
CO_2 = carbon dioxide
ISO rating = International Standards Organization rating at standard atmospheric conditions of 59°F, 60% relative humidity, and 14.696 pounds of atmospheric pressure per square inch
lb = pound
MMBtu = million British thermal unit
MW = megawatt
MWe = megawatts, electric
NO_x = nitrogen oxides
NSPS = New Source Performance Standard
PM_f = total filterable particulates
PM_{10} = particulates having diameter less than 10 microns
S = sulfur
SO_x = oxides of sulfur

a. The difference between "net" and "gross" is electricity consumed by auxiliary equipment and environmental control devices [USDOE 2002, pg. 109].

Table 8.1-2
Air Emissions from Super-Critical Coal-Fired Alternative

Parameter	Result
Annual coal consumption	7,326,650 tons
SO_x	3,689 tons per year
NO_x	1,832 tons per year
CO	1,832 tons per year
PM_f	826 tons per year
PM_{10}	190 tons per year
CO_2	13.1 million tons per year (assuming 210 lb CO_2/MMBtu)

SO_x = oxides of sulfur
NO_x = nitrogen oxides
CO = carbon monoxide
PM_f = total filterable particulates
PM_{10} = particulates having diameter less than 10 microns
CO_2 = carbon dioxide
lb = pound
MMBtu = Million British thermal units

Reference: Enercon 2011b

8.1.1.5 Waste

Entergy concurs with the GEIS assessment that the coal-fired alternative would generate substantial solid waste, as shown in Table 8.1-3. The super-critical coal-fired plant would annually consume approximately 7,326,650 tons of coal having an ash content of 11.27%. After combustion, 99.8% of this ash (approximately 824,888 tons per year) would be collected and disposed of at either an onsite or offsite landfill. In addition, approximately 201,059 tons of scrubber waste would be disposed of each year (based on annual calcium hydroxide usage of approximately 67,864 tons). Entergy estimates that ash and scrubber waste disposal over a 40-year plant life would require approximately 590 acres. The amount of land needed for final disposal of ash may be less, dependant upon the availability of local recycling or reuse options for the ash. While only half this waste volume and land use would be attributable to the 20-year license renewal period alternative, the total numbers are pertinent as a cumulative impact.

Entergy believes that with proper siting coupled with current waste management and monitoring practices, waste disposal would not destabilize any resources. Some terrestrial habitat would be lost to the waste disposal, which could be significant depending on the occurrence of threatened or endangered species in the area. However, after closure of the waste site and revegetation, the land could potentially be available for other uses. Any impacts would be mitigated as part of the waste disposal permitting process. For these reasons, Entergy believes that construction and operational impacts on waste would be MODERATE; the impacts of increased waste disposal would be clearly noticeable, but would not destabilize any important resource.

Table 8.1-3
Solid Waste from Super-Critical Coal-Fired Alternative

Parameter	Result
Annual SO_x generated[a]	77,542 tons
Annual SO_x removed	73,665 tons
Annual ash generated	824,062 tons
Annual lime consumption[b]	67,864 tons
Annual calcium sulfate waste[c]	197,666 tons
Annual scrubber waste[d]	201,059 tons
Total volume of scrubber waste (40-year period)[e]	111,082,320 ft^3
Total volume of ash (40-year period)[f]	659,249,600 ft^3
Total volume of solid waste (40-year period)	770,331,920 ft^3
Waste pile area	589 acres, 30 ft high
Note: Calculations based on annual coal consumption of 7,326,650 tons per year (Table 8.1-2).	
SO_2 = sulfur dioxide SO_x = oxides of sulfur $CaSO_4 \cdot 2H_2O$ = calcium sulfate dihydrate ft = feet ft^3 = cubic foot lb = pound	

Reference: Enercon 2011b

a. Calculations assume 100% combustion of coal.
b. Lime consumption is based on total SO_2 generated.
c. Calcium sulfate generation is based on total SO_2 removed.
d. Total scrubber waste includes scrubbing media carryover.
e. Density of $CaSO_4 \cdot 2H_2O$ is 144.8 lb/ft^3.
f. Density of coal bottom ash is 100 lb/ft^3 [FHA].

8.1.1.6 Human Health

Super-critical coal-fired power generation introduces worker risk from coal and limestone mining, worker and public risk from coal and lime/limestone transportation, worker and public risk from disposal of coal combustion wastes, and public risk from inhalation of stack emissions. Emission impacts can be widespread and health risk is difficult to quantify. The super-critical coal-fired alternative also introduces the risk of coal pile fires and attendant inhalation risk.

The USNRC stated in the GEIS that there could be human health impacts (cancer and emphysema) from inhalation of toxins and particulates from a coal-fired plant, but the GEIS does not identify the significance of these impacts [USNRC 1996, Section 8.3.9]. In addition, the discharges of uranium and thorium from coal-fired plants can potentially produce radiological doses in excess of those arising from nuclear power plant operations [Gabbard].

Regulatory agencies, including the USEPA and State agencies, set air emission standards and requirements based on human health impacts. These agencies also impose site-specific emission limits, as needed to protect human health. USEPA has concluded that certain segments of the U.S. population (e.g., the developing fetus and subsistence fish-eating populations) are believed to be at potential risk of adverse health effects due to mercury exposures from sources such as coal-fired power plants. However, in the absence of more quantitative data, construction and operational impacts from radiological doses and inhaling toxins and particulates are considered to be SMALL.

8.1.1.7 Socioeconomics

Based on Table 8.1 of the GEIS, the peak workforce is estimated to range from 1.2 to 2.5 additional workers per MWe during the construction period. Therefore, for the 1,614 gross MWe plant utilized in this analysis, the workforce could range from approximately 1,937 to 4,035 workers.

Communities around the new site would have to absorb the impacts of a large, temporary workforce (up to approximately 4,035 workers at the peak of construction) and a permanent workforce of approximately 0.25 workers per MWe based on Table 8.2 of the GEIS, or approximately 404 workers for the 1,614 gross MWe plant utilized in this analysis.

During construction, the communities surrounding the plant site would experience increased demand for rental housing and public services. In addition, the relative economic contributions of construction workers to local business and tax revenues would vary over time. After construction, some local communities may be affected by the loss of construction jobs and associated loss in demand for business services. In addition, the rental housing market could experience increased vacancies and decreased prices. In the GEIS, it is stated that impacts at a rural site would be larger than at an urban site, because more of the peak construction workforce would need to move to the area to work. Therefore, socioeconomic impacts from construction could range from SMALL to LARGE based on the location of the plant site. During the operational phase, the plant would pay property taxes to the county. Therefore, socioeconomic impacts could be SMALL to MODERATE beneficial dependant upon location and economic conditions within the community.

During construction, up to potentially 4,035 workers would be commuting daily to the site. In addition to commuting workers, trucks would transport construction materials and equipment to the worksite increasing the amount of traffic on local roads, while trains or barges may also be used to transport large components to the site. The increase in vehicular traffic on roads would peak during shift changes, resulting in temporary levels of service impacts and potential delays at intersections. Although site-dependent, transportation impacts during construction would likely be MODERATE.

Transportation traffic-related impacts would be greatly reduced after construction but would not disappear during plant operations. The maximum number of plant operating personnel commuting to the site would be approximately 404 workers. At most alternate sites, coal and lime would be delivered by rail, although barge delivery is feasible for a location on navigable waters. Waste disposal would also add to transportation impacts if the disposal location were located offsite. Dependent on the delivery method of coal and lime/limestone to the site, transportation impacts during operations could range from SMALL to MODERATE.

8.1.1.8 Aesthetics

The introduction of tall stacks and cooling towers with the associated plume could potentially have a MODERATE impact at an alternative site, although the impact may be incremental if the site is located in an existing industrialized area. There would also be an aesthetic impact if construction of a new transmission line, barge docking facility, and/or rail spur were needed. Noise impacts associated with rail delivery of coal and lime/limestone would be most significant for residents living in the vicinity of the facility and along the rail route. Although noise from passing trains significantly raises noise levels near the rail corridor, the short duration of the noise reduces the impact. In a more suburban location, the impacts are considered MODERATE. This is due to the frequency of train transport, the fact that many people are likely to be within hearing distance of the rail route, and the impacts of noise on residents in the vicinity of the facility and the rail line. At a more rural location, the impacts could be SMALL. Noise and light from the plant would be detectable offsite. Overall, the construction and operational impacts on aesthetics could range from SMALL to MODERATE, depending on the characteristics of the alternative site.

8.1.1.9 Historic and Archaeological Resources

Before construction at an alternate site, studies would be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on cultural resources. The studies would be needed for areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission corridors, rail lines, or other ROW). Overall, construction and operational impacts on historic and archeological resources can generally be effectively managed and as such are considered SMALL.

Table 8.1-4
Summary of Environmental Impacts from Super-Critical Coal-Fired Generation Using Closed-Cycle Cooling at an Alternate Site

Impact Category	Impact	Comments
Land Use	MODERATE	Approximately 2,744 acre site, with additional land potentially needed for transmission lines and rail line for coal delivery.
Ecology	MODERATE to LARGE	Impact will depend on ecology of site and need for additional transmission lines and rail spur.
Surface Water Use and Quality	SMALL to MODERATE	Plant discharges to the receiving water during construction and operation would be regulated by a permit. Operational impacts could be MODERATE if located on a small river.
Groundwater Use and Quality	SMALL	Except for potable uses, groundwater would most likely not be utilized to support plant operations.
Air Quality	MODERATE	SO_x - 3,689 tons/yr - allowances required NO_x - 1,832 tons/yr - allowances required Carbon monoxide - 1,832 tons/yr Particulate (filterable) - 826 tons/yr Particulate (unfilterable) - 190 tons/yr Carbon dioxide - 13.1 million tons/yr Trace amounts of mercury, arsenic, chromium, beryllium, and selenium
Waste	MODERATE	Total ash and scrubber sludge waste volume would be approximately 1,025,121 tons/yr.
Human Health	SMALL	Regulatory controls and oversight would be protective of human health.
Socioeconomics	SMALL to MODERATE (Beneficial)	Communities would have to absorb impacts of a large, temporary workforce (up to approximately 4,035 workers) with impacts at a rural site being LARGE. Operational impacts of a permanent workforce (approximately 404 workers) would be SMALL to LARGE beneficial depending on location and economic conditions. Transportation-related impacts associated with construction and operational activities would be site dependent.
Aesthetics	SMALL to MODERATE	Could reduce aesthetic impact if siting is in an industrial area; impact could be MODERATE if siting is in a largely undeveloped area.
Historic and Archaeological Resources	SMALL	Any potential impacts can be effectively managed.

8.1.2 Natural Gas-Fired Generation

Consistent with NUREG-1817, Entergy has chosen to evaluate the construction of three 528 MWe natural gas-fired plants using a closed-cycle cooling system with cooling towers at the GGNS site, with an operating life of 40 years. Entergy has assumed that the plants would use combined-cycle turbines and used site-specific input as appropriate. The environmental impacts associated with constructing and operating a natural gas-fired plant at the GGNS site using a closed-cycle cooling system with cooling towers are discussed below and summarized in Table 8.1-7.

8.1.2.1 Land Use

The natural gas-fired plant would require approximately 110 acres for the power block and support facilities and likely would be sited on land that was previously disturbed during the construction of GGNS. Assuming the natural gas-fired plant uses a closed-cycle cooling system, an additional land area of up to 30 acres would be required for cooling towers and support systems. Construction of a natural gas pipeline from the GGNS site to the closest natural gas distribution line could require up to 85 acres. Thus, the total land use commitment would be approximately 225 acres. [USNRC 2006a, Section 8.2.2.2]

For any new natural gas-fired plant, additional land would be required for natural gas wells and collection stations. Based on the GEIS, it was estimated for a 1,000 MWe plant that approximately 3,600 acres would be required for wells, collection stations, and pipelines to bring the natural gas to the facility. Therefore, for the 1,584 gross MWe natural gas-fired plant being evaluated, approximately 5,700 acres would possibly be needed. However, most of this land requirement would occur on land where gas extraction already occurs. [USNRC 2006a, Section 8.2.2.2]

Impacts to land use during construction can be effectively managed in accordance with applicable state and federal requirements (i.e., stormwater, Section 404). Operational impacts should be minimal since most of the land would not be disturbed further once facilities are sited. Therefore, construction and operational impacts on land use are considered to be SMALL.

8.1.2.2 Ecology

Siting of the natural gas-fired plant would occur mostly in areas that were previously disturbed during the construction of GGNS. Constructing a new underground gas pipeline to the site would cause temporary ecological impacts. Ecological impacts on the plant site and utility easements would not affect threatened or endangered species, although some wildlife habitat loss and fragmentation, reduced productivity, and a local reduction in biological diversity would be likely. Withdrawal and discharge of makeup water for the cooling system could affect aquatic resources, and drift of condensation from the cooling towers could affect terrestrial ecology. Overall, construction and operational impacts on ecology could range from SMALL to MODERATE. [USNRC 2006a, Section 8.2.2.2]

8.1.2.3 Water Use and Quality

8.1.2.3.1 Surface Water

As previously discussed in Section 8.0, it is assumed that the natural gas-fired plant would utilize GGNS' existing construction and drinking water wells and radial wells. Therefore, surface water impacts would be limited to stormwater runoff associated with construction and operational activities.

Construction of new gas-fired generation at the GGNS site would not be expected to significantly affect surface water use or water quality. Although increased intensity of stormwater discharges may occur during construction due to increased impervious surface areas or decreased vegetative cover, standard engineering stormwater management practices pursuant to the site's NPDES stormwater management program would adequately mitigate any potential adverse impact. In addition, all effluents generated during construction would be managed and discharged in accordance with applicable state and federal discharge limitations as set by MDEQ and USEPA, and in accordance with the USACE Clean Water Act Section 404 permit program. Therefore, the anticipated impact would be SMALL. [USNRC 2006a, Section 8.2.2.2]

During the operational phase, any increase in stormwater runoff as a result of increased impervious surfaces would be addressed using standard engineering stormwater practices under the site's NPDES stormwater management program. Therefore, operational impacts are anticipated to be SMALL. [USNRC 2006a, Section 8.2.2.2]

8.1.2.3.2 Groundwater

At GGNS, the area of impact due to construction water use would be limited to the site property and is not expected to affect offsite water use or water users. All of the potential water use impacts in floodplain and wetlands areas are anticipated to be effectively managed. Groundwater used for construction purposes would be withdrawn from the Upland Complex or the Mississippi River Alluvium aquifers and not the Catahoula Formation. Therefore, construction impacts are anticipated to be SMALL.

During the operational phase, all potable water wells would be screened in the Upland Complex. In the event that the Upland Complex cannot meet the demand, additional wells may be sited in the Mississippi River Alluvium. If the replacement gas-fired plant continued to use the existing radial well collector system, the impacts would be anticipated to be similar to those for GGNS Unit 1 operation. All of the potential water use impacts in floodplain and wetlands areas would be anticipated to be effectively managed. Therefore, potential operational impacts due to hydrological alterations as a result of plant operations are anticipated to be SMALL.

As previously discussed in Section 8.0, it is assumed that the natural gas-fired plant would utilize GGNS' existing construction and drinking water wells and radial wells. Therefore, construction and operational impacts on groundwater quality would continue to be SMALL.

8.1.2.4 Air Quality

Natural gas is a relatively clean-burning fuel. When compared with a coal-fired plant, a natural gas-fired plant would release similar types of emissions, but in lower quantities [USNRC 2006a, Section 8.2.2.2]. Table 8.1-5 presents the basic gas-fired alternative characteristics and Table 8.1-6 presents emission estimates. Emission control technology and percent control assumptions were based on alternatives that the USEPA has identified as being available for minimizing emissions [USEPA 2000].

A new natural gas-fired power generation plant would likely need a prevention of significant deterioration permit and an operating permit under the CAA. A new combined-cycle, natural gas-fired plant would also be subject to the new source performance standards specified in 40 CFR Part 60, Subparts Da and GG. These regulations establish emission limits for particulates, opacity, SO_x, and NO_x. [USNRC 2006a, Section 8.2.2.2]

USEPA has various regulatory requirements for visibility protection in 40 CFR Part 51, Subpart P, including a specific requirement for review of any new major stationary source in areas designated as attainment or unclassified under the CAA. The GGNS site is in an area designated as attainment or unclassified for criteria pollutants (40 CFR 81.325). [USNRC 2006a, Section 8.2.2.2]

Section 169A of the CAA (42 USC 7491) establishes a national goal of preventing future impairment of visibility and remedying existing impairment in mandatory Class I Federal areas when impairment is from air pollution caused by human activities. In addition, USEPA regulations provide that for each mandatory Class I Federal area located within a State, state regulatory agencies must establish goals that provide for reasonable progress toward achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for the most impaired days over the period of the implementation plan and ensure no degradation in visibility for the least impaired days over the same period (40 CFR 51.308(d)(1)). If a new natural gas-fired power plant were located close to a mandatory Class I area, additional air pollution control requirements could be imposed. There are no mandatory Class I Federal areas within 100 miles of the GGNS site. Louisiana has one Class I Federal area, the Breton Wilderness. The Breton Wilderness is located approximately 200 miles southeast of the GGNS site. [USNRC 2006a, Section 8.2.2.2]

Entergy estimates the gas-fired alternative emissions to be as follows (Table 8.1-6).

- Sulfur oxides = 151 tons per year
- Oxides of nitrogen = 4,404 tons per year
- Carbon monoxide = 667 tons per year
- Filterable particulates = 85 tons per year (all particulates are PM_{10})
- Total particulates = 294 tons per year
- Carbon dioxide = 5.2 million tons per year

PM_{10} is particulate matter having an aerodynamic diameter less than or equal to 10μ (40 CFR 50.6(c)). A natural gas-fired power plant would also have carbon dioxide emissions that could contribute to global warming. [USNRC 2006a, Section 8.2.2.2] It should also be noted that the particulate emissions from the cooling towers are not included in the above estimates. However, for comparison purposes, the cooling towers at GGNS could potentially emit approximately 65 tons/year of PM_{10} (worst case) [GGNS 2008g].

The combustion turbine portion of the combined-cycle plant would be subject to USEPA's National Emission Standards for Hazardous Air Pollutants for Stationary Combustion Turbines (40 CFR Part 63, Subpart YYYY) if the site is a major source of hazardous air pollutants. Major sources have the potential to emit 10 tons/yr or more of any single hazardous air pollutant or 25 tons/yr or more of any combination of hazardous air pollutants (40 CFR 63.6085(b)). [USNRC 2006a, Section 8.2.2.2]

A natural gas-fired power plant would also have carbon dioxide emissions that could contribute to global warming. Gas-fired electricity generation emissions of CO_2 are approximately half of those from coal. As shown in Table 8.1-6, emissions of CO_2 from gas-fired power generation is estimated at approximately 117 pounds per MMBtu, or approximately 5.2 million tons per year assuming current emissions controls.

The fugitive dust emissions from construction activities would be mitigated using best management practices; such emissions would be temporary. The impacts of emissions from a natural gas-fired power generation plant would be clearly noticeable but would not be sufficient to destabilize air resources. Overall, it is concluded that construction and operational impacts on air quality could range from SMALL to MODERATE. [USNRC 2006a, Section 8.2.2.2]

Table 8.1-5
Gas-Fired Alternative Emission Control Characteristics

Characteristic	Basis
Total unit size = 1,584 MW ISO rating gross/ 1,524 MWe ISO rating net[a]	Manufacturer's standard size gas-fired combined cycle plant
Individual unit size = 528 MWe ISO rating gross/ 508 MWe ISO rating net[a]	Based on approximately 4% onsite power usage
Number of units = 3	
Fuel type = natural gas	Assumed
Fuel heating value = 1,025 Btu/ft^3	2009 value for gas used in Mississippi [USDOE 2011a, Table 3.7]
Fuel sulfur content = 0.0034 lb/MMBtu	Used when sulfur content is not available [USEPA 2000, Table 3.1-2a]
NO_x control = selective catalytic reduction with steam/water injection	Best available for minimizing NO_x emissions [USEPA 2000]
Fuel NO_x content = 0.099 lb/MMBtu	Typical for natural gas fired turbine, lean-premix [USEPA 2000, Table 3.1-1]
Fuel CO content = 0.015 lb/MMBtu	Typical for natural gas fired turbine, lean-premix [USEPA 2000, Table 3.1-1]
CO_2 emission rate - gas turbine, lean premix = 117 lb/MMBtu	USDOE 2010c
Heat rate = 7,543 Btu/kWh	Typical for combined cycle gas-fired turbines [USDOE 2011a, Table 5.4]
Uncontrolled filterable particulates = 0.0019 lb/ MMBtu	USEPA 2000, Table 3.1-2a
Uncontrolled total particulate matter = 0.0066 lb/MMBtu	USEPA 2000, Table 3.1-2a
Capacity factor = 0.85	Typical for large gas-fired base load units.

Btu/kWh = British thermal unit per kilowatt hour
Btu/ft^3 = British thermal unit per cubic foot
CO = carbon monoxide
CO_2 = carbon dioxide
ISO rating = International Standards Organization rating at standard atmospheric conditions of 59°F, 60% relative humidity, and 14.696 pounds of atmospheric pressure per square inch
lb/MMBtu = pound per million British thermal unit
MW= megawatt
MWe = megawatts, electrical
NO_x = nitrogen oxides

a. The difference between "net" and "gross" is electricity consumed by auxiliary equipment and environmental control devices. [USDOE 2002, pg. 109]

Table 8.1-6
Air Emissions from Gas-Fired Alternative

Parameter	Result
Annual gas consumption	86,795,748,246 ft^3 per year
Annual Btu input	88,965,642 MMBtu per year
SO_x	151 tons per year
NO_x	4,404 tons per year
CO	667 tons per year
PM_f	85 tons per year
PM_T	294 tons per year
CO_2	5.2 million tons per year (assuming 117 lb CO_2/MMBtu)

Btu = British thermal units
SO_x = oxides of sulfur
NO_x = oxides of nitrogen
CO = carbon monoxide
PM_f = total filterable particulates
PM_t = total particulates
CO_2 = carbon dioxide
ft^3 = cubic foot
lb = pound
MMBtu = million British thermal units

Reference: Enercon 2011b

8.1.2.5 Waste

There are only small amounts of solid waste products (i.e., ash) from burning natural gas fuel. The GEIS concluded that waste generation from gas-fired technology would be minimal. Gas firing results in very few combustion by-products because of the clean nature of the fuel. Waste generation would be limited to typical office wastes. This impact would be SMALL; waste generation impacts would be so minor that they would not noticeably alter important resource attributes.

Siting the facility at an alternate greenfield site would not alter the waste generation; therefore, the impacts on waste would continue to be SMALL.

8.1.2.6 Human Health

The GEIS analysis mentions potential gas-fired alternative health risks (cancer and emphysema). The risk may be attributable to NO_x emissions that contribute to ozone formation, which in turn contributes to health risks. As discussed in Section 8.1.1.6 for the coal-fired alternative, legislative and regulatory control of the nation's emissions and air quality are protective of human health; therefore, human health impacts during the construction and operational period would be SMALL; that is, human health effects would not be detectable or would be so minor that they would neither destabilize nor noticeably alter important attributes of the resource.

8.1.2.7 Socioeconomics

Socioeconomic impacts would result from the approximately 150 workers needed to operate the natural gas-fired facility, demands on housing and public services during construction, and the loss of jobs after construction. Overall, these construction and operational impacts would be SMALL because of the mitigating influence of the site's proximity to the surrounding population area and the relatively small number of workers needed to construct and operate the plant in comparison to nuclear and coal-fired generation alternatives. During the operational period the plant would pay property taxes to Claiborne County, and considering the population and economic condition of the County, taxes would have a MODERATE beneficial impact. [USNRC 2006a, Section 8.2.2.2]

Based on Table 8.1 of the GEIS, the workforce is estimated to be 1.2 additional workers per MWe during the construction period. Therefore, for the 1,584 gross MWe plant utilized in this analysis, the construction workforce would be approximately 1,900 workers, in addition to the workers currently employed at GGNS. However, roads in the vicinity of the GGNS site have sufficient capacity to handle the increase [USNRC 2006a, Section 4.5.4.1]. Therefore, construction impacts to transportation are anticipated to be SMALL.

During the operational period, the current road network has sufficient capacity to accommodate site-related traffic. [USNRC 2006a, Section 5.5.4.1] Therefore, operational impacts to transportation would be SMALL.

8.1.2.8 Aesthetics

The turbine buildings, three exhaust stacks (approximately 200 ft tall) and associated emissions, cooling towers, condensation plumes from the cooling towers, and the gas pipeline compressors would be visible during daylight hours from offsite. Noise and light from the plant would be detectable offsite. [USNRC 2006a, Section 8.2.2.2] For the purpose of this evaluation, Entergy assumed that no new transmission lines would be needed to serve the natural gas-fired plant located at the GGNS site. A mitigating factor is that the GGNS site is currently an industrial site located in a rural, forested area. Overall, construction and operational impacts on aesthetics would be SMALL.

8.1.2.9 Historic and Archaeological Resources

The site was disturbed during construction of the GGNS. As a result, significant historical and cultural and historic resource impacts would be unlikely and would be minimized by survey and recovery techniques. A cultural resources inventory would likely be needed for any onsite property that has not been previously surveyed. However, construction and operational impacts on historic and archaeological resources can be effectively managed and kept SMALL.

Table 8.1-7
Summary of Environmental Impacts from Natural Gas-Fired Generation at the GGNS Site

Impact Category	GGNS Site	
	Impact	Comments
Land Use	SMALL	~225 acres for power block, support facilities, and cooling towers. Additional land needed for gas pipeline. Land impacts managed in accordance with regulatory requirements. Operational impacts minimal once facilities are sited.
Ecology	SMALL to MODERATE	Many impacts to occur in areas previously disturbed during GGNS construction, thus potential habitat loss and fragmentation and reduced productivity and biological diversity would be negligible. Impacts on terrestrial ecology from cooling tower drift could occur.
Surface Water Use and Quality	SMALL	Existing site water well systems to be utilized; surface water use for construction not needed; stormwater and plant effluent discharges during construction and operation would be regulated by a permit.
Groundwater Use and Quality	SMALL	Groundwater impacts would continue to be similar to those of GGNS Unit 1 operations.
Air Quality	SMALL to MODERATE	Primarily NO_x impacts could be noticeable, but not destabilizing.
Waste	SMALL	Only small amounts of solid waste products (i.e., ash); GEIS concluded waste generation would be minimal; and waste generation would be limited to typical office wastes.
Human Health	SMALL	Regulatory controls and oversight would be protective of human health.
Socioeconomics	SMALL to MODERATE Beneficial	Construction and operations workforces relatively small. Property tax base, while smaller than for nuclear or coal-fired plant, might still be quite noticeable. Roads have sufficient capacity for construction and operational workforce.
Aesthetics	SMALL	Best management practices can be used to mitigate visual impacts from plant buildings, exhaust stacks, cooling towers, and condensation plumes from cooling tower operation.
Historic and Archaeological Resources	SMALL	Any potential impacts can likely be effectively managed.

8.1.3 Nuclear Power Generation

Since 1997, the USNRC has certified four new standard designs for nuclear power plants under 10 CFR Part 52, Subpart B. Additional designs are under review and awaiting certification and others are undergoing pre-application reviews. As of July 2011, eighteen applications, for twenty-eight units, for COLs and six applications for an ESP have been submitted to the USNRC for review. Four ESP applications have been approved and issued.

SERI submitted an application for an ESP for the Grand Gulf site on October 16, 2003, and the USNRC issued the Grand Gulf ESP on April 5, 2007. SERI submitted an application for a combined license for an Economic Simplified Boiling Water Reactor designated as GGNS Unit 3 on February 27, 2008. On January 9, 2009, SERI informed the USNRC that it was considering alternate reactor design technologies and requested the USNRC suspend its review effort until further notice. Therefore for purposes of the new nuclear alternative, the analysis is being based on information already contained in NUREG-1817 and the GGNS Unit 3 COLA, to the extent practicable. It is also being assumed that the new nuclear plant would have an initial 40-year license term with the opportunity to renew for an additional 20-year license term. Entergy assumed that the new nuclear alternative at the GGNS site would not utilize the existing radial wells or cooling towers due to potential thermal heat load differences but would utilize the existing transmission lines. Therefore, transmission line impacts analyzed in NUREG-1817 and the GGNS Unit 3 COLA were not considered in Entergy's analysis as it relates to the nuclear alternative at the GGNS site. However, transmission line impacts in NUREG-1817 were considered for the alternate site at RBS.

The environmental impacts associated with transporting fuel and waste to and from a light-water cooled nuclear power reactor are summarized in Table S-4 of 10 CFR 51.52. The summary of the USNRC's findings on NEPA issues for license renewal of nuclear power plants in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, is also relevant, although not directly applicable, for consideration of environmental impacts associated with the operation of a replacement nuclear power plant. [USNRC 2003, Section 8.2.3] However as discussed in NUREG-1817 and the GGNS Unit 3 COLA, environmental impacts associated with transporting fuel and waste would be SMALL [USNRC 2006a, Section 6.1.1.9; SERI 2008b, Section 5.7].

Consistent with NUREG-1817, Entergy evaluated the nuclear alternative using closed-cycle cooling with cooling towers at the GGNS site and an alternate site (RBS). The environmental impacts associated with this alternative are discussed below and summarized in Table 8.1-8.

8.1.3.1 Land Use

An estimated 234 acres of the 2,100-acre GGNS site would be affected by construction of a new facility. Including the intake structure laydown, an estimated 132 acres would be overlain by permanent structures. Acreage not containing permanent structures would amount to 102 acres and would be expected to be reclaimed to the maximum extent possible. On-site excavations, grading and dredging activities create construction spoils and borrows. Excess material is anticipated to be disposed in an upland location on-site in accordance with appropriate soil management and stormwater control practices. No rail service is anticipated to be required for the construction of the unit at the GGNS site. Therefore, the land-use impact associated with construction is anticipated to be SMALL. [SERI 2008b, Section 4.1.1] During the operational period, NUREG-1817 concluded that land-use impacts would be SMALL. [USNRC 2006a, Section 5.1.1].

NUREG-1817 determined that land-use impacts of new facility construction and operations (i.e., physical, ecological, social, and radiological impacts) at an alternate site would likely be similar to those expected at the GGNS site. Therefore, land-use impacts would be SMALL. [USNRC 2006a, Section 8.5.1.1]

8.1.3.2 Ecology

Locating a replacement nuclear power plant at the GGNS site could alter ecological resources because of construction and the need to convert currently unused land to industrial use. In total, impact could include habitat degradation, fragmentation, or loss as a result of construction activities and conversion of land to industrial use. Ecological communities may also experience reduced productivity and biological diversity from disturbing previously intact land. Based on NUREG-1817, overall the ecological impacts of the nuclear alternative at the GGNS site during the construction and operational periods are considered SMALL [USNRC 2006a, Sections 4.4.1.5, 4.4.2, 4.4.3.3, 5.4.1.10, 5.4.2.6, and 5.4.3.3].

Based on NUREG-1817 and mainly attributable to the construction of additional transmission lines, construction and operational impacts on ecology at an alternate site would range from SMALL to MODERATE [USNRC 2006a, Tables 9-1 and 9-2].

8.1.3.3 Water Use and Quality

8.1.3.3.1 Surface Water

At the GGNS site, the use of surface water for construction is not expected [SERI 2008b, Section 4.2.2.1]. Although increased intensity of stormwater discharges may occur during construction due to increased impervious surface areas or decreased vegetative cover, standard engineering stormwater management practices pursuant to the site's NPDES stormwater management program would adequately mitigate any potential adverse impact [SERI 2008b, Section 4.2.1.1; USNRC 2006a, Section 4.3.1]. In addition, all effluents generated during construction would be managed and discharged in accordance with applicable state and federal discharge limitations as set by MDEQ and USEPA, and in accordance with the USACE Clean Water Act Section 404 permit program [SERI 2008b, Section 4.2.2.9]. Therefore, the anticipated impact during the construction period would be SMALL.

During the operational phase, any increase in stormwater runoff as a result of increased impervious surfaces would be addressed using standard engineering stormwater practices under the site's NPDES stormwater management program. In addition, given the small amount of water withdrawn for a new nuclear facility relative to the large flow of the Mississippi River, the intake and discharge would have minimal impact on the river's flow pattern adjacent to the shoreline. Therefore, impacts during the operational period are anticipated to be SMALL. [SERI 2008b, Section 5.2.1; USNRC 2006a Section 5.3.1]

Based on NUREG-1817, the impacts to surface water during the construction and operational periods at an alternate site would be similar to those at GGNS. Therefore, impacts would be SMALL. [USNRC 2006a, Tables 9-1 and 9-2]

8.1.3.3.2 Groundwater

At GGNS, the area of impact due to construction water use would be limited to the site property and is not expected to adversely affect offsite water use or water users. All of the potential water use impacts in floodplain and wetlands areas are anticipated to be effectively managed. Groundwater used for construction purposes would be withdrawn from the Upland Complex or the Mississippi River Alluvium aquifer and not the Catahoula Formation. Therefore, impacts are anticipated to be SMALL. [SERI 2008b, Section 4.2.2.4] During the operational phase, all potable water wells would be screened in the Upland Complex. In the event that the Upland Complex cannot meet the demand, additional wells may be sited in the Mississippi River Alluvium. Therefore, potential impacts due to hydrological alterations as a result of plant operations are SMALL. [SERI 2008b, Section 5.2.1]

Based on NUREG-1817, the impacts to groundwater during construction and operation at an alternate site would be similar to those at GGNS. Therefore, impacts would be SMALL [USNRC 2006a, Tables 9-1 and 9-2]

8.1.3.4 Air Quality

At the GGNS site, ground-clearing, grading, and excavation activities would raise dust, as would the movement of materials and machinery. Fugitive dust may also rise from cleared areas during windy periods. Dust from construction activities could be mitigated using such measures as wetting of unpaved roads and construction areas during dry periods and seeding or mulching bare areas. The concrete batch plant would be equipped with a dust-control system that would be checked and maintained on a routine basis. Construction equipment burning gasoline or diesel fuel would also be inspected and maintained to prevent excessive exhaust emissions. Any open burning would be conducted in a burn pit using technology to increase combustion efficiency and reduce smoke level in compliance with applicable air-permit requirements established by the MDEQ. [USNRC 2006a, Section 4.2.1] Exhaust from the vehicles required to transport the construction workforce would decrease air quality somewhat, but it is unlikely that air quality would be degraded sufficiently to be noticeable beyond the immediate vicinity of site. Mitigation of potential air quality impacts of increased traffic could be achieved by arranging shift changes for construction workers. [USNRC 2006a, Section 4.2.2] Therefore, it is concluded that air quality impacts during construction would be SMALL. Based on NUREG-1817, the air quality impacts during the operational phase would be SMALL because the emission sources would be operated intermittently and emissions would be within Federal, State, and local air quality limits [USNRC 2006a, Table 5-17].

Based on NUREG-1817, the impacts to air quality during the construction and operational periods at an alternate site would be similar to those at GGNS. Therefore, impacts on air quality would be SMALL. [USNRC 2006a, Tables 9-1 and 9-2]

In addition, as discussed in Section 8.3, GHG emissions that would be associated with nuclear are lower than fossil fuel-based energy sources, and similar to the lifecycle GHG emissions from renewable energy sources. Therefore, air quality impacts associated with new nuclear at the GGNS site or at an alternate site would be beneficial to climate change.

8.1.3.5 Waste

The waste impacts associated with operation of a nuclear power plant are listed in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B. Construction-related debris would be generated during construction activities and removed to an appropriate disposal site. Overall, waste impacts of a new nuclear plant at either the GGNS site or an alternate site are considered SMALL.

8.1.3.6 Human Health

Human health impacts for an operating nuclear power plant are identified in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. Overall, human health impacts of a new nuclear plant at either the GGNS site or an alternate site are considered SMALL, which is consistent with the impact determination in NUREG-1817 [USNRC 2006a, Tables 9-1 and 9-2].

8.1.3.7 Socioeconomics

For the new nuclear at GGNS, it was assumed that the construction period would be five years and the peak construction workforce would be approximately 3,150 [USNRC 2006a, Section 4.5.3]. Surrounding communities would experience significant, but not necessarily destabilizing, demands on housing and public services. After construction, the communities would be impacted by the loss of the construction jobs. In total, the socioeconomic impacts during the construction period for the nuclear alternative at the GGNS site are considered to range from a SMALL to LARGE beneficial impact based on the positive aspects of station construction on the regional economies [USNRC 2006a, Section 4.5.5].

Based on NUREG-1817, construction impacts at an alternate site would range from a SMALL to LARGE beneficial impact based on the positive aspects of station construction on the regional economies [USNRC 2006a, Table 9-1].

The replacement nuclear unit is assumed to have an operating workforce approximately similar to the employees currently working at GGNS. The replacement nuclear unit would provide a continuing tax base to offset the loss of tax base associated with decommissioning of GGNS. For all of these reasons, socioeconomic impacts during the operational period for the nuclear alternative at the GGNS site are considered to range from a SMALL to LARGE beneficial impact based on the positive aspects of station operation on the regional economies [USNRC 2006a, Section 5.5.3.3].

Based on NUREG-1817, operational impacts at an alternate site would range from a SMALL to LARGE beneficial impact based on the positive aspects of station operation on the regional economies [USNRC 2006a, Table 9-2].

8.1.3.7.1 Transportation

During the five-year construction period, up to approximately 3,150 construction workers could be working at the site, in addition to the workers currently employed at GGNS. However, roads in the vicinity of the GGNS site have sufficient capacity to handle the increase [USNRC 2006a, Section 4.5.4.1]. Therefore, impacts are anticipated to be SMALL.

Roads within the vicinity of the GGNS site would experience a temporary increase in traffic at the beginning and the end of the operational workday period. However, the current road network has sufficient capacity to accommodate the increase. [USNRC 2006a, Section 5.5.4.1] Therefore, impacts during the operational period would be SMALL.

Based on NUREG-1817, the impacts of a construction workforce and related transportation of construction supplies and materials on the transportation infrastructure at an alternate site would be noticeable (and temporary), and impacts of an operations workforce and related transportation impacts would be much less noticeable. [USNRC 2006a, Section 8.5.1.5] Therefore, transportation-related impacts associated with commuting construction and plant operating personnel at an alternate site could range from SMALL to MODERATE [USNRC 2006a, Tables 9-1 and 9-2].

8.1.3.8 Aesthetics

Construction activities would be temporary and would occur on a site already occupied by a nuclear power facility [USNRC 2006a, Table 4-3]. At the GGNS site, the nearest residential area is about 1,650 feet from the GGNS site and is shielded by woods. Given this distance, residents near the site would not have a clear view of the new unit. Some structures of the new facility may be visible from the Mississippi River (for example, intake structure, cooling towers) and from the GGMP. Bluffs on the site east of the Mississippi River are about 65 feet above the average river level, and dense forest throughout the vicinity would help conceal the new structures. The natural draft cooling tower, if used, would be up to 550 feet tall, so some visual impact would result. However, the existing cooling tower at GGNS is similar in height and is difficult to see from most vantage points offsite. Mechanical draft cooling towers would be considerably shorter (60 feet). Either type of tower would generate a visible water vapor plume. Longest visible plumes would occur in the winter with an estimated average length of 2.32 miles for natural draft cooling towers and 1.36 miles for mechanical draft cooling towers. [USNRC 2006a, Section 5.5.1.4] Therefore, it is anticipated that impacts would be SMALL. Aesthetic impacts at an alternate site would be similar to that at GGNS and are consistent with the SMALL impact finding in NUREG-1817 [USNRC 2006a, Tables 9-1 and 9-2].

During construction at the GGNS site, noise would increase with the operation of vehicles, earthmoving equipment, materials-handling equipment, impact equipment, and other stationary equipment (such as pumps and compressors), and the increase of human activity. The surrounding counties are predominantly rural tracts. However, areas that are subject to farming are prone to seasonal noise-related events, such as planting and harvesting. Wooded areas provide natural noise abatement. Noise level also attenuates with distance. In addition some noise-related activities (for example, blasting) could be restricted to daylight hours. [USNRC 2006a, Section 4.5.1.1] Therefore, impacts from noise levels can be effectively managed and kept SMALL.

There would be sources at GGNS that introduce continuous and intermittent noise from plant operation. Continuous sources include the mechanical equipment associated with normal plant operations. Intermittent sources include the use of outside loudspeakers and the commuting of plant employees. At the GGNS site, the plant operation noises would be similar to existing noise levels from operating the plant. Therefore noise impacts of the nuclear alternative at GGNS are considered to be SMALL and are consistent with the impact finding in NUREG-1817 [USNRC 2006a, Section 5.5.1.5].

Based on NUREG-1817, noise impacts during the construction and operational periods at an alternate site would be similar to those of GGNS. Therefore, it is concluded that the impacts on aesthetics would be SMALL. [USNRC 2006a, Tables 9-1 and 9-2]

8.1.3.9 Historic and Archeological Resources

At the GGNS site, the impacts of plant construction on historic properties would be managed in accordance with procedures that include cultural resource surveys conducted in areas recommended by the SHPO prior to construction and immediate stop work orders for inadvertent discovery of cultural resources during construction activities. Operational activities such as trenching, excavation, or ground penetration would be managed under these same procedures. [USNRC 2006a, Sections 4.6 and 5.6; SERI 2008b, Sections 4.1.3 and 5.1.3] Therefore, impacts to cultural resources can be effectively managed and kept SMALL.

Based on NUREG-1817, there would be no significant differences between the GGNS site and an alternate site that would make any material difference in the potential for historic properties or other important cultural sites to be adversely affected. Therefore, it was concluded that the impacts on historic and cultural resources would be SMALL. [USNRC 2006a, Section 8.5.1.6]

Table 8.1-8
Summary of Environmental Impacts from Nuclear Power Generation at GGNS and Alternate Site

Impact Category	GGNS Site		Alternate Site	
	Impact	Comments	Impact	Comments
Land Use	SMALL	Requires approximately 234 acres for the plant; construction and operational activities would be managed in accordance with appropriate stormwater management practices.	SMALL	Same impacts as GGNS site.
Ecology	SMALL	Potential habitat loss and fragmentation; potential reduced productivity and biological diversity.	SMALL to MODERATE	Potential habitat loss and fragmentation; reduced productivity and biological diversity. Level of impact depends on transmission line route.
Surface Water Use and Quality	SMALL	Surface water use for construction not needed; stormwater and plant effluent discharges during construction and operation would be regulated by the USEPA, MDEQ, and USACE. Consumptive use of water due to evaporation from cooling towers would occur.	SMALL	Same impacts as GGNS site.
Groundwater Use and Quality	SMALL	Groundwater would only be used as potable and plant process water.	SMALL	Same impacts as GGNS site.

Table 8.1-8 (Continued)
Summary of Environmental Impacts from Nuclear Power Generation at GGNS and Alternate Site

Impact Category	GGNS Site		Alternate Site	
	Impact	**Comments**	**Impact**	**Comments**
Air Quality	SMALL (Beneficial to Climate Change)	During construction, fugitive emissions and emissions from vehicles and equipment would be temporary. During operation, small amount of emissions from diesel generators and possibly other sources would be insignificant and regulated by MDEQ.	SMALL (Beneficial to Climate Change)	Same impacts as GGNS site.
Waste	SMALL	Waste impacts for an operating nuclear power plant are set out in 10 CFR Part 51, Appendix B, Table B-1. Debris would be generated and removed to an appropriate disposal site.	SMALL	Same impacts as GGNS site.
Human Health	SMALL	Human health impacts for an operating nuclear power plant are set out in 10 CFR Part 51, Appendix B, Table B-1.	SMALL	Same impacts as GGNS site.

Table 8.1-8 (Continued)
Summary of Environmental Impacts from Nuclear Power Generation at GGNS and Alternate Site

Impact Category	GGNS Site		Alternate Site	
	Impact	Comments	Impact	Comments
Socioeconomics	SMALL to LARGE Beneficial	During construction, demands on housing and public services would not be destabilized and regional economies would beneficially benefit from the approximately 3,150 workers. During operation, replacement workforce would offset loss of tax base associated with GGNS decommissioning. Overall, socioeconomic impacts range from SMALL to LARGE beneficial. Roads have sufficient capacity to handle construction workers and commuting workers during operations.	SMALL to LARGE Beneficial	During construction, demands on housing and public services would not be destabilized and regional economies would beneficially benefit from the approximately 3,150 workers. Regional economies would continue to benefit during the operational period. Overall, socioeconomic impacts range from SMALL to LARGE beneficial. Transportation impacts associated with construction could be noticeable (MODERATE) and temporary due to the construction workforce and associated supplies. Commuting personnel during operations and related impacts would be less noticeable (SMALL).
Aesthetics	SMALL	Introduction of cooling towers and associated plume; height of natural draft towers could be 550 feet and mechanical draft towers 60 feet. Noise would be temporary during construction and intermittent during operation.	SMALL	Same impacts as GGNS site.
Historic and Archaeological Resources	SMALL	Any potential impacts can be effectively managed.	SMALL	Same impacts as GGNS site.

8.1.4 Wind with CAES

Wind and solar power have gained widespread popularity as potential renewable energy sources. Both also have similar characteristics when considered for base-load power in that their intermittency creates challenges for delivering power when it is needed. Entergy has chosen wind with CAES as representative of renewable energy generation for a NEPA environmental impacts review because of widespread plans for deployment, especially in the U.S. Midwest. In addition, due to the limitations discussed in Section 8.2.2, solar deployment conditions are not ideal in the Southeast.

As discussed in Section 8.2.1, wind power creates significant challenges for grid stability, especially as these types of renewable energy sources increase. The variability of wind generation makes grid stability much more complex when unexpected losses of generation occur. Wind generation cannot provide contingency or backup reserve power; and due to the increasing potential for sudden unexpected generation losses as the deployment of wind generation increases, increased backup reserve capacity from conventional generation will be needed to maintain an acceptably consistent power on the grid. This makes it unlikely that wind energy alone without some form of energy storage will provide base-load generation. [LBNL]

For wind energy to be considered for replacement base-load energy production for GGNS, it must provide equivalent MWe power at similar capacity factors by the end of the current operating license in 2024. Whereas a single wind farm or solar generation unit would not provide consistent power, proponents believe that multiple generating units scattered within a region and interconnected together via the grid could theoretically provide for more consistent power generation. Interconnecting wind farms through the transmission grid may be a simple and effective way of reducing deliverable wind power swings caused by wind intermittency [Archer and Jacobson].

As more farms are interconnected in an array, wind speed correlation among sites decreases and so does the probability that all sites experience the same wind regime at the same time. The array consequently behaves more and more similarly to a single farm with steady wind speed and thus steady deliverable wind power. In a recent study, the benefits of interconnecting wind farms were evaluated for 19 sites located in the Midwestern U.S. with annual average wind speeds at 80 m above ground, the hub height of modern wind turbines, greater than 6.9 meters per second (class 3 or greater). It was found that an average of 33% and a maximum of 47% of yearly averaged wind power from interconnected farms can be used as reliable, base-load electric power. Equally significant, interconnecting multiple wind farms to a common point and then connecting that point to a far-away city can allow the long-distance portion of transmission capacity to be reduced, for example, by 20% with only a 1.6% loss of energy. [Archer and Jacobson]

Backup power sources are needed when the available wind cannot meet energy demands. Generally, reserve capacity is provided by conventional fossil-fueled generation sources. Energy storage technologies do not generate electricity but can deliver stored electricity to the electric grid or an end-user. They are used to improve power quality by correcting voltage sags, flicker, and surges, or correcting for frequency imbalances. Storage devices are also used as uninterruptible power supplies by supplying electricity during short utility outages. [CEC 2002]

Technologies currently available or under consideration for deployment as potential energy storage alternatives include battery storage, flow batteries, flywheel, superconducting magnetic energy storage, supercapacitor, and CAES. [CEC 2002] Entergy has chosen CAES as being representative of the potential energy storage technologies because of the potential for supplying adequate amounts of backup power of a longer duration.

CAES uses pressurized air as the energy storage medium. An electric motor-driven compressor is used to pressurize the storage reservoir using off-peak energy, and air is released from the reservoir through a turbine during on-peak hours to produce energy. The turbine is essentially a modified turbine that can also be fired with natural gas or distillate fuel. Ideal locations for large CAES reservoirs are aquifers, conventional mines in hard rock, and hydraulically mined salt caverns. Air can be stored in pressurized tanks for small systems. [CEC 2002]

CAES promotes the development of renewable energy by offering a way to store electricity produced by intermittent resources such as wind and solar. However, no large-scale, base-load CAES facilities are in operation anywhere in the world, nor are any existing CAES facilities combined with either wind or solar power. A 200- to 300-MW CAES facility integrated with a 75- to 150-MW wind farm, referred to as the Iowa Stored Energy Park, was proposed in Iowa but was terminated in July 2011 due to geology limitations specific to the Dallas Center site. The Iowa Stored Energy Park Association members terminated the project because they have easier, less expensive and less risky conventional alternatives to meet their customers' future electric needs. [ISEP; PEI]

Two CAES facilities combined with natural gas power plants, a 110-MW facility in Alabama and a 290-MW plant in Germany, have been built and are in operation. A CAES facility powered with energy from generation facilities already on the power grid is proposed for Norton, Ohio. This facility, which is still in the project development and permitting stage, is planned to eventually provide 804 MW of peaking power generation [PEI]. The Norton Energy Storage (NES) CAES project is somewhat different from the other CAES projects in that a pre-existing mine would be utilized. The size and the mining engineered construction of the pre-existing mine allows a much greater planned capacity for the Norton facility as compared to other CAES projects.

The theory behind the combination of wind power generation with energy storage is that when the generation capacity is available, the amount of power produced could, at times, exceed the demand for power at that time. CAES facilities are currently operated as peaking plants with energy placed into storage during the less expensive, non-peak demand hours and generated from the storage units during the higher priced, peak demand hours. During peak demand hours, the compressed air is used in combination with a heat source, such as natural gas, to drive turbines and generate electricity. To generate electricity from the CAES, natural gas usage is one third the amount needed to generate the same amount of electricity at a natural gas generating plant [Gardner and Haynes]. Due to the cost differential between peak and non-peak hours and the reduction in the volume of natural gas used to generate a specific amount of power, a CAES facility can be an economically attractive method of producing peak power [RESGS; PEI].

In order for this combination of wind generation and CAES technologies to function as base-load power, the wind energy source must provide reliable excess generation to power the CAES. This means the wind generation source would have to be sized to be larger than the GGNS base-load power level of 1,475 MWe in order to place energy into storage. For example, if an interconnected wind generation source was conservatively assumed to be available for 12 hours every day and if the energy storage technology was conservatively assumed to be 100% efficient, wind generation of 2,950 MWe would be needed to provide 1,475 MWe of base-load generation for 12 hours and to supply excess generation for 1,475 MWe of power generation from the storage units for 12 hours. In reality, the wind generation may have to be even greater than 2,950 MWe because CAES technologies do not approach 100% efficiency in energy transfer capability. CAES systems with the potential for supplying 1,475 MWe might be expected to be dependent upon the availability and capacities of a suitable underground cavern or multiple caverns. It should also be noted that one or more CAES facilities may be required, with distributed impacts, if multiple facilities were required. For the purposes of Entergy's analysis, it has been assumed a single CAES facility could be identified to support base-load power generation to the GGNS ROI.

8.1.4.1 Land Use

The transmission system required for interconnection with the grid and demand centers in the SERC, including a transmission system needed to transfer power to the GGNS ROI, does not currently exist and will require development of hundreds of miles of new ROWs which will alter land use and potentially alter both terrestrial and aquatic ecological communities along their courses. Proposals have been developed by some grid operators for deployment of various transmission scenarios to take advantage of wind power. The National Renewable Energy Laboratory concludes that new transmission will be required for all the future wind scenarios in the Eastern Interconnection. Planning is imperative because it takes longer to build new transmission capacity than it does to build new wind plants. [NREL 2011]

Land use impacts will occur due to transmission system construction and operation. Since the ROW would have to be maintained throughout the 20-year license renewal period and likely beyond, the total land use would be permanently affected, limiting its use for other purposes. It is not possible to accurately predict the number of acres of land use required for transmission system build-out due to lack of current planning documents to implement an interconnected wind energy generation system within the Southeast. However, it is anticipated that hundreds of miles of ROW of varying sizes might be needed. If a ROW width of 150 feet or greater were needed for the extremely high voltage portions (345 kV or greater), this committed and disturbed land could amount to over 1,818 acres per 100 miles of transmission line ROW, or approximately 2.8 mi^2 per 100 miles of transmission line ROW. Many land use factors are affected by transmission systems, and are considered to the degree possible in siting of ROWs, including but not limited to proximity to existing or planned human development (e.g., for residential housing, churches, schools, cemeteries, shopping centers, or industrial developments), concerns over electromagnetic fields and induced current shock hazards, and potential issues related to environmental justice.

Transmission lines can also affect farm operations and increase costs for the farm operator. Potential impacts depend on the transmission line design and the type of farming. Transmission lines can affect field operations, irrigation, aerial spraying, wind breaks, and future land uses. The use of existing ROWs such as railroad lines, roads, pipelines, and existing transmission corridors could possibly be utilized to reduce the impact to land resources, but would not be expected to fully mitigate land use impacts. Therefore, while some of the construction impacts could be mitigated and are temporary, there could be a LARGE environmental impact along new ROW's since zoning plans, prospects for future developments, and incorporation of the ROWs into the existing land use scenarios would have to be considered.

Development of large-scale, land-based wind power facilities also have the potential to alter the use of thousands of acres of land, distributed across a widespread area. The environmental impacts of a large-scale wind farm are described in the GEIS [USNRC 1996, Section 8.3.1]. Wind turbine deployment would alter the existing and future use of the land due to the construction of roads, transmission lines to connect to the regional transmission grid, and turbine tower supports which would result in both short-term and long-term impacts. Construction in undeveloped areas would have the potential to disturb and impact zoning planning and existing and future development options. Some of these may be somewhat mitigated by proper planning during siting of wind farms, but some permanent land use alterations are unavoidable.

Land use requirements for wind generation and its associated grid system are quite large compared to fossil-fuel and nuclear plants. The construction of roads, laydown areas and turbine tower supports would result in short-term impacts. The average land use required for the wind development is about 84 ± 54 acres per megawatt (or 30 to 138 acres per megawatt) of installed capacity. The total direct impact area (both temporary and permanently disturbed land) is approximately 0.75 to 4.2 acres per megawatt due to the land occupied by turbines, access roads, and other equipment and the land disturbed during construction. In general, the capacity density for wind energy deployment is approximately 3.4 to 12.2 megawatts per square mile. [NREL 2009] Assuming using wind as the only renewable source to generate the equivalent of GGNS' net output of 1,475 MWe base-load power plus an additional 1,475 MWe of excess generation to provide the power for energy storage, the deployment would require from 88,500 to 407,100 acres, with about 2,213 to 12,390 acres occupied by turbines and support facilities. Based on the average deployed capacity density, 2,950 MWe of wind to replace GGNS' generation would require from 242 to 868 square miles if it were assumed that the wind generation had the same capacity factor as GGNS. In reality, wind has a much lower capacity factor, and thus the actual amount of land use would be much greater unless energy storage could be utilized to address the intermittency of wind energy generation.

Wind turbine deployment is traditionally in a rural setting where the existing use is predominantly agricultural cropland with scattered residences and woodlots, or forested ridge lines. Located in a rural area, the change in land use would be locally apparent and could include displacement of cropland. In a rural setting, a substantial buffer with respect to incompatible land uses (e.g., residential use) could be provided and destabilization of overall land use would not be expected. Agricultural practices could continue along most of the area occupied by wind farms and offsite ROWs. However, as the more favorable lands are utilized, future options for wind energy deployment may be more restricted by existing and future land use or plans, especially near urban areas. In addition, since the wind power generation would have to be maintained throughout the 20-year license renewal period and likely beyond, the total land use would be permanently affected, limiting its use for other purposes. The impacts of the wind farms, similar to those described above in the discussion of construction and operation of an interconnected grid, would add to the overall cumulative impacts.

Partially offsetting these offsite land requirements would be the elimination of the need for uranium mining to supply fuel for GGNS. The GEIS estimates that approximately one acre per MWe would be affected for mining and processing the uranium during the operating life of a nuclear power plant [USNRC 1996, Section 8.3.12]. Therefore, for uranium mining and processing associated with fuel for GGNS, approximately 1,475 acres of land would be required. This is compared to from 88,500 to 407,100 acres for wind farm land use estimated above.

Commitment of land would also be required for the CAES facility needed for backup power. If existing mines or subterranean compressed air reservoirs are utilized, these would limit other uses, such as for natural gas CO_2 storage. The pressures involved in the subsurface storage could result in concerns about other environmental impacts, such as spread of contaminants into fresh water supplies similar to the concerns alleged in shale oil and gas production. Regardless, the CAES facility would require additional land to support the air storage, turbines, and ancillary operational equipment and structures required. This adds to the cumulative land use impacts.

Based on this data, the overall impacts of land use from construction and operation of the representative land-based wind power facilities, CAES and transmission system at alternative sites would depend on their locations and could range from MODERATE to LARGE.

Potential impacts of offshore wind energy deployment may be similar to those associated with onshore wind power. A portion of the transmission system would be constructed offshore and would likely consist of buried or submerged cable. Environmental concerns include impacts on marine life, coastal terrestrial communities, avian communities, aesthetics, fishing impacts, boating and yachting safety, due to the impacts from construction and maintenance [USDOI 2009, Executive Summary]. The full range of potential environmental impacts from offshore wind is unknown today in the U.S., since no projects have yet been installed. The only project evaluated thus far is discussed in the Cape Cod Wind Energy final environmental impact statement (FEIS) prepared by the U.S. Department of Interior Minerals Management Service. The document, released in January 2009, did not identify any significant impacts, but a range of specific mitigation measures and monitoring studies are proposed. The classification of impact categories (negligible, minor, moderate, major) in the Cape Cod Wind FEIS is slightly different than that used for USNRC license renewal (SMALL, MODERATE, LARGE) but is similar enough for comparison. [USDOI 2009, Executive Summary]

The Cape Cod Wind Energy FEIS indicated the offshore land use impacts from wind energy development would be generally negligible to moderate (impact to commercial fishing was moderate), while onshore impacts would also be negligible to moderate (moderate for communications radar). Overall, the offshore land use impacts of offshore wind energy generation and transmission could be similar to the Cape Cod Wind project and would be expected to be SMALL to MODERATE. Any new onshore transmission required to deliver power to the CAES facilities and wheel the power to the GGNS ROI would be expected to be similar to that described above, or MODERATE to LARGE. Therefore, overall land use impacts associated with an offshore wind facility, CAES and transmission system could range from SMALL to LARGE.

Although most land use impacts associated with a single wind farm are typically SMALL or can be mitigated, the cumulative impacts from several wind farms that would be needed to support an interconnected grid system could be LARGE due to the number of wind turbines required, the transmission system needed for the interconnection, and the CAES needed for backup power.

Therefore, overall land use impacts to replace GGNS generation with interconnected onshore and/or offshore wind, CAES and transmission system would range from SMALL to LARGE.

8.1.4.2 Ecology

Siting of the wind energy generation and its transmission interconnections with the grid would disturb large land areas as described in Section 8.1.4.1 above. Constructing new transmission lines would cause temporary ecological impacts as would construction of the wind turbines, haul roads and service facilities. Construction in areas not previously disturbed could result in some wildlife habitat loss and fragmentation, reduced productivity, and a local reduction in biological diversity. Some permanent loss of habitat due to road construction, laydown areas and transmission tower pads would occur. Transmission ROWs in forested areas would permanently alter forest ecosystems even after construction is complete due to line maintenance and vegetative management requirements.

8.1.4.2.1 Terrestrial Ecology Impacts

Wetlands occur in many different forms and serve vital functions including storing runoff, regenerating groundwater, filtering sediments and pollutants, and providing habitat for aquatic species and wildlife. The construction and maintenance of transmission lines or siting of wind turbines can damage wetlands in the following ways [PSCW]:

- Heavy machinery can crush wetland vegetation and wetland soils.
- Wetland soils, especially very peaty soils, can be easily compacted, increasing runoff, blocking flows, and greatly reducing the wetland's water holding capacity.
- The construction of access roads can change the quantity or direction of water flow, causing permanent damage to wetland soils and vegetation.

- Construction and maintenance equipment that crosses wetlands can stir up sediments, endangering fish and other aquatic life.

- Transmission lines can be collision obstacles for sandhill cranes, waterfowl and other large water birds.

- Clearing forested wetlands can expose the wetland to invasive and shrubby plants, thus removing habitat for species in the forest interior.

- Vehicles and construction equipment can introduce exotic plant species. With few natural controls, these species may out-compete high-quality native vegetation, destroying valuable wildlife habitat.

Any of these activities can impair or limit wetland functions. Organic soils consist of layers of decomposed plant material that formed very slowly. Disturbed wetland soils are not easily repaired. [PSCW] It would be expected that any construction of facilities within wetland areas would be controlled and mitigated under the USACE Section 404 permitting process and would therefore be minimized.

Migratory bird, eagle and raptor, and bat mortality are potential impact issues related to wind turbines. The deaths of birds and bats at wind farm sites have raised concerns by fish and wildlife agencies and conservation groups. USFWS estimates indicate that wind turbine rotors kill 33,000 birds annually [USFWS 2002]. Concerns of the potential impacts of wind power deployment have led the USFWS to release draft guidance that provides agency employees, developers, federal agencies, and state organizations information for reviewing and selecting sites for utility-scale and community-scale wind energy facilities to avoid and minimize negative impacts to fish, wildlife, plants and their habitats [USDOI 2011]. Direct effects include blade strikes, barotrauma, loss of habitat, and "displacement." Indirect effects occur later in time and include introduction of invasive vegetation that result in alteration of fire cycles; increase in predators or predation pressure; decreased survival or reproduction of the species; and decreased use of the habitat that may result from effects of the project or resulting "habitat fragmentation." [USFWS 2011] Strikes to high tension transmission and distribution lines also lead to additional avian mortality [USFWS 2002]. Cumulative terrestrial ecological impacts of replacement wind power from new transmission lines to interconnect wind farm sites and the mortality, avoidance, and barotrauma associated with turbines, along with other ecological impacts mentioned above may range from MODERATE to LARGE. While the impacts to terrestrial ecological communities can be mitigated to different degrees depending on the siting of both wind turbines and transmission lines, cumulatively, the incremental increase of wind power as a replacement alternative to GGNS coupled with the overall impacts from nationwide wind development projects may lead to impacts that could range from MODERATE to LARGE.

Potential impacts of offshore wind energy deployment may be similar to those associated with onshore wind power. However, a portion of the transmission system would be constructed offshore and would likely consist of buried or submerged cable. Environmental concerns include impacts on marine life, coastal terrestrial communities, avian communities, and fishing impacts, due to the impacts from construction and maintenance [USDOI 2009].

The Cape Cod Wind Energy FEIS indicated generally negligible impacts would be expected to terrestrial ecosystems due to offshore wind energy development, with the exception of avifauna. The impacts to raptors might be negligible, but the impact to other avian species could be negligible to moderate, with the potential impacts to certain species of marine birds being negligible to major. [USDOI 2009] Thus, it would be expected that the potential terrestrial ecological impact associated with offshore wind energy development as replacement power for GGNS, when the onshore transmission and CAES facilities are also included, could range from SMALL to LARGE.

While many of the impacts could be mitigated through siting restrictions, best management practices, and permitting compliance, the overall terrestrial ecological impacts associated with construction and operation of onshore and/or offshore wind energy generation facilities, CAES, and transmission system needed to provide replacement power to GGNS' ROI would be expected to range from SMALL to LARGE.

8.1.4.2.2 Aquatic Ecology Impacts

Ecological communities along transmission line crossings of creeks, streams, rivers, and lakes could be disturbed during construction, as could adjacent waterbodies near wind generation sites. Water quality can be affected not only by work within a wetland or waterbody but also by nearby clearing and construction activities. The removal of adjacent vegetation can cause water temperatures to rise and negatively affect aquatic habitats. It can also increase erosion of adjacent soils, causing sediment to be deposited into the waterbody especially during rain events. These construction impacts to aquatic ecological communities could be mitigated through impact avoidance during site selection and best management practices to minimize impacts. Operational impacts from wind and the interconnected transmission systems could occur due to maintenance activities for vegetative management. However, these operational impacts could also be managed by best management practices and proper use of herbicides by certified applicators. The onshore aquatic ecological impacts due to construction and operation of new transmission systems and wind farms would be expected to be SMALL.

For the CAES facility, however, impacts to aquatic ecological resources would be expected to be similar to an equivalently sized natural gas-fired generation facility (i.e., one of equivalent use of natural gas) due to the need for cooling water intake and discharge. Impacts would vary depending on the water body, its size, other potential uses, and the potential threatened and endangered species that might be affected. The most significant potential impacts to aquatic communities relate to operation of the cooling water system. The cooling system for the plant would be designed and operated in compliance with the Cooling Water Act (CWA), including NPDES permitting limitations for physical and chemical parameters of potential concern and provisions of CWA Sections 316(a) and 316(b), which are respectively established to ensure appropriate protection of aquatic communities from thermal discharges and cooling water intakes. Also, the siting, design, and operation of the plant would be subject to USEPA or other state environmental agency's rules. Due to the potential for cumulative impacts and impacts to threatened and endangered aquatic species, potential impacts to small waterbodies, or low flow streams, the aquatic ecological impact for the CAES facility could range from SMALL to MODERATE.

Therefore, overall aquatic ecological impacts associated with a land-based wind facility, CAES and transmission system could range from SMALL to MODERATE.

Potential aquatic ecological impacts of offshore wind energy deployment may be similar to those associated with onshore wind power. However, a portion of the transmission system would be constructed offshore and would likely consist of buried or submerged cable. Environmental concerns include impacts on marine mammals, fish, and other subtidal offshore resources due to construction and maintenance [USDOI 2009].

The Cape Cod Wind Energy FEIS indicated generally negligible to minor impacts would be expected to aquatic/marine ecosystems due to offshore wind energy development, with the exception of the impacts due to pollution from spills which was estimated to be minor to moderate [USDOI 2009]. Thus, the marine ecological impacts from offshore deployment of wind energy generation for GGNS replacement power could range from SMALL to MODERATE. As noted elsewhere, the replacement of GGNS base-load power would also require onshore transmission and CAES, for which the impacts to aquatic ecology could range from SMALL to MODERATE. Thus, it would be expected that the potential aquatic ecological impact associated with offshore wind energy development as replacement power for GGNS, when the onshore transmission and CAES facilities are also included, could range from SMALL to MODERATE.

While many of the impacts could be mitigated through siting restrictions, best management practices, and with regulatory and permitting compliance, the overall aquatic ecology impacts associated with construction and operation of onshore and/or offshore wind energy generation, CAES, and transmission systems needed to provide replacement power to GGNS' ROI would be expected to range from SMALL to LARGE.

8.1.4.3 Water Use and Quality—Surface Water

8.1.4.3.1 Surface Water and Quality

Wind generation and transmission line operations do not require cooling water or intake or discharge structures. Therefore, there would be little impact on water use due to onshore wind generation and transmission.

Construction of wind turbines, the CAES facility, access roads and laydown areas, operation and maintenance facilities, and operation and maintenance of transmission lines could have an impact on water quality due to erosion, sedimentation and accidental release of petroleum products or other chemicals during construction activities.

Water quality can be impacted not only by work activities within a lake or river but also by nearby clearing and construction activities. The removal of adjacent vegetation can cause water temperatures to rise and negatively affect aquatic habitats. It can also increase erosion of adjacent soils causing sediment to be deposited into the waterbody, especially during precipitation events. Construction often requires the building of temporary bridges across small channels, which if improperly installed may damage banks and cause erosion. There could be a need for significantly greater maintenance. These impacts would be minimized by using best management practices during construction activities. It would be expected that proper erosion and spill prevention practices would be maintained during construction to ensure those environmental impacts are minimized.

CAES have cooling towers associated with the use of natural gas turbines to produce electricity and compressors to recharge the storage structure. These cooling towers are much smaller than those typically used for coal- and gas-fired generation plants. Cooling makeup water evaporative losses and discharge flows for the plant would be considerably less than that of GGNS, primarily because less power would be derived from a steam cycle.

Construction activities would be regulated under the CWA stormwater permitting process and oil pollution prevention regulations, along with the restrictions provided by the RCRA and Toxic Substance Control Act to ensure protection of water resources. During CAES operation, cooling water intake and wastewater discharges would be regulated under the federal CWA and corresponding state programs by an NPDES permit.

Potential water use or water quality impacts of offshore wind energy deployment may be similar to those associated with onshore wind power. Environmental concerns include impacts associated with spills due to construction and maintenance activities, although these would be mitigated by permitting regulations and best management practices such that the expected impacts related to offshore wind energy generation would be SMALL [USDOI 2009].

As noted elsewhere, the replacement of GGNS base-load power would also require an onshore transmission system and CAES, for which the impacts to surface water use and quality would be expected to be SMALL. Thus, it would be expected that the potential surface water use and quality impact associated with offshore wind energy development as replacement power for GGNS, when the onshore transmission system and CAES facilities are also included, would be SMALL.

Overall, the impacts from construction and operation of onshore and/or offshore wind generation facilities, CAES representative plant and transmission system on surface water use and quality would be SMALL.

8.1.4.3.2 Groundwater Use and Quality

Groundwater resources would not likely be affected during construction of the transmission system or wind energy generation facilities, with the potential exception of spills of petroleum products or herbicide application associated with vegetative management activities.

Impacts to groundwater use and quality would likely depend on the characteristics of local aquifers and whether the CAES plant would use groundwater for cooling or potable water supply purposes. Most states allocate or regulate groundwater use through a registration and permitting program. Groundwater use would be managed by state or local authorizations that ensure conflicts are minimized. Best management practices would likely be implemented to minimize spills and releases. The greatest potential for groundwater impact could be related to the use of subsurface mines or caverns for the compressed air storage, especially if there were already existing nearby groundwater contamination from past mining activities, nearby waste disposal activities, nearby oil and gas exploration and production activities, or if there were saltwater in close proximity to fresh groundwater supplies. If the pressures within the mine or cavern(s) used for the CAES were allowed to influence the hydraulic pressures of the local groundwater regimes, there could be unexpected and unintended impacts. Unintended release of compressed air in the subsurface could cause contamination from nearby sources to be forced into groundwater or surface water resources. These potential impacts would be controlled by site selection and engineering controls, so the most likely impacts would be SMALL. Therefore, the impacts to groundwater use and quality would be expected to be SMALL.

Overall, the environmental impacts to groundwater use and quality from onshore and/or offshore wind energy generation, transmission system, and CAES should be SMALL.

8.1.4.4 Air Quality

Air quality could be temporarily affected in localized areas during the construction of the wind turbines, transmission system, and the CAES facilities. The construction of roads, transmission lines, and turbine tower supports would result in short-term impacts in air quality. Construction of the various facilities would be distributed across the area of the interconnected wind energy generation and transmission system. However, localized impacts may be more significant, depending upon the area.

A recent air quality evaluation for the Pacific Wind Energy Project (PWEP) in Kern County, California, identified air quality impacts, some of which could be significant. Since few empirical data are available on actual air emissions from wind energy projects, the PWEP project offers illustration of potential air quality impacts. Those impacts would be of concern if a particular wind farm were constructed near or within an area that is in non-attainment with the National Ambient Air Quality Standards and where a State Implementation Plan (SIP) requires controls of certain pollutants. Based on the PWEP evaluation, construction activities would generate short-term emissions of criteria pollutants. Particulates would be generated from excavation and site grading, and exhaust emissions would be generated from construction equipment and vehicular trips to and from the proposed project site. The daily emissions of volatile organic compounds (VOCs) associated with the construction activities would likely be below the emission thresholds of significance and, as such, would be expected to result in a less than significant impact to air quality during construction. However, the daily emissions of NO_x and the annual emissions of PM_{10} associated with the construction activities could be above thresholds of significance and, as such, would be expected to result in a significant impact to air quality during construction. [ENXCO]

Based on the PWEP evaluation, operation of a wind farm could result in emissions of criteria pollutants due to maintenance activities and vehicular trips to and from the wind farm site. The daily emissions of VOCs and the annual emissions of PM_{10} associated with the proposed project's operational activities may be below the daily thresholds of significance and, as such, would be expected to result in a less than significant impact to air quality during operation. However, the daily emissions of NO_x associated with the wind farm's operational activities might be above the SIP thresholds of significance and, as such, may result in a significant impact to air quality during operation and maintenance. [ENXCO] While the actual emissions from a wind farm might be offset to some degree by the reduction of personnel at GGNS, the impact of the emissions of NO_x during operation and maintenance of the wind farm could be more significant if the emissions exceed the SIP provisions for that area. Therefore, the potential air quality due to construction and operation of wind energy facilities and transmission systems could range from SMALL to MODERATE depending on project proximity to non-attainment areas.

A gas turbine generation system utilizing CAES will emit the same types of pollutants as a conventional gas turbine generation facility. However, because a CAES gas turbine facility consumes about two-thirds less fuel than a standard gas turbine facility, the total amount of air pollutants emitted from the CAES facility will be approximately one-third of that emitted by a standard gas turbine generator of the same power rating. [Beckwith] CAES facilities use natural gas which is a relatively clean-burning fuel with nitrogen oxides being the primary focus of combustion emission controls. As noted in the GEIS, air quality impacts for all natural gas technologies are generally less than for other fossil technologies of equal capacity because fewer pollutants are emitted [USNRC 1996, Section 8.3.10]. However, the emissions of regulated pollutants would still be greater than those from GGNS.

The NES facility will convert an idle man-made limestone mine brown-field site into a CAES facility. This facility, which is still in the project development and permitting stage, is planned to eventually provide 804 MW of peaking power generation to Ohio and the East Central Area Reliability region [PEI].

The NES Project CAES facility received an Air Pollution Permit to Install and Operate proposed emission units. The permit (Number P0106714) was issued on September 7, 2010, by the Ohio EPA. The permit establishes emission limitations, air emission controls, monitoring, reporting, and recordkeeping requirements. The proposed emission units established in the permit are based on six combustion trains and one cooling tower. Each combustion train includes a 589 MMBtu/hr combustion turbine, to be operated in a simple-cycle mode, and a 1 MMBtu/hr in-line heater. The combustion turbines and in-line heaters would fire only pipeline quality natural gas. The only other sources associated with this facility are an emergency generator and a back-up firewater pump, both of which would be diesel-fired. [NES]

Maximum permitted emissions (in tons per year) from this facility, based on six combustion trains, are as follows: [NES]

- SO_2 = 42.41 tpy.

- NO_x = 93.67 tpy.
- CO = 90.36 tpy.
- $PM_{10}/PM_{2.5}$ = 46.65 tpy.
- VOCs = 26.40 tpy.

The NES facility would also have an induced draft mechanical wet cooling tower subject to particulate emissions limits of 4.28 tons per year. Thus the total permitted particulate emissions for the facility are as follows [NES]:

- $PM_{10}/PM_{2.5}$ = 50.93 tpy.

Maximum emissions of each criteria pollutant to be emitted from the proposed NES facility would be below the 100 tons per year major source threshold, and emissions of HAPs would be below the single HAP threshold of 10 tpy and the aggregate of 25 tpy of total HAPs. As such the facility is currently permitted as a minor source. The emissions from the proposed facility would not cause or contribute to an exceedance of the National Ambient Air Quality Standards and would not cause levels of toxic pollutants to exceed the state-regulated Threshold Limit Values.

Based on the current air permit, it is estimated that CO_2 annual emissions from all sources would be approximately 1,814,108 tons. However, these CO_2 emissions could change if different equipment is used during plant operations.

While replacement wind energy generation and transmission construction and operational phases would not be expected to result in substantial increases in GHG emissions, GGNS also contributes almost no greenhouse gases. However, the operation of the CAES would be expected to have a net increase in GHG emissions when compared to GGNS.

Potential CAES development in depleted oil and gas fields raises questions and concerns and highlights the need for CAES-specific air emissions regulation. Kansas promulgated proposed air emission regulations for CAES facilities in 2010. The proposed Kansas regulations state that research is yet to be done on what level of risk CAES may pose to the public health or the environment. However, what is known is the nature and presence of hydrocarbon constituents trapped in liquid and gaseous forms underground, particularly in oil and gas fields where CAES facilities in Kansas likely would be located. The proposed regulation would ensure monitoring and control of any VOCs or HAPs that may be emitted as a result of a CAES facility's operation. [KDHE].

Therefore, based on available information, the overall air quality impact due to construction and operations of interconnected wind energy generation, transmission system and CAES could range from SMALL to LARGE, depending on local non-attainment status and whether the CAES facility causes unintended releases of VOCs or other emissions associated with the use of oil and gas fields.

8.1.4.5 Waste

Construction of wind farms and transmission lines could result in the generation of large amounts of waste vegetation from land clearing activities. If this material is managed correctly (e.g., recycled or composted), then the impacts should be SMALL.

All wind energy projects would generate solid and hazardous wastes and involve the shipment, storage, use, and disposal of hazardous materials. It would also be expected that wastes would be generated from offshore development of wind, similar to that of onshore development. However, best management practices for addressing these activities would effectively mitigate potential impacts. Waste volumes would likely be limited compared with other wastes generated regionally, particularly if wastes generated during decommissioning of turbines and ancillary structures were recycled for other uses. As a result, cumulative impacts resulting from hazardous material use and waste generation would be SMALL.

Like natural gas-fired generation, a CAES site would result in minimal waste generation, producing minor (if any) impacts (USNRC 1996, Section 8.3.10). As a result, waste management impacts from the operation of the representative CAES plant would be SMALL.

Overall, onshore and/or offshore wind generation, transmission system, and CAES facilities would potentially generate solid and hazardous waste. However, waste impacts are expected to be SMALL due to regulations, permitting and best management practices that would govern waste activities.

8.1.4.6 Human Health

The GEIS analysis of wind energy generation states that except for a potential small number of occupational injuries, human health would not be affected by operations. [USNRC 1996, Section 8.3.1] It is expected that the CAES would have similar human health risks as the natural gas-fired alternative of equivalent natural gas utilization with a potential for increased cancer and emphysema. The risk may be attributable to NO_x emissions that contribute to ozone formation, which in turn contributes to health risks. As discussed in Section 8.1.2 for the natural gas-fired alternative, legislative and regulatory control of the nation's emissions and air quality are protective of human health, and the human health impacts during the construction and operational period would be SMALL; that is, human health effects would not be detectable or would be so minor that they would neither destabilize nor noticeably alter important attributes of the resource.

8.1.4.7 Socioeconomics

Wind power developments on rural lands could potentially produce adverse cumulative impacts on other commercial uses of these lands and adjacent lands, including agriculture, forestry, mining, oil and gas development, electric power generation and transmission line facilities, recreation, and residential development. Quantification of these impacts depends on the location and economic variables (e.g., the price of renewable [forest products] and nonrenewable [fossil energy] natural resources) and policy variables, such as federal and state legislation of natural resources. Major sources of potential socioeconomic impacts from the construction of an interconnected transmission systems, wind farms, and the CAES would include temporary increases in jobs, economic activity, and demand for housing and public services in communities surrounding the installation process during the construction period. Operations of these systems would also result in potential increases in jobs, economic activity, taxes, and demand for housing and public services in communities surrounding the various facilities; however, due to the distributed nature of the facilities, the local beneficial or adverse socioeconomic impact may be lessened. Countering these increases are losses in permanent jobs, tax revenues, and economic activity attributable to operation of GGNS. The loss of jobs and tax revenue could be significant to the communities near GGNS and thus have an impact that would range from MODERATE to LARGE.

8.1.4.8 Aesthetics

Visual resources could be affected by wind energy projects. The heights, type, and color of turbines, together with their placement with respect to local topography (i.e., on a ridge or mesa), are factors that would contribute to visual intrusion on the landscape. Also, the need for additional transmission lines to connect wind energy projects to the regional power grid could contribute to cumulative impacts. The level of public acceptance of visual impacts may vary considerably from project to project. Depending on the number and height of turbines and transmission line towers in these viewsheds, wind farms could result in cumulative impacts on visual resources. [USDOI 2005, Chapter 6]

Visual impacts are intangible, highly subjective, and dynamic, and because they cannot be completely avoided, they are one of the greatest sources of objection to wind energy development projects. During construction, there are several possible sources of visual impacts. Road development (new roads or expansion of existing roads) may introduce strong visual contrasts in the landscape, depending on the route relative to surface contours, and the width, length, and surface treatment of the roads. Site development may be progressive, persisting over a significant period of time. It may also be intermittent, staged, or phased, giving the appearance that work starts and stops. Repeated visual experiences may provoke perceptions of lost benefit and productivity, like that alleged for idle equipment. Timing and duration concerns may result. There would be a temporary presence of large cranes or a self-erection apparatus to assemble and mount towers, nacelles, and rotors. Duration may be short, depending on the number of turbines. All such equipment would produce emissions while operational and may thus create visible exhaust plumes. There may also be a temporary presence of support facilities and fencing associated with the construction work site. [USDOI 2005, Section 5.11]

Ground disturbance would result in visual impacts that produce contrasts of color, form, texture, and line. Excavating for turbine foundations and ancillary structures; trenching to bury electrical distribution systems; grading and surfacing roads; clearing and leveling staging areas; and stockpiling soil and spoils (if not removed) would (1) damage or remove vegetation, (2) expose bare soil, and (3) suspend dust. Destruction and removal of vegetation due to clearing, compaction, and dust are expected. Soil scars and exposed slope faces would result from excavation, leveling, and equipment movement. Invasive species may colonize disturbed and stockpiled soils and compacted areas. These species may be introduced naturally or in seeds, plants, or soils introduced for intermediate restoration, or by vehicles. The land area or footprint of installed equipment would be typically small, as little as 5 to 10% of the site, but could be susceptible to broader disturbance and alteration over longer periods of time. Site restoration activities would reduce many of these impacts. [USDOI 2005, Section 5.11]

Wind energy development projects on rural lands would be highly visible because of the introduction of turbines into typically rural or natural landscapes, many of which have few other comparable structures. The artificial appearance of wind turbines may have visually incongruous "industrial" associations for some, particularly in a predominantly natural landscape. Visual evidence of wind turbines cannot be avoided, reduced, or concealed, owing to their size and exposed location; therefore, effective mitigation could be limited. [USDOI 2005, Section 5.11]

All aboveground ancillary structures (including fences around substations) would potentially produce visual contrasts by virtue of their design attributes (form, color, line, and texture) and by virtue of the reflectivity of their surfaces and resulting glare. If security and safety lighting are used, even if they are downwardly focused, visibility of the site would increase, particularly in dark nighttime sky conditions typical of rural areas. It would also contribute to sky glow resulting from ambient artificial lighting. Any degree of lighting would produce off-site "light trespass"; it would be most abbreviated, however, if the lighting were limited to just the substation and controlled by motion sensors. [USDOI 2005, Section 5.11]

Federal Aviation Administration (FAA) rules would require lights mounted on nacelles that flash white during the day and twilight (20,000 candela) and red at night (2,000 candela). White lights would be less obtrusive in daylight, but red lights would likely be conspicuous at great distances against dark skies. Typically, the FAA requires warning lights on the first and last turbines in a string and every 1,000 to 1,400 feet in between. Although these beacons would concentrate light in the horizontal plane, they would increase visibility of the turbines, particularly in dark nighttime sky conditions typical of rural areas. Beacons would likely not contribute (because of intermittent operation) to sky glow resulting from artificial lighting. The emission of light to off-site areas could be considerable. [USDOI 2005, Section 5.11]

Towers, nacelles, and rotors may need to be upgraded or replaced, thereby repeating initial visual impacts of construction and assembly. Opportunity and pressures to break uniformity between turbines and among components (different sizes, styles, and mixes) may be greater than during initial construction, thus potentially increasing visual contrast and visual "clutter." Additional construction and installation of monitoring equipment may be required to optimize measurements (change locations) or to replace or upgrade equipment. Repeated visual evidence of disturbance would result. Infrequent outages, disassembly, and repair of equipment may occur. These may produce the appearance of idle or missing rotors, "headless" towers (when nacelles are removed), and lowered towers. Negative visual perceptions of "lost benefits" (e.g., loss of wind power) and "bone yards" (for storage) may result. [USDOI 2005, Section 5.11]

Potential aesthetic impacts of construction and operation of a CAES plant may include visual impairment resulting from the presence of a large industrial facility, including multiple exhaust stacks and mechanical-draft cooling towers with associated condensate plumes. Considering the flat topography in many areas where a CAES may be placed, the stacks and condensate plumes would likely be visible for several miles from the site; new transmission lines constructed to connect the plant to the grid would also be relatively visible for the same reason, though would not be out of character for most rural areas.

Overall, the impacts to aesthetics from construction and operation of a series of wind generation facilities, transmission system and the CAES site would depend on location and could range from MODERATE to LARGE.

8.1.4.9 Cultural Resources

While impacts to cultural resources are determined on a site-specific basis, certain activities associated with wind energy development have a greater potential for adversely affecting cultural resources than others, assuming such resources are present in the project area. Earthmoving activities (e.g., grading and digging) have the highest potential for disturbing or destroying significant cultural resources; however, pedestrian and vehicular traffic and indirect impacts of earthmoving activities, such as soil erosion, may also have an effect. Visual impacts on significant cultural resources, such as sacred landscapes, historic trails, and viewsheds from other types of historic properties (e.g., homes and bridges) may also occur. [USDOI 2005, Section 5.12]

The construction of the infrastructure necessary for wind energy development has the greatest potential to impact cultural resources because of the increased ground disturbance. The amount of area disturbed could be considerable and would destroy cultural resources if they were present in that area. The development of a wind energy project and its associated access roads would provide access to areas that might have been previously inaccessible. Any increase in the presence of humans in an uncontrolled and unmonitored environment containing significant cultural resources increases the potential for adverse impacts caused by looting (unauthorized collection of artifacts), vandalism, and inadvertent destruction to unrecognized resources. [USDOI 2005, Section 5.12]

In addition, visual impacts on cultural resources could occur during the construction phase. Large areas of exposed ground surface, increases in dust, and the presence of large-scale machinery, equipment, and vehicles could contribute to an adverse impact on cultural resources (e.g., those with a landscape component that contributes to their significance, such as a historic trail or sacred landscape). [USDOI 2005, Section 5.12]

Before construction at a wind development site, studies would be needed to identify, evaluate, and address mitigation of the potential impacts of new construction on cultural resources. The studies would be needed for areas of potential disturbance at the proposed site and along associated corridors where new construction would occur (e.g., roads, transmission corridors, rail lines, or other ROWs). Overall, construction and operational impacts on historic and archeological resources can generally be effectively managed and as such are considered SMALL.

Table 8.1-9
Summary of Environmental Impacts from Wind with CAES at Alternate Site

Impact Category	Impact	Comments
Land Use	SMALL to LARGE	~1,818 acres per 100 miles needed for transmission line ROW. From 88,500 to 407,100 acres for wind turbines and support facilities plus additional land for the CAES facility. ROWs would affect zoning plans, prospects for future developments, and existing land use scenarios.
Ecology	SMALL to LARGE	Impact will depend on ecology of the wind turbine sites (especially avian ecology), transmission lines, and CAES facility.
Surface Water Use and Quality	SMALL	Construction impacts minimized in accordance with regulatory protocols and best management practices. Cooling water not required for wind turbines. Cooling make-up water evaporative losses and discharge flows for the CAES facility would be considerably less than that of GGNS.
Groundwater Use and Quality	SMALL	Construction impacts minimized in accordance with regulatory protocols and best management practices. Impacts associated with CAES facility would be controlled by site selection and engineering controls.
Air Quality	SMALL to LARGE	Construction and operational impacts of wind energy facilities and transmission systems dependent on project proximity to non-attainment areas. Gas turbine associated with CAES facility would emit primary air pollutants including greenhouse gases. Dependent on location, CAES facility may also cause unintended releases of VOCs or other emissions associated with the use of oil and gas fields.
Waste	SMALL	Only small amounts of solid waste products. Best management practices would effectively mitigate potential impacts.
Human Health	SMALL	Regulatory controls and oversight would be protective of human health.

Table 8.1-9
Summary of Environmental Impacts from Wind with CAES at Alternate Site

Impact Category	Impact	Comments
Socioeconomics	MODERATE to LARGE	Commercial uses of lands (i.e., agriculture, forestry, mining, oil and gas development, recreation, and residential development) impacted. Beneficial or adverse impacts may be lessened due the distributed nature of the facilities. Loss of jobs and tax revenue associated with GGNS would be significant to nearby communities.
Aesthetics	MODERATE to LARGE	Construction activities would change aesthetics of natural landscape. Mitigation of wind turbine aesthetics is limited due to their size and exposed location. CAES facility stacks and condensate plume would be visible from several miles.
Historic and Archaeological Resources	SMALL	Any potential impacts can be effectively managed.

8.1.5 Purchased Electrical Power

"Purchased power" is power purchased and transmitted from electric generation plants that the applicant does not own and that are located elsewhere within the region, nation, Canada, or Mexico. If power to replace GGNS capacity were to be purchased from sources within the U.S. or a foreign country, the generating technology would likely be one of those described in this ER and in the GEIS (probably coal, natural gas, or nuclear). The description of the environmental impacts of other technologies in Chapter 8 of the GEIS is representative of the purchased power alternative to renewal of the GGNS OL. Thus, the environmental impacts of purchased power would still occur but would be located elsewhere within the region, nation, or another country.

If the purchased power alternative were implemented, the only environmental unknown is whether new transmission line ROWs would be required. The construction of these lines could have both environmental and aesthetic consequences, particularly if new transmission line ROWs have to be acquired. Therefore, the local environmental impacts from purchased power would be SMALL when existing transmission line ROWs are used and could range from SMALL to LARGE if acquisition of new ROWs is required. The environmental impacts of power generation would depend on the generation technology and location of the generation site and, therefore, are unknown.

For the reasons discussed above, Entergy does not believe that purchasing power to replace the generation at GGNS is a reasonable alternative to providing new base-load power generation capacity.

8.2 Alternatives Not Within the Range of Reasonable Alternatives

Other commonly known generation technologies considered are listed in the following paragraphs. However, these sources have been eliminated as reasonable alternatives to the proposed action because the generation of approximately 1,475 net MWe of electricity as a base-load supply using these technologies is not technologically feasible. It should also be noted that the states of Louisiana and Mississippi do not have established renewable energy standards [PEW]. As noted in Section 8.0, the goal of the proposed action (license renewal) is the continued production of approximately 1,475 net MWe of base-load generation, which includes the anticipated EPU scheduled for 2012. The impacts of alternatives that would not reasonably be available for production of replacement base-load power are not considered in detail.

8.2.1 Wind

Relatively recent concerns related to climate change and energy independence in the U.S. has led to development of alternative electric power generation options. Most significant of these alternatives is wind power generation, which produces no greenhouse gases during operation. However, as currently deployed or under development, significant wind power generation centers are not located within the GGNS service area.

Entergy's most recent Strategic Resource Plan noted that it is reasonable to expect that renewable generation will become a component of Entergy's long-term supply portfolio over the next decade. However, it is not realistic to assume that renewable generation can satisfy all or even most of Entergy's incremental needs. Conventional generation alternatives will still be a substantial part of the resource portfolios that the Entergy Operating Companies will need to provide reliable and economic service to their customers. In general, renewable generation alternatives are not economically viable when compared to conventional technologies. Further, the intermittent (non-firm / non-dispatchable) nature of some renewable technologies (e.g., wind and solar) create planning and operational issues that serve to effectively increase cost. The inclusion of intermittent technologies in the portfolio would result in additional need for flexible capability. [Entergy 2009c]

Compared with other regions of the country, the Entergy region served by GGNS is not climatically well-situated for wind power [USDOE 2009a]. Mississippi is in a wind power Class 1 region (average wind speeds lower than 5.6 m/s), having the lowest potential for wind energy generation. Although small wind turbines may have applications in some areas of Mississippi, the state does not have sufficient wind resources to use large-scale wind turbines. [USNRC 2006a, Section 8.2.3.2] As of October 2010, there were no grid-connected wind power facilities in Mississippi or Louisiana [AWEA]. Further, neither Mississippi nor Louisiana is suitable for large scale onshore wind energy deployment [USDOE 2011b]. While Louisiana may have suitable conditions for offshore wind power development, its potential along Mississippi's Gulf coast is limited. The data indicating a potential for offshore wind along the Louisiana coast do not include environmental or human use factors such as shipping lanes, marine habitat areas, submerged obstacles, military areas, and ocean-bottom topography. [USDOE 2011c] Based on currently available information, there is no indication that it is reasonable to expect wind power development in sufficient capacity to provide replacement base-load power, either alone or in combination with other renewable energy sources, in the area served by GGNS prior to the expiration of the current license term.

Also as discussed in Section 8.3.1 of the GEIS, wind has a high degree of intermittency and average annual capacity factors for wind plants are relatively low (typically 25–35 percent) as compared to 90–95 percent for a base-load plant such as nuclear. Wind power in conjunction with energy storage mechanisms might serve as a means of providing base-load power. However, current energy storage technologies are too expensive for wind power to serve as a large base-load generator. [USNRC 2006a, Section 8.2.3.2; USNRC 2006c, Section 8.2.5.2]

Proponents of wind power suggest interconnected regional wind farms could someday provide base-load generation. However, any widespread interconnected grid is unlikely to occur prior to 2024. The NERC 2009 Long-Term Reliability Assessment points out that siting of new bulk power transmission lines brings with it unique challenges due to the high visibility, their span through multiple states/provinces and, potentially, the amount of coordination/cooperation required among multiple regulating agencies and authorities. Lack of consistent and agreed upon cost allocation approaches, coupled with public opposition due to land-use and property valuation concerns, have, at times, resulted in long delays in transmission construction. When construction is delayed, special operating procedures to maintain bulk power system reliability may be needed. For example, the American Electric Power Company worked fourteen years to obtain siting approval for a 90-mile 765 kV transmission project, while only two years were required to construct it. Therefore, new transmission, including transmission in the USDOE's designated "National Interest Electric Transmission Corridors," can be delayed or halted by states, increasing the difficulty to site bulk transmission, including those projects focused on unlocking location constrained renewable generation. This creates a potential congestion issue and challenges the economic viability of new generation projects. [NERC]

As noted above, replacement power for GGNS' 1,475 net MWe of base-load power is limited by wind resources within Entergy's service area. Obstacles to construction of bulk transmission make it also unlikely that replacement power can be imported from another region.

Wind power may not provide for grid stability; at the least, the variability of wind generation makes grid stability much more complex when unexpected losses of generation occurs. Wind generation cannot provide contingency or backup reserve power; and due to the increasing potential for sudden unexpected generation losses as the deployment of wind generation increases, increased backup reserve capacity from conventional generation will be needed to maintain an acceptably consistent power on the grid. This makes it unlikely that wind will provide base-load generation within the current GGNS license period, or even within the period of extended operation. [LBNL]

Even if wind capacity were available in the state of Mississippi, development of large-scale, land-based wind power facilities are likely not only to be costly, but could have MODERATE to LARGE impacts on aesthetics, archaeological resources, land use, and terrestrial ecology.

Wind power could potentially be included in a combination of alternatives to replace GGNS, if it were imported power. The environmental impacts of a large-scale wind farm are described in the GEIS [USNRC 1996, Section 8.3.1]. The construction of roads, transmission lines, and turbine tower supports would result in short-term impacts, such as increases in erosion and sedimentation and decreases in air quality from fugitive dust and equipment emissions. Construction in undeveloped areas would have the potential to disturb and impact cultural resources or habitat for sensitive species. During operation, some land near wind turbines could be available for compatible uses such as agriculture. The continuing aesthetic impact would be considerable and there is a potential for bird and bat collisions with turbine blades as discussed in Section 8.1.4.2.1. Wind farms generate very little waste and pose no human health risk other than from occupational injuries. Although most impacts associated with a single wind farm are SMALL or can be mitigated, some impacts such as the continuing aesthetic impact and impacts to sensitive habitats could be LARGE, depending on the location.

For the reasons discussed above, Entergy does not believe that wind power is a reasonable alternative to renewing the GGNS OL.

8.2.2 Solar

Solar technologies use the sun's energy to provide heat, cooling, light, hot water, and electricity for homes, businesses, and industry. Solar power technologies, both photovoltaic and thermal, cannot currently compete with conventional fossil-fueled technologies in grid-connected applications due to higher capital costs per kilowatt of capacity. Capacity factors are low because solar power is an intermittent resource, providing power when the sun is strong, whereas GGNS provides constant base-load power. Solar technologies simply cannot make up for the capacity from GGNS during the night and in overcast conditions. As currently deployed or under development, solar power generation centers are not located within the GGNS service area.

The GGNS site receives approximately 4,500 to 5,000 watt-hr/m^2/day that can be used for flat-plate solar systems and approximately 4,000 to 4,500 watt-hr/m^2/day that can be used for solar concentrating systems. Areas in the southwest U.S. receive up to 7,500 watt-hr/m^2/day. The solar resource in Mississippi can be used for water heating or photovoltaic systems but not for large concentrating solar thermal utility systems. [USNRC 2006a, Section 8.2.3.3]

Solar power is similar to wind power generation in its variability and unsuitability for base-load power. Like wind power, solar power variability makes grid stability much more complex when unexpected losses of generation occur. Solar generation also requires contingency or backup reserve power; and due to the increasing potential for sudden unexpected generation losses as the deployment of solar and wind generation increases, increased backup reserve capacity from conventional generation will be needed to maintain an acceptably consistent power on the grid. This makes it unlikely that solar will provide base-load generation within the current GGNS license period, or even within the period of extended operation. [LBNL]

Solar power generation requires cooling water similar to conventional base-load generation from coal and nuclear power. A coal-fired plant uses 110 to 300 gallons/MWh; a nuclear plant uses from 500 to 1,100 gallons/MWh; and a solar parabolic trough plant uses 760–920 gallons/MWh.

[AWR] Therefore, impacts to aquatic resources would be expected to be similar to base-load fossil or nuclear power and depend on the site location and type of cooling system employed.

There would also be substantial impacts to other resources (terrestrial habitat, land use, and aesthetic impacts) from construction of solar power generation facilities. As stated in the GEIS, land requirements are high. Based on the land requirements of 14 acres for every 1 MWe generated, approximately 20,650 acres would be required to replace the 1,475 net MWe of base-load power produced by GGNS [USNRC 1996, Section 8.3.3]. There is not enough land for either type of solar electric system at the existing GGNS site and both types of systems would have LARGE environmental impacts at an alternate site.

Solar power generation produces no greenhouse gases during operation, but backup generation from fossil plants is required. Emissions (principally PM_{10}) from solar power would be similar to other thermal power generation sources due to emissions from cooling towers necessary for the steam cycle. Particulates emissions could create significant impacts, especially for those areas designated as non-attainment or maintenance areas under the Clean Air Act.

The operating facility would have considerable aesthetic impact. Solar installations pose no human health risk other than from occupational injuries. The manufacturing process for constructing a large amount of photovoltaic cells would result in waste generation, but this waste generation has not been quantified. Some impacts, such as impacts to sensitive areas, loss of productive land, and the continuing aesthetic impact, could be LARGE, depending on the location. Therefore, solar energy is not a reasonable alternative to renewal of the GGNS OL.

8.2.3 Hydropower

Mississippi has a technical potential for 128 MWe of additional installed hydroelectric capacity. This 128 MWe is divided amongst 19 potential sites, with the largest having a potential for 16 MWe. Eighty-four percent of the sites have a potential capacity of less than 10 MWe. [INEL] As stated in Section 8.3.4 of the GEIS, hydropower's percentage of U.S. generating capacity is expected to decline because the facilities have become difficult to site as a result of public concern about flooding, destruction of natural habitat, and alteration of natural river courses.

If the capacity was available in Mississippi, an additional area for potential consideration would be that of hydropump storage. Hydropump storage could be used as an intermediate source, but is not used as base-load power. Siting such a facility could potentially be an issue as well.

The GEIS estimated that land requirements for hydroelectric power are approximately 1 million acres per 1,000 MWe. Replacement of the GGNS generating capacity would therefore require flooding a substantial amount of land (1.475 million acres). Due to the large land-use and related environmental and ecological resource impacts associated with siting hydroelectric facilities large enough to replace GGNS, it can be concluded that local hydropower alone is not a reasonable alternative to the renewal of the GGNS OL, even if the capacity for development were available in Mississippi [USNRC 2006a, Section 8.2.3.4]. Any attempts to site hydroelectric facilities large enough to replace GGNS would result in LARGE environmental impacts.

8.2.4 Geothermal

Geothermal has an average capacity factor of 90 percent and can be used for base-load power where available. However, as illustrated by Figure 8.4 in the GEIS, geothermal plants would primarily be located in the western continental U.S., Alaska, and Hawaii where geothermal reservoirs are prevalent. This technology is not widely used as base-load generation due to the limited geographic availability of the resource and the immature status of the technology. [USNRC 1996, Section 8.3.5] Mississippi may have the potential for the use of geothermal energy in a heating/thermal capacity, but it does not have the potential for development of geothermal powered electricity. [USNRC 2006a, Section 8.2.3.5] Therefore, geothermal energy is not a reasonable alternative to renewal of the GGNS OL.

8.2.5 Wood Energy

The use of wood waste to generate electricity is largely limited to those states with significant wood resources, such as California, Maine, Georgia, Minnesota, Oregon, Washington, and Michigan. Electric power is generated in these states by the pulp, paper, and paperboard industries, which consume wood and wood waste for energy, benefiting from the use of waste materials that could otherwise represent a disposal problem. [USNRC 2006c, Section 8.2.5.6]

A wood-burning facility can provide base-load power and operate with an average annual capacity factor of around 70 to 80 percent and with 20 to 25 percent efficiency. The fuels required are variable and site-specific. A significant barrier to the use of wood waste to generate electricity is the high delivered-fuel cost and high construction cost per MWe of generating capacity. The larger wood-waste power plants are only 40 to 50 MWe in capacity. Estimates in the GEIS suggest that the overall level of construction impact per megawatt of installed capacity should be approximately the same as that for a coal-fired plant, although facilities using wood waste for fuel would be built at smaller scales. Like coal-fired plants, wood-waste plants require large areas for fuel storage and processing and involve the same type of combustion equipment. [USNRC 2006c, Section 8.2.5.6]

Due to uncertainties associated with obtaining sufficient wood and wood waste to fuel a base-load generating facility, ecological impacts of large-scale timber cutting (e.g., soil erosion and loss of wildlife habitat), and high inefficiency, wood waste is not a reasonable alternative to renewing the GGNS OL.

8.2.6 Municipal Solid Waste

Municipal solid-waste combustors incinerate the waste and use the resultant heat to produce steam, hot water, or electricity. The combustion process can reduce the volume of waste by up to 90 percent and the weight of the waste by up to 75 percent. Municipal waste combustors use three basic types of technologies: mass burn, modular, and refuse-derived fuel. Mass burning technologies are most commonly used in the U.S. This group of technologies processes raw municipal solid waste "as is," with little or no sizing, shredding, or separation before combustion. [USNRC 2006a, Section 8.2.3.7]

The GEIS determined that the initial capital costs for this technology are much greater than the comparable steam-turbine technology found at wood-waste facilities. This is due to the need for specialized municipal solid waste-handling and waste-separation equipment and stricter environmental emissions controls. The decision to burn municipal waste to generate energy is usually driven by the need for an alternative to landfills rather than by energy considerations. [USNRC 1996, Section 8.3.7] High costs prevent this technology from being economically competitive.

As of 2007, there are 87 waste-to-energy plants operating in the U.S., none of which are located in Mississippi. These plants generate approximately 2,720 MWe, or an average of approximately 31 MWe per plant, much smaller than needed to replace the approximately 1,475 net MWe of base-load power at GGNS. [IWSA]

Estimates in the GEIS suggest that the overall level of construction impact from a waste-fired plant should be approximately the same as that for a coal-fired plant. Additionally, waste-fired plants have the same or greater operational impacts (including impacts on the aquatic environment, air, and waste disposal). Some of these impacts would be MODERATE. Therefore, municipal solid-waste combustors would not be a reasonable alternative to renewal of the GGNS OL, particularly at the scale required.

8.2.7 Other Biomass-Derived Fuels

In addition to wood and municipal solid waste fuels, there are several other concepts for fueling electric generators, including burning energy crops, converting crops to a liquid fuel such as ethanol (ethanol is primarily used as a gasoline additive for automotive fuel), and gasifying energy crops (including wood waste) [USNRC 2001, Section 8.2.4.7]. The GEIS points out that none of these technologies has progressed to the point of being competitive on a large scale or of being reliable enough to replace a base-load plant such as GGNS. For these reasons, such fuels do not offer a reasonable alternative to renewal of the GGNS OL. In addition, these systems have LARGE impacts on land use.

8.2.8 Oil

Oil-fired operation is more expensive than nuclear or coal-fired operation, which has resulted in a steady decline in its use for electricity generation. Future increases in oil prices are expected to make oil-fired generation increasingly more expensive than coal-fired generation. In addition, increasing domestic concerns over oil security will only exacerbate the move away from oil-fired electricity generation. Therefore, oil-fired generation by itself is not considered a reasonable alternative to the renewal of the GGNS OL.

8.2.9 Fuel Cells

Fuel cells work without combustion and its environmental side effects. Power is produced electrochemically by passing a hydrogen-rich fuel over an anode, passing air over a cathode, and separating the two by an electrolyte. The only by-products are heat, water, and carbon dioxide. Hydrogen fuel can come from a variety of hydrocarbon resources by subjecting them to steam under pressure. Natural gas is typically used as the source of hydrogen. [USNRC 2006c, Section 8.2.5.9]

Phosphoric acid fuel cells are generally considered first-generation technology. Higher temperature, second-generation fuel cells achieve higher fuel-to-electricity and thermal efficiencies. The higher temperatures contribute to improved efficiencies and give the second generation fuel cells the capability to generate steam for cogeneration and combined-cycle operations. [USNRC 2006a, Section 8.2.3.9]

During the past three decades, significant efforts have been made to develop more practical and affordable fuel cell designs for stationary power applications, but progress has been slow. Currently, the most widely marketed fuel cells cost about $4,500 per kW of installed capacity. By contrast, a diesel generator costs $800 to $1,500 per kW of installed capacity, and a natural gas turbine can be even less. [USNRC 2006a, Section 8.2.3.9]

Therefore, at the present time, fuel cells are not economically or technologically competitive with other alternatives for base-load electricity generation. Fuel cells are, consequently, not a reasonable alternative to renewal of the GGNS OL.

8.2.10 Tidal, Ocean Thermal, and Wave

Technologies to harness electrical power from the ocean are tidal power, ocean thermal energy, and wave power conversion. These technologies are still in the early stages of development and are not commercially available to replace a large base-load generator such as GGNS.

Tidal power technologies extract energy from the diurnal flow of tidal currents caused by the gravitational pull of the moon. Unlike wind and wave power, tidal streams offer entirely predictable output. All coastal areas consistently experience two high tides and two low tides over a period of approximately 25 hours. However, because the lunar cycle is longer than a 24-hour day, the peak outputs differ by about an hour each day, and so tidal energy cannot be guaranteed at times of peak demand. [Feller] Tidal power technologies consist of tidal turbines and barrages. Tidal turbines, similar in appearance to wind turbines, are mounted on the seabed. They are designed to exploit the higher energy density, but lower velocity, of tidal flows compared to wind. Tidal barrages are similar to hydropower dams in that they are dams with gates and turbines installed along the dam. When the tides produce an adequate difference in the level of the water on opposite sides of the dam, the gates are opened and water is forced through turbines, which turns a generator. For those tidal differences to be harnessed into electricity, the difference in water height between the high and low tides must be at least 16 feet. There are only about 20 sites on Earth with tidal ranges of this magnitude. [USDOE 2009b, Section 1.3] The only sites with adequate tidal differences within the U.S. are in Maine and Alaska [CEC 2011]. Therefore, tidal resources off the coast of the ROI do not provide a viable tidal energy resource.

Ocean thermal energy conversion (OTEC) technology capitalizes on the fact that water temperatures decrease with depth. As long as the temperature between the warm surface water and the cold deep water differs by about 36°F, an OTEC system can produce a significant amount of power. The most promising locations for OTEC in North America are Hawaii, the U.S.

Virgin Islands and Puerto Rico. [OPM] Therefore, OTEC technology is not considered a viable energy resource for the ROI.

Wave energy conversion takes advantage of the kinetic energy in the ocean waves (which are mainly caused by interaction of wind with the surface of the ocean). Wave energy offers an irregular, oscillatory, low frequency energy source that must be converted to a 60-Hertz frequency before it can be added to the power grid. [CEC 2011] Wave energy resources are best from 30 to 60 degrees latitude in both hemispheres and the potential tends to be greatest on western coasts [RNP]. Offshore technologies that harness the energy of ocean waves and current are in their infancy and have not been used at utility scale. [NREL 2008, pg. 2] Since the late 1990s, new technologies have been introduced to harness the energy of the ocean's waves, currents, and tides. Nearly 100 companies worldwide have joined this effort, but most companies struggle to deploy their first prototypes and not all can be funded from the public sector. A viable strategy to help mature the marine renewable energy industry does not exist [NREL 2008, pg. 8]. Hence, although some technologies may be available in the future, none has yet been demonstrated to be capable of providing the electrical generating capacity needed to replace GGNS' base-load generating capacity.

Therefore, Entergy believes that tidal, ocean thermal, and wave technologies have not matured sufficiently to provide a viable supply of replacement base-load electricity for GGNS. As a result, Entergy has concluded that, due to cost and production limitations, these technologies are not reasonable alternatives to GGNS license renewal.

8.2.11 Delayed Retirement

The amount of generation that Entergy either owns or controls on a long-term basis is currently about 1 GW short of meeting the System's reliability requirement. This assessment is based on the current capability ratings of the existing operating fleet, the expected peak load requirement, and the planning reserve margin target. In addition, capacity requirements are expected to grow by approximately 600 MW/year on average over the next twenty years due to growth in projected peak load and expected deactivation of some of the System's less economic generating units. [Entergy 2009c, pg. 8-7]

Thus, even if substantial capacity were scheduled for retirement and could be delayed, some of the delayed retirement would be needed just to meet load growth. Therefore, any such retirements that do occur in this period would merely act to further increase projected demand.

GGNS would be required, in part, to offset any actual retirements that occur. Delayed retirement of other Entergy generating units would not provide a replacement of the base-load power supplied by GGNS and would not be a reasonable alternative to renewing the GGNS OL.

8.2.12 Utility-Sponsored Conservation

The concept of conservation as a resource does not meet the primary USNRC criterion "that a reasonable set of alternatives should be limited to analysis of single, discrete electric generation sources and only electric generation sources that are technically feasible and commercially viable." [USNRC 1996, Section 8.1] It is neither single, nor discrete, nor is it a source of generation.

Demand side management (DSM) resource strategies aimed at increasing energy efficiency on the customer side of the electric meter generally fall under the following categories.

- Energy efficiency-selecting equipment that will perform the same work with less energy input.
- Load response-customers who agree to respond to utility requests to reduce use during times of utility peak demand.
- Load management, which encourages customers to reduce their loads during peak times of day and peak season through the use of time-of-use rates, seasonal rates, and interruptible contracts; or direct load control, in which a utility interrupts power supply to customer equipment.

Typically, DSM induced load reductions are acknowledged in load forecasts.

The environmental impacts of an energy conservation program would be SMALL, but the potential to displace GGNS' entire base-load generation solely with conservation is not realistic. Although Entergy is committed to pursuing cost-effective DSM programs, information on market potential and penetration rates concludes that DSM cannot be relied upon to meet all, or even a majority, of future resource needs. Supply-side alternatives, both conventional and renewable, will be needed to meet the bulk of needs reliably and economically over the next twenty years. [Entergy 2009c, pg. 9-9] Although it is recognized that energy conservation is promoted and increases in energy efficiency occur as a normal result of replacing older equipment with modern equipment, the conservation option by itself is not considered a reasonable replacement for the GGNS OL renewal alternative.

8.2.13 Combination of Alternatives

USNRC indicated in the GEIS that, while many methods are available for generating electricity and a huge number of combinations or mixes can be assimilated to meet system needs, such expansive consideration would be too unwieldy given the purposes of this alternatives analysis. Therefore, USNRC determined that a reasonable set of alternatives should be limited to analysis of single discrete electrical generation sources and only those electric generation technologies that are technically reasonable and commercially viable [USNRC 1996, Section 8.1]. Although several of these alternatives could be considered in combination for replacement power generation at multiple sites, they do not generally provide base-load generation and would entail greater environmental impacts compared to renewing the GGNS OL.

However, Entergy has assessed the environmental impacts of an assumed combination of two 508 net MWe natural gas combined-cycle generating units at the GGNS site using closed-cycle cooling with cooling towers, 30 MW of wind energy (alternate site), 30 MW of hydropower (alternate site), 90 MW from biomass sources including municipal solid waste (alternate site), and 309 MW from conservation and demand-side management programs. A summary of the environmental impacts of this combination of alternatives is provided in Table 8.2-1.

Table 8.2-1
Summary of Environmental Impacts of a Combination of Alternatives

Impact Category	Impact	Comment
Land Use	SMALL to MODERATE	Natural gas-fired plant would have land use impacts for power block, cooling towers and support systems, and connection to a natural gas pipeline. Wind, hydro, and biomass facilities and associated transmission lines would also have land use impacts.
Ecology	SMALL to MODERATE	Many of the impacts would occur in areas that were previously disturbed during the construction of GGNS. Thus, potential habitat loss and fragmentation and reduced productivity and biological diversity would be minimal. Impacts on terrestrial ecology from cooling tower drift could occur. Wind energy facilities could result in some avian mortality. Hydropower facilities would impact terrestrial and aquatic habitat.
Water Use and Quality	SMALL	Impacts would be comparable to the impacts of renewing the GGN OL.
Air Quality	SMALL to MODERATE	SO_x - 111 tons per year NO_x - 356 tons per year CO - 75 tons per year PM_{10} - 62 tons per year Some hazardous air pollutants.
Waste	SMALL	The only significant waste would be spent SCR catalyst used for control of NO_x emissions and ash from biomass sources.
Human Health	SMALL	Regulatory controls and oversight would be protective of human health.
Socioeconomics	MODERATE (Beneficial)	Construction and operational workforces are both relatively small. Addition to property tax base, while smaller than for a nuclear, coal-fired, or solely natural gas-fired plant, might still be quite noticeable. Construction-related impacts would be noticeable. Impacts during operation would be minor because of the small workforce involved.

Table 8.2-1
Summary of Environmental Impacts of a Combination of Alternatives

Impact Category	Impact	Comment
Aesthetics	SMALL to MODERATE	Best management practices can be used to mitigate visual impacts from plant buildings, exhaust stacks, cooling towers, and condensation plumes from operation of the cooling towers. Wind energy towers would have aesthetic impact.
Historic and Archaeological Resources	SMALL	Any potential impacts could likely be effectively managed. Most of the facilities and infrastructure at the GGNS site would be built on previously disturbed ground.

8.3 Proposed Action vs. No Action

The proposed action is to renew the GGNS OL which would preserve the option for Entergy to continue to operate GGNS Unit 1 to produce base-load power throughout the 20-year license renewal period. The analysis of the environmental impacts required by 10 CFR 51.53(c)(3)(ii) concluded that environmental impacts from the continued operation of GGNS during the license renewal period would either be not detectable or so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

The no-action alternative to the proposed action is the decision not to pursue renewal of the GGNS OL. The environmental impacts of the no-action alternative would be the impacts associated with the construction and operation of the type of replacement power utilized. In effect, the net environmental impacts would be transferred from the continued operation of GGNS to the environmental impacts associated with the construction and operation of a new generating facility. Therefore, the no-action alternative would have no net environmental benefits.

The environmental impacts associated with the proposed action (the continued operation of GGNS) were compared to the environmental impacts from the no-action alternative (the construction and operation of other reasonable sources of electric generation). Entergy believes this comparison shows that the continued operation of GGNS would produce fewer significant environmental impacts than the no-action alternative. There are significant differences in the impacts to air quality and land use between the proposed action and the reasonable alternative generation sources. In addition, there would be adverse socioeconomic impacts (including local unemployment, loss of local revenue, and higher energy costs) to the area around GGNS from the decision not to pursue license renewal.

Two-thirds of the world's electricity consumption is met by fossil fuel generation (coal, oil, and gas) that is responsible for a third of all anthropogenic carbon dioxide emissions. Carbon dioxide emissions are a major contributor to anthropogenic greenhouse gas emissions, which many scientists believe contribute to climate change; therefore posing the greatest environmental threat of the 21st century and challenging us globally to radically revise our energy supply systems. As shown in Table 8.3-1, which includes the amount of CO_2 produced when various fuels are burned to produce electricity, GHG emissions that would be associated with nuclear are lower than those associated with fossil fuel-based energy sources. In addition, as previously discussed in Section 2.11.3, GHG emissions associated with renewal of an operating license would be similar to the lifecycle GHG emissions from renewable energy sources and lower than those associated with fossil fuel-based energy sources.

Therefore, it is important to maintain the operation of the current fleet of nuclear power plants which can contribute to alleviate global climate change and also help in other energy challenges, such as reducing dependence on imported oil, diversifying the U.S. domestic electricity supply system, expanding U.S. exports of energy technologies, and reducing air and water pollution. The renewal of the GGNS OL is consistent with these objectives and would therefore have a beneficial effect as it relates to climate change.

Table 8.3-1
CO_2 Emissions From Electricity Generation

Fuel	Pounds CO_2 per Million Btu
Subbituminous coal	213
Bituminous coal	205
Lignite coal	215
#6 fuel oil	174
Natural gas	117
Nuclear	0
Renewable sources	0

Reference: USDOE 2010c

8.4 Summary

The proposed action is to renew the GGNS OL which would preserve the option to continue to operate GGNS Unit 1 to produce approximately 1,475 net MWe of base-load power throughout the 20-year license renewal period. The environmental impacts of the proposed action have been compared to the environmental impacts from the no-action alternative (the construction and operation of other reasonable sources of electric generation). Although impacts from license renewal and the new nuclear plant alternative at the GGNS site are similar as shown in Table 8.4-1, impacts from license renewal would still be superior because there are no associated impacts from construction activities. Therefore, the continued operation of GGNS would create significantly less environmental impact than the construction and operation of new base-load generation capacity. In addition, the continued operation of GGNS will have a significant positive economic impact on the communities surrounding the station such as reduced local unemployment, significant contributions to local property tax revenue, economic support of surrounding communities, and lower energy costs.

Table 8.4-1
Summary of Environmental Impacts of Proposed Action and Alternatives

Alternative	Impact Area								
	Land Use	Ecology	Water Use and Quality	Air Quality	Waste	Human Health	Socioeconomics	AestheticS	Historical and Archaeological Resources
License Renewal	SMALL	SMALL	SMALL	SMALL (Beneficial)[a]	SMALL	SMALL	SMALL to LARGE (Beneficial)	SMALL	SMALL
Supercritical Coal-Fired Plant at Alternate Site	MODERATE	MODERATE to LARGE	SMALL to MODERATE	MODERATE	MODERATE	SMALL	SMALL to MODERATE (Beneficial)	SMALL to MODERATE	SMALL
Natural Gas-Fired Plant at GGNS site	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL	SMALL	SMALL to MODERATE (Beneficial)	SMALL	SMALL
Nuclear Plant at GGNS Site	SMALL	SMALL	SMALL	SMALL (Beneficial)[a]	SMALL	SMALL	SMALL to LARGE (Beneficial)	SMALL	SMALL
Nuclear Plant at Alternate Site	SMALL	SMALL to MODERATE	SMALL	SMALL (Beneficial)[a]	SMALL	SMALL	SMALL to LARGE (Beneficial)[b]	SMALL	SMALL
Wind and CAES	SMALL to LARGE	SMALL to LARGE	SMALL	SMALL to LARGE	SMALL	SMALL	MODERATE to LARGE	MODERATE to LARGE	SMALL
Combination of Alternatives	SMALL to MODERATE	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL	SMALL	MODERATE (Beneficial)	SMALL to MODERATE	SMALL
Decommissioning	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL

a. Beneficial to climate change.
b. SMALL to MODERATE transportation impact.

9.0 STATUS OF COMPLIANCE

9.1 Requirement [10 CFR 51.45(d)]

"The environmental report shall list all Federal permits, licenses, approvals, and other entitlements which must be obtained in connection with the proposed action and shall describe the status of compliance with these requirements. The environmental report shall also include a discussion of the status of compliance with applicable environmental quality standards and requirements including, but not limited to, applicable zoning and land-use regulations, and thermal and other water pollution limitations or requirements which have been imposed by Federal, State, regional, and local agencies having responsibility for environmental protection……."

9.1.1 GGNS Authorizations

Table 9.1-1 provides a summary of authorizations held by GGNS for current plant operations. Authorizations in this context include any permits, licenses, approvals, or other entitlements. With the exception of the Small Construction General Permit MSR15, Large Construction General Permit MSR10-5946, and Nationwide Permit 12, which are related to GGNS EPU activities that will be completed in the current licensing term, these authorizations would continue to be in place as appropriate throughout the period of extended operation given their respective renewal schedules. Table 9.1-2 lists environmental consultations related to the renewal of the GGNS OL.

Table 9.1-1
GGNS Environmental Permits and Compliance Status

Agency	Authority	Requirement	Number	Expiration Date	Authorized Activity
MAWPCC	Federal Water Pollution Control Act Section 401	401 Water Quality Certification	February 5, 1974	None	Discharge of wastewaters to water of the State.
MDEQ	Federal Water Pollution Control Act Section 402	NPDES Permit	MS0029521	August 31, 2016	Discharge of wastewaters to water of the State.
MDEQ	Federal Water Pollution Control Act Section 402	Baseline Stormwater General NPDES Permit	MSR000883	September 28, 2015	Discharge of stormwater to waters of the State.
MDEQ	Federal Water Pollution Control Act Section 402	Small Construction General Permit	MSR15	December 31, 2012	Discharge of stormwater to waters of the State.
MDEQ	Federal Water Pollution Control Act Section 402	Large Construction General Permit	MSR10-5946	December 31, 2015	Discharge of stormwater to waters of the State.
MDEQ	Federal Clean Air Act	Air Permit	0420-00023	May 31, 2009[a]	Operation of air emission sources (emergency diesel generators, diesel engines and pumps, diesel fueled outage equipment, and cooling towers).
MDEQ	HW-1 Hazardous Waste Management Regulations, Part 262	Hazardous Waste Generator Identification	MSD000644617	None	Hazardous waste generation and shipments.
MDEQ	Mississippi Water Laws, Mississippi Code Sections 5 1-3-1, et seq.	Well Permit (Radial Well 1)	MS-GW-02971	September 25, 2016	Groundwater withdrawal.
MDEQ	Mississippi Water Laws, Mississippi Code Sections 5 1-3-1, et seq.	Well Permit (Radial Well 3)	MS-GW-02970	September 25, 2016	Groundwater withdrawal.

Table 9.1-1 (Continued)
GGNS Environmental Permits and Compliance Status

Agency	Authority	Requirement	Number	Expiration Date	Authorized Activity
MDEQ	Mississippi Water Laws, Mississippi Code Sections 5 1-3-1, et seq.	Well Permit (Radial Well 4)	MS-GW-02969	September 25, 2016	Groundwater withdrawal.
MDEQ	Mississippi Water Laws, Mississippi Code Sections 5 1-3-1, et seq.	Well Permit (Radial Well 5)	MS-GW-00371	September 25, 2016	Groundwater withdrawal.
MDEQ	Mississippi Water Laws, Mississippi Code Sections 5 1-3-1, et seq.	Well Permit (Radial Well 6)	MS-GW-16714	March 10, 2020	Groundwater withdrawal.
MDEQ	Mississippi Water Laws, Mississippi Code Sections 5 1-3-1, et seq.	Well Permit (Construction Well 1)	MS-GW-02967	September 25, 2016	Groundwater withdrawal.
MDEQ	Mississippi Water Laws, Mississippi Code Sections 5 1-3-1, et seq.	Well Permit (Construction Well 3)	MS-GW-14989	September 25, 2016	Groundwater withdrawal.
MDEQ	Mississippi Water Laws, Mississippi Code Sections 5 1-3-1, et seq.	Well Permit (Construction Well 4)	MS-GW-15026	September 25, 2016	Groundwater withdrawal.
MDEQ	Mississippi Water Laws, Mississippi Code Sections 5 1-3-1, et seq.	Well Permit (Dewatering Well 1)	MS-GW-02979	September 25, 2016	Groundwater withdrawal.
MDEQ	Mississippi Water Laws, Mississippi Code Sections 5 1-3-1, et seq.	Well Permit (Dewatering Well 2)	MS-GW-02978	September 25, 2016	Groundwater withdrawal.
MDEQ	Mississippi Water Laws, Mississippi Code Sections 5 1-3-1, et seq.	Well Permit (Dewatering Well 3)	MS-GW-02977	September 25, 2016	Groundwater withdrawal.

Table 9.1-1 (Continued)
GGNS Environmental Permits and Compliance Status

Agency	Authority	Requirement	Number	Expiration Date	Authorized Activity
MDEQ	Mississippi Water Laws, Mississippi Code Sections 5 1-3-1, et seq.	Well Permit (Dewatering Well 4)	MS-GW-02976	September 25, 2016	Groundwater withdrawal.
MDEQ	Mississippi Water Laws, Mississippi Code Sections 5 1-3-1, et seq.	Well Permit (Dewatering Well 5)	MS-GW-02975	September 25, 2016	Groundwater withdrawal.
MDEQ	Mississippi Water Laws, Mississippi Code Sections 5 1-3-1, et seq.	Well Permit (Dewatering Well 6)	MS-GW-02974	September 25, 2016	Groundwater withdrawal.
MDEQ	Mississippi Water Laws, Mississippi Code Sections 5 1-3-1, et seq.	Well Permit (Dewatering Well 7)	MS-GW-02973	September 25, 2016	Groundwater withdrawal.
MDEQ	Mississippi Water Laws, Mississippi Code Sections 5 1-3-1, et seq.	Well Permit (Dewatering Well 8)	MS-GW-02972	September 25, 2016	Groundwater withdrawal.
MDEQ	Mississippi Underground Storage Tank Regulations, Part 280	Underground Storage Tanks Registration	5913	June 30, 2012	Underground diesel fuel storage
MEMA	Chapter 432, Laws of 1982 Mississippi Radioactive Waste Transportation Act	GGNS Radioactive Waste Transport Permit	4600	June 30, 2012	Transportation of radioactive waste through the State of Mississippi
UDEQ	Utah Radiation Control Rules R313-26	Generator Site Access Permit	0204001347	April 30, 2012	Site access permit for disposal of Class A wastes
USACE	Federal Water Pollution Control Act Section 404	Nationwide Permit	NW 12	June 2, 2012	Radial Well #6 construction activities in wetland areas

Table 9.1-1 (Continued)
GGNS Environmental Permits and Compliance Status

Agency	Authority	Requirement	Number	Expiration Date	Authorized Activity
USDOT	49 CFR 107, Subpart G	Hazardous Materials Certificate of Registration	053111551003T	June 30, 2012	Radioactive and hazardous materials shipments.
USFWS	16 USC 703-712	Depredation Permit	MB798276-0	March 31, 2012	Taking of migratory birds
USNRC	Atomic Energy Act 10 CFR Part 50	GGNS License to Operate	NPF-29	November 1, 2024	Operation of GGNS
TDEC	Tennessee Department of Environment and Conservation Rule 1200-2-10-32	GGNS Radioactive Waste License for Delivery	T-MS002-L11	December 31, 2011	Shipment of radioactive material into Tennessee to a disposal/processing facility

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

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

Table 9.1-2
Environmental Consultations Related to License Renewal

Agency	Authority	Activity Covered	Response
U.S. Fish and Wildlife Service (Mississippi Office)	Endangered Species Act Section 7 (16 USC 1636)	Requires federal agency issuing a license to consult with USFWS.	No adverse impacts due to GGNS license renewal.
U.S. Fish and Wildlife Service (Louisiana Office)	Endangered Species Act Section 7 (16 USC 1636)	Requires federal agency issuing a license to consult with USFWS.	No adverse impacts due to GGNS license renewal.
National Oceanic and Atmospheric Administration	Endangered Species Act Section 7 (16 USC 1636)	Requires federal agency issuing a license to consult with USFWS.	No adverse impacts due to GGNS license renewal.
Mississippi Natural Heritage Program	Endangered Species Act Section 7 (16 USC 1636)	Requires federal agency issuing a license to consult with the fish and wildlife agency at the state level.	No adverse impacts due to GGNS license renewal.
Louisiana Natural Heritage Program	Endangered Species Act Section 7 (16 USC 1636)	Requires federal agency issuing a license to consult with the fish and wildlife agency at the state level.	No adverse impacts due to GGNS license renewal.
Mississippi Department of Archives and History	National Historic Preservation Act Section 106	Requires federal agency issuing a license to consider cultural impacts and consult with SHPO and/or THPO.	No adverse impacts due to GGNS license renewal.
Louisiana Office of Historic Preservation	National Historic Preservation Act Section 106	Requires federal agency issuing a license to consider cultural impacts and consult with SHPO and/or THPO.	No adverse impacts due to GGNS license renewal.
Mississippi Band of Choctaw Indians	National Historic Preservation Act Section 106	Requires federal agency issuing a license to consider cultural impacts and consult with SHPO and/or THPO.	As of the time of the ER submittal, no response received in reply to Entergy's consultation letter.
Louisiana Tunica-Biloxi Tribal Historic Preservation Office	National Historic Preservation Act Section 106	Requires federal agency issuing a license to consider cultural impacts and consult with SHPO and/or THPO.	As of the time of the ER submittal, no response received in reply to Entergy's consultation letter.

9.1.2 Status of Compliance

GGNS has established control measures in place to ensure compliance with the authorizations listed in Table 9.1-1, including monitoring, reporting, and operating within specified limits. GGNS Chemistry personnel are primarily responsible for monitoring and ensuring that the site complies with its environmental permits and applicable regulations. Monitoring and sampling results associated with environmental programs are submitted to appropriate agencies, as specified in the permits and/or governing regulations.

9.1.3 Federal, State, and Local Regulatory Standards - Discussion of Compliance

9.1.3.1 Notice of Violations

Based on review of records associated with the various environmental programs and permits that GGNS is subject to and complies with, there have been no regulatory notices of violations issued to the facility over the previous five years (2006–2010).

9.1.3.2 Remediation Activities

There is no surface or sub-surface areas on-site that are contaminated with nonradiological industrial constituents. Therefore, there are no current or ongoing remediation activities or investigations occurring at the GGNS site that are subject to any regulatory standards.

9.1.3.3 Clean Water Act

9.1.3.3.1 Water Quality (401) Certification

Federal CWA, Section 401, requires an applicant for a federal license to conduct an activity that may result in a discharge into navigable waters to provide the licensing agency a certification from the state that the discharge will comply with applicable CWA requirements (33 USC 1341) or the state must have waived certification. The MAWPCC issued a Section 401 State Water Quality Certification (WQC) for GGNS on February 5, 1974 (Attachment C). Based on conversation with the MDEQ, because the GGNS footprint and plant operations are not changing as a result of license renewal, and because GGNS holds a valid state-issued NPDES permit, a new 401 WQC is not needed. Additionally, the current 401 WQC remains valid and satisfies the exemption provide by Section 401(a)(3) [Entergy 2011d; MDEQ 2011b].

The USNRC also indicated in its GEIS that issuance of an NPDES permit implies continued certification by the state [USNRC 1996, Section 4.2.1.1]. The USEPA has granted Mississippi the authority to issue NPDES permits under a fully delegated NPDES program. Attachment C contains the NPDES permit that authorizes plant discharges at GGNS. Consistent with the GEIS, GGNS is providing a copy of its NPDES permit as further demonstration of the existing state water quality (401) certification.

9.1.3.3.2 NPDES Permit

The release of pollutants in wastewaters at the GGNS facility is regulated and controlled through NPDES Permit MS00029521 issued by the MDEQ. As discussed in Section 3.2.8.2, there are 11 outfalls (three external and eight internal) identified in the NPDES Permit. Monitoring results associated with these outfalls are submitted in Discharge Monitoring Reports to the MDEQ at the frequency specified in the Permit. Compliance with the NPDES Permit over previous years has been excellent. For example, based on annual sample load (typically ~950 samples), compliance has been >99% with the limits and conditions specified in the permit for these samples over the previous five years. Noncompliances associated with the NPDES Permit over these same five years have been infrequent, with any deviations properly addressed and reported in accordance with either the conditions outlined in the permit or as recommended by the regulatory agency. Table 9.1-3 provides a summary of noncompliances from 2006 through 2010.

Table 9.1-3
GGNS NPDES Permit Noncompliances, 2006–2010

NPDES Outfall	Noncompliance	Date
016 (Energy Services Center)	pH exceedance	July 2006
014 (Sedimentation Basin B)	pH exceedance	October 2006
001 (Discharge Basin)	Missed free available chlorine sample	October 2006
013 (Sedimentation Basin A)	Unauthorized discharge	March 2007
010 (Sewage Treatment Plant)	pH exceedance	January 2008
NA	Late Discharge Monitoring Report submittal	May 2008
002 (Cooling Tower Blowdown)	Total recoverable zinc exceedance	July 2008
010 (Sewage Treatment Plant)	Free residual chlorine exceedance	August 2008
016 (Energy Services Center)	Missed sample	January 2009

Reference: Entergy 2010e

9.1.3.3.3 Stormwater Permits

Stormwater discharges associated with industrial activities at the GGNS site are regulated and controlled through Baseline Stormwater General NPDES Permit MSR000883 issued by the MDEQ. Stormwater discharges associated with EPU activities at the GGNS site are regulated and controlled through Small Construction General Permit MSR15 (Radial Well #6) and Large Construction Permit MSR10-5946 (Laydown Area) issued by the MDEQ. GGNS is required under these permits to develop, maintain, and implement a stormwater pollution prevention plan that identifies potential sources of pollution that would reasonably be expected to affect the quality of stormwater and identify the practices that will be used to prevent or reduce the pollutants in stormwater discharges [GGNS 2006c; GGNS 2010i; GGNS 2011b]. GGNS is in compliance with the terms and conditions of these permits as it relates to the stormwater program.

9.1.3.3.4 Sanitary Wastewaters

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.

GGNS is required to have personnel certified in accordance with MDEQ Regulation WPC-3 (Regulations for the Certification of Municipal and Domestic Wastewater Facility Operators) for operation of the onsite sanitary wastewater treatment plant. GGNS maintains an onsite certified wastewater operator; therefore, the site is in compliance with this program.

9.1.3.3.5 Spill, Prevention, Control, and Countermeasures

SPCC Plan (40 CFR Part 112)

The USEPA's Oil Pollution Prevention Rule became effective January 10, 1974, and was published under the authority of Section 311(j)(1)(C) of the Federal Water Pollution Control Act. The regulation has been published in 40 CFR Part 112 and facilities subject to the rule must prepare and implement a Spill Prevention, Control, and Countermeasure (SPCC) Plan to prevent any discharge of oil into or upon navigable waters of the U.S. or adjoining shorelines. GGNS is subject to this rule and has a written SPCC Plan that identifies and describes the procedures, materials, equipment, and facilities that are utilized at the station to minimize the frequency and severity of oil spills in order to meet the requirements of this rule [GGNS 2011k].

Reportable Spills (40 CFR Part 110)

GGNS is subject to the reporting provisions of 40 CFR Part 110 as it relates to the discharge of oil in such quantities as may be harmful pursuant to Section 311(b)(4) of the Federal Water Pollution Control Act. Any discharges of oil in such quantities that may be harmful to the public health or welfare or the environment must be reported to the National Response Center. There have been no releases at GGNS that have triggered this notification requirement over the previous five years (2006–2010).

9.1.3.3.6 Facility Response Plan

GGNS is not subject to the Facility Response Plan Risk requirements described in 40 CFR 112.20 since the facility does not transfer oil over water to or from vessels and does not store oil in quantities greater than 1 million gallons.

9.1.3.3.7 Section 404 Permit

Approximately 40% of the GGNS property consists of wetlands. For these wetland areas, either an Individual or Nationwide Section 404 Permit would have to be obtained from the USACE prior to performing activities in these type areas. GGNS currently has a Nationwide Permit which regulates the new radial well construction project activities that are being conducted in a floodplain area (Table 9.1-1). GGNS is in compliance with this permit.

9.1.3.4 Safe Drinking Water Act

GGNS is classified as a non-transient non-community public water system and is subject to the sampling, reporting and management requirements specified in Mississippi State Department of Health Regulation Title 15, Part III, Subpart 72, Chapter 01 (Mississippi Primary Drinking Water Regulation). GGNS is in compliance with these requirements.

GGNS is also required to have personnel certified in accordance with MDH Regulation Title 15, Part III, Subpart 72, Chapter 02 (Regulation Governing the Certification of Municipal and Domestic Water System Operators) for operation of the onsite water treatment plant. GGNS maintains an onsite certified operator; therefore, the site is in compliance with this program.

9.1.3.5 Mississippi Water Use Law

There are 16 groundwater wells currently permitted for withdrawal purposes at the GGNS site as shown in Table 9.1-1. There are eight wells for plant dewatering activities, although there has not been a need to operate them over previous years. Construction Wells 1, 3, and 4 (North Construction Well and North and South Drinking Water Wells) 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 radial wells which supply water to the PSW system, with an additional well being installed to supplement the existing wells. GGNS is in compliance with the groundwater permits and submits annual groundwater usage reports to the MDEQ when requested by the agency [GGNS 2006a; GGNS 2010b].

9.1.3.6 Clean Air Act

9.1.3.6.1 Air Permit

GGNS has a permit to operate emergency diesel generators, fire water pump diesel engines, diesel engines, and portable outage engines. Operation of these air emission sources is maintained within the operational run times and sulfur limits established in the station air permit, issued by MDEQ. As required by the air permit, operational run times are reported annually to the MDEQ [GGNS 2007c; GGNS 2008f; GGNS 2009e; GGNS 2010j; GGNS 2011c]. Although the cooling towers are also permitted emission sources, there are no associated permit conditions. For purposes of the CAA, GGNS is considered a minor air emission source and is reflected as such in the air permit. GGNS is in compliance with this permit.

9.1.3.6.2 Chemical Accident Prevention Provisions (40 CFR Part 68)

GGNS is not subject to the Risk Management Plan requirements described in 40 CFR Part 68 since the amount of regulated chemicals present on-site do not exceed the threshold quantities specified in 40 CFR 68.130.

9.1.3.6.3 Stratospheric Ozone (40 CFR Part 82)

Under Title VI of the CAA, the USEPA is responsible for several programs that protect the stratospheric ozone layer. Regulations promulgated by USEPA to protect the ozone layer are in 40 CFR Part 82. Refrigeration appliances and motor vehicle air conditioners are regulated under Sections 608 and 609 of the CAA, respectively. A number of service practices, refrigerant reclamation, technician certification, and other requirements are covered by these programs. GGNS is in compliance with Sections 608 (stationary refrigeration appliances) and 609 (motor vehicle air conditioners) of the CAA as amended in 1990 and the implementing regulations codified in 40 CFR Part 82. The program to manage stationary refrigeration appliances and motor vehicle air conditioners at GGNS is described in Entergy's fleet procedure [Entergy 2008g].

9.1.3.7 Atomic Energy Act

9.1.3.7.1 Radioactive Waste

As a generator of both low-level and high-level radioactive wastes, GGNS is subject to and complies with provisions and requirements of the Low-Level Radioactive Waste Policy Amendment Act of 1985 and the Nuclear Waste Policy Act of 1982, as subsequently amended.

GGNS is also subject to and complies with MEMA requirements for transporting radioactive wastes within or through Mississippi, TDEC requirements for shipping radioactive material into or within Tennessee to a disposal/processing facility that is licensed by Tennessee to receive such material, and UDEQ requirements for delivering radioactive wastes to a land disposal facility located within Utah.

9.1.3.7.2 Liquid and Gaseous Effluent Monitoring Program

Liquid and gaseous radioactive effluents are monitored as required by the GGNS ODCM [GGNS 2009a, Section 6.11]. Based on monitoring conducted over the previous five years (2006 - 2010), all effluent releases were within the concentration and total release limits specified by the ODCM. Projected offsite doses were also within the limits specified by the ODCM, 10 CFR Part 20, 40 CFR Part 190, and Appendix I to 10 CFR Part 50. [GGNS 2007d; GGNS 2008a; GGNS 2009h; GGNS 2010k; GGNS 2011d] In summary, releases were generally consistent from year to year, allowing for variations based on plant operation, the number of refueling outages, and the scope of routine maintenance work performed. No adverse trend was observed.

9.1.3.7.3 Radiological Environmental Monitoring Program

The airborne, direct radiation, waterborne and ingestion pathways are monitored as required by the GGNS ODCM [GGNS 2009a, Section 6.12.1]. To supplement this program, GGNS also collects duplicate samples and special samples such as vegetation, sediment, or surface water in order to provide a comprehensive and well-balanced program. Based on monitoring conducted over the previous five years (2006–2010), review of data has shown no unusual trends and no significant or measurable radiological impact from GGNS operations [GGNS 2007e; GGNS 2008b; GGNS 2009d; GGNS 2010g; GGNS 2011e].

9.1.3.8 NEI Industry Initiative

As discussed in Section 3.2.6, GGNS began sampling representative groundwater wells at the site in 2007 based on the initial site characterization. While no detectable tritium has been detected in offsite REMP wells or the nearest offsite well discussed below, tritium has been detected in onsite groundwater in the Upland Complex aquifer. In 2010, after GGNS identified additional representative wells for sampling and installed new wells, detectable tritium was identified in wells located near the power block area, with the highest concentrations detected on the east side of the power block area [GGNS 2011d]. Strontium-89, strontium-90, and gamma radionuclides including iron-55 and nickel-63, have not been detected. In addition, no plant-related tritium has been detected in groundwater sampled from the Catahoula aquifer nor in GGNS' onsite non-community, non-transient water supply system which withdraws groundwater from the Upland Complex.

Although groundwater in the Upland Complex and Catahoula aquifers is considered suitable for potable water purposes, the nearest well that provides water to an offsite residence is located on Bald Hill Road, approximately one mile south-southeast from the center of GGNS Unit 1, as previously discussed in Section 2.3.4.2. There are no residences on Grand Gulf Road bordering the GGNS property with functioning wells. Further, there are no potentially affected residences that exist to the west of GGNS, as the GGNS property borders the Mississippi River, which provides a hydraulic boundary to groundwater transport to the west [SERI 2005b, Section 2.3.1.2.1].

Based on data collected since 2007, there is no indication that tritium is migrating off the GGNS plant site property at detectable concentrations. Therefore, the current risk of exposure to radionuclides associated with licensed plant operations to offsite residents is minimal.

9.1.3.9 Resource Conservation and Recovery Act

9.1.3.9.1 Nonradioactive Wastes

As a generator of hazardous and nonhazardous wastes, GGNS is subject to and complies with the RCRA and specific MDEQ regulations contained in HW-1 Hazardous Waste Management Regulations, Part 262. As previously discussed in Section 3.2.8.1, GGNS is classified as a small quantity generator, therefore hazardous wastes routinely make up only a small percentage of the total wastes generated. As a generator of hazardous waste, GGNS maintains an EPA identification number (Table 9.1-1), and reports hazardous wastes generated at the site electronically to the MDEQ on an annual basis.

Reportable Events (40 CFR Part 262)

GGNS is subject to the reporting provisions of 40 CFR 262.34(d)(5)(iv)(C) as it relates to a fire, explosion, or other release of hazardous waste which could threaten human health outside the facility boundary or when the facility has knowledge that a spill has reached surface water. Any such events must be reported to the National Response Center. There have been no events at GGNS that have triggered this notification requirement over the previous five years (2006–2010).

9.1.3.9.2 Mixed Wastes

Radioactive materials are regulated by the USNRC under the Atomic Energy Act of 1954, and hazardous wastes are regulated by the USEPA under the RCRA of 1976. Based on the previous five years [2006-2010], mixed waste consisting of lead paint debris and a lead acid battery was generated once in 2007, and was managed in accordance with USNRC and USEPA regulatory requirements. Currently, there are no mixed waste streams being generated or stored on the GGNS site.

9.1.3.9.3 Underground Storage Tanks

GGNS has four diesel fuel oil underground storage tanks that are located on-site, three 75,000 gallon tanks and one 6,000 gallon tank. The three 75,000 gallon tanks are the fuel supply for the Standby and High Pressure Core System Emergency Generators while the 6,000 gallon tank supplies fuel for the Energy Services Center Emergency Generator. In accordance with 40 CFR Part 280 of the Mississippi Underground Storage Tank Regulations, GGNS is required to register these tanks with MDEQ and pay an annual tank regulatory fee. GGNS is also subject to the release response and corrective actions, and financial responsibility associated with 40 CFR Part 280. GGNS is in compliance with these requirements.

Reportable Spills (40 CFR Part 280)

GGNS is subject to the reporting provisions of 40 CFR 280.50 as it relates to discovering a release of a regulated substance at the underground storage site or in the surrounding area. Any such events must be reported to the MDEQ. There have been no releases at GGNS that has triggered this notification requirement over the previous five years (2006 - 2010).

9.1.3.10 Pollution Prevention Act

As a generator of hazardous waste, GGNS must develop a waste minimization plan for the facility and submit annual waste minimization certified reports to the MDEQ as required by the Mississippi Comprehensive Multimedia Waste Minimization Act. [Entergy 2008c; Entergy 2008h; GGNS 2007b; GGNS 2008c; GGNS 2009b; GGNS 2010c; GGNS 2011f] GGNS is in compliance with these requirements.

9.1.3.11 Federal Insecticide, Fungicide, and Rodenticide Act

Pesticide and herbicide usage occurs periodically at the site. Pesticides utilized typically consist of three insecticides and one rodenticide, while herbicides typically consist of six products utilized to control grass, brush, and trees. Pesticides are hand-applied and herbicides may either be hand-applied or mechanically applied. Since only licensed contractors are utilized on-site for applying pesticides and herbicides, GGNS is in compliance with this program.

9.1.3.12 Toxic Substance Control Act

The Toxic Substances Control Act of 1976 regulates polychlorinated biphenyls (PCBs) (40 CFR Part 761) and asbestos (40 CFR Part 763), both of which are present at GGNS. PCBs are periodically identified in lighting ballasts, while asbestos is contained in specific types of insulation and gaskets. GGNS is in compliance with the PCB and asbestos regulations applicable to the facility.

9.1.3.13 Hazardous Materials Transportation Act

Since GGNS ships USDOT hazardous materials off-site to licensed facilities for processing and/ or disposal, the facility is subject to and complies with the applicable requirements of the Hazardous Materials Transportation Act described in 49 CFR, including maintaining a current Hazardous Materials Certificate of Registration.

9.1.3.14 Emergency Planning and Community Right-to-Know Act

9.1.3.14.1 Section 312 Reporting (40 CFR Part 370)

GGNS is subject to and complies with Section 312 of the Emergency Planning and Community Right-to-Know Act (EPCRA) that requires the submittal of an emergency and hazardous chemical inventory report (Tier II) to the Local Emergency Planning Commission, the State Emergency Response Commission, and the local fire department. This report which typically includes, but is not limited to, such chemicals as charcoal, carbon dioxide, freons, fuel oil, electrohydraulic fluid, ethylene glycol, gasoline, hydrogen, lubricating oils, water treatment products, nitrogen, oxygen, resin, sodium hydroxide, sodium hypochlorite, sulfuric acid, and transformer oil is submitted to these agencies annually [GGNS 2007f; GGNS 2008d; GGNS 2009f; GGNS 2010e; GGNS 2011g].

9.1.3.14.2 Section 313 Reporting (40 CFR Part 372)

GGNS is not subject to Section 313 of the EPCRA since the station does not combust coal or oil for the purpose of generating power for distribution in commerce.

9.1.3.15 Comprehensive Environmental Response, Compensation, and Liability Act

GGNS is subject to the hazardous substance release and reporting provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as subsequently amended. Any release of reportable quantities of listed hazardous substances to the environment requires a report to the National Response Center and to the MDEQ and subsequent written follow-up. There have been no CERCLA reportable spills at the GGNS site over the previous five years (2006 - 2010).

9.1.3.16 Migratory Bird Treaty Act

GGNS maintains a Federal Migratory Bird Depredation Permit to manage primarily two species that transit the site: Barn Swallows and Cliff Swallows. This permit authorizes GGNS to take 200 cliff swallows, 200 cliff swallow nests (including eggs), 200 barn swallows and 200 barn swallow nests (including eggs). To minimize the lethal taking of these species, non-lethal control measures utilized by GGNS include removing abandoned nests after the migration is begun and cleaning the nest sites to remove residuals that encourage nesting the following season, painting structures to discourage nest rebuilding the next year, periodic relocation of fake predators such as owl-netting, plastic door coverings, noise makers, and wire barricades. A report is submitted to the USFWS annually regarding depredation activities that occur at the site [GGNS 2007g; GGNS 2008e; GGNS 2009g; GGNS 2010f; GGNS 2011h]. GGNS is in compliance with this permit.

9.1.3.17 Endangered Species Act

Potential impacts on federal- and state-listed species were considered in Entergy's review and analysis and impacts were determined to be SMALL. However, per Section 7 of the ESA, a more structured consultation process with the USFWS may be initiated by the USNRC.

9.1.3.18 Bald and Golden Eagle Protection Act

Although bald eagle occurrences have not been reported within 10 miles of the GGNS site and there are no known nests located on-site, GGNS would comply with the requirements associated with this Act, as appropriate.

9.1.3.19 Coastal Zone Management Act

GGNS is not subject to the Federal Coastal Zone Management Act (16 USC 1451 et seq.) as the facility is not located in a designated coastal zone area.

9.1.3.20 Magnuson-Stevens Fishery Conservation and Management Act

Since GGNS is located on a freshwater body and no anadromous fish have migratory ranges within the vicinity of the Station, the consultation requirements of Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act, as amended by the National Marine Fisheries Service Sustainable Fisheries Act of 1996, are not required.

9.1.3.21 Marine Mammal Protection Act

GGNS is not subject to the Marine Mammal Protection Act since the facility is located on a freshwater body.

9.1.3.22 Farmland Protection Policy Act

The Farmland Protection Policy Act only applies to "Federal programs." The term "Federal program" under this Act does not include Federal permitting or licensing for activities on private or non-Federal lands. Therefore, since license renewal is considered a Federal licensing activity and GGNS is located on non-Federal lands, the Farmland Protection Policy Act is not applicable.

9.1.3.23 National Historic Preservation Act

Potential impacts on cultural resources were considered in Entergy's review and analysis and impacts were determined to be SMALL. However, per Section 106 of the NHPA, a more structured consultation process with the SHPO may be initiated by the USNRC.

As previously discussed in Section 2.12.5, Entergy has a fleet procedure in place for management of cultural resources ahead of any future ground-disturbing activities at the plant [Entergy 2008d]. This procedure, which requires reviews, investigations, and consultations as needed, ensures that existing or potentially existing cultural resources are adequately protected, and assists GGNS in meeting state and federal expectations.

9.1.3.24 Federal Aviation Act

Coordination with the FAA is required when it becomes necessary to ensure that the highest structures associated with the project do not impair the safety of aviation. Submission of a letter of notification (with accompanying maps and project description) to the FAA would result in a written response from the FAA certifying that no hazard exists or recommending project changes and/or the installation of warning devices such as lighting.

The site elevation is dominated by the 522-foot high natural draft cooling tower that is equipped with a FAA lighting system. There are no plans at this time to build any new structures during the license renewal period; therefore, no new notifications to the FAA are required.

9.1.3.25 Claiborne County Ordinances

9.1.3.25.1 Zoning

GGNS is not subject to any Claiborne County zoning-related codes.

9.1.3.25.2 Noise

There are no noise ordinances imposed by Claiborne County that limit allowable sound levels at GGNS. Given the industrial nature of the station, noise emissions from GGNS are generally nothing more than an intermittent minor nuisance. Although USEPA uses 55 dBA level as a threshold level to protect against excess noise during outdoor activities, this threshold does "not constitute a standard, specification, or regulation," but was intended to provide a basis for State and local governments establishing noise standards.

9.1.4 Environmental Reviews

Entergy has fleet procedural controls in place to ensure that environmentally sensitive areas at GGNS, if present, are adequately protected during site operations and project planning [Entergy 2008e]. These controls, which encompass nonradiological program areas such as air, stormwater, NPDES, spill prevention, and waste, consist of the following:

- Required review and documentation process prior to engaging in additional construction or operational activities that may result in an environmental impact or change conditions set forth in an existing permit.

- Required review for protection of either existing or potentially existing cultural resources.

These measures ensure that appropriate local, state, and/or federal permits are obtained or modified as necessary, that cultural resources and threatened and endangered species are protected if present, and that other regulatory issues are adequately addressed as necessary.

9.2 Requirement [10 CFR 51.45(d)]

".....The discussion of alternatives in the report shall include a discussion of whether the alternatives will comply with such applicable environmental quality standards and requirements."

9.2.1 Alternatives

The coal, gas, new nuclear, and wind with CAES alternatives discussed in Chapter 8 could probably be constructed and operated to comply with all applicable environmental quality standards and requirements. However, increasingly stringent air quality protection requirements could make the construction of a large fossil-fueled power plant infeasible in certain regional locations.

10.0 REFERENCES

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.

74 FR 38117. Revisions to Environmental Review for Renewal of Nuclear Plant Operating Licenses. July 31, 2009.

74 FR No. 45. 2009. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Louisiana Black Bear (*Ursus americanus luteolus*); Final Rule. Page 10349-10409. March 10, 2009.

75 FR 64675. Approval and Promulgation of Implementation Plans and Designation of Areas for Air Quality Planning Purposes; Texas; Beaumont/Port Arthur Ozone Nonattainment Area: Redesignation to Attainment for the 1997 8-Hour Ozone Standard and Determination of Attainment for the 1-Hour Ozone Standard; Clarification of EPA's Approval of the El Paso Section 110(a)(1) Maintenance Plan for the 1997 8-Hour Ozone Standard. October 20, 2010.

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