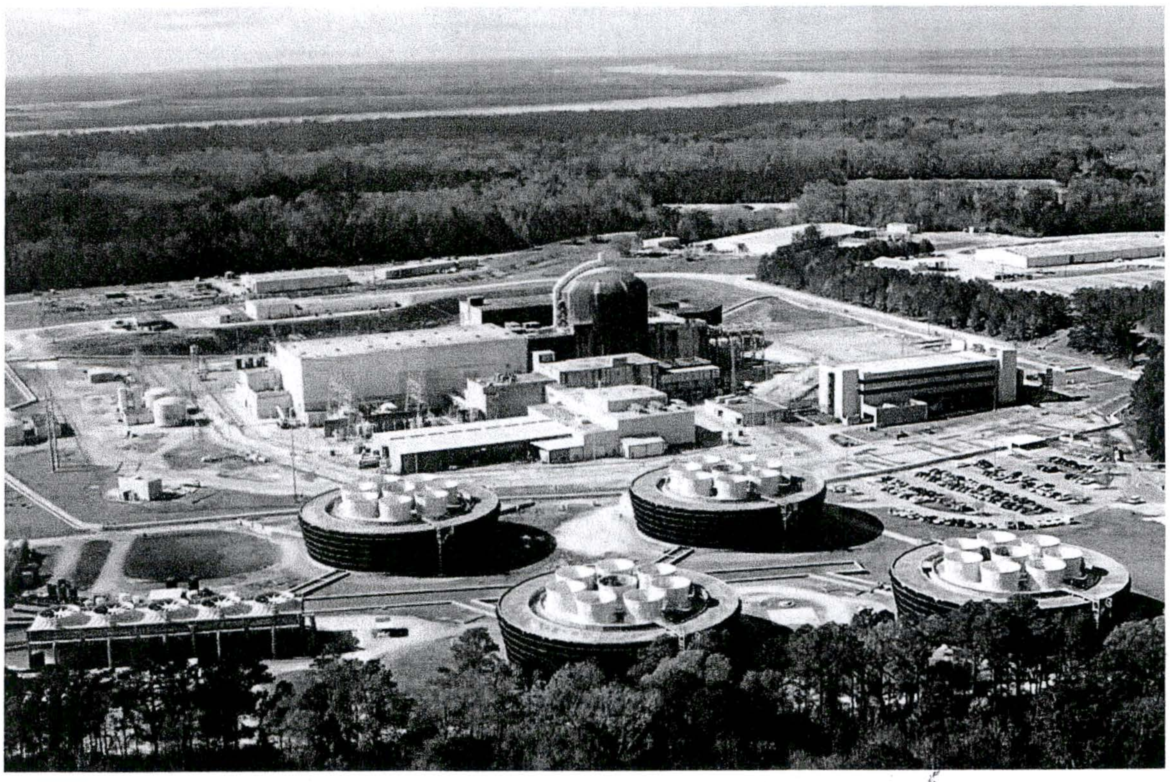
# Appendix E

# Applicant's Environmental Report

# Operating License Renewal Stage



# River Bend Station

## May 2017

Non - Proprietary Version

# INTRODUCTION

Entergy Louisiana, LLC and Entergy Operations, Inc. (collectively referred to as "Entergy"), both subsidiaries of Entergy Corporation, submit this environmental report (ER) in conjunction with the application to the U. S. Nuclear Regulatory Commission (NRC) to renew the operating license (OL) for River Bend Station, Unit 1 (hereafter referred to as "RBS") for 20 years beyond the end of the current license term. In compliance with applicable NRC requirements, this ER analyzes potential environmental impacts associated with renewal of the RBS OL. This ER is designed to assist the NRC staff with the preparation of the RBS-specific supplemental environmental impact statement (SEIS) required for license renewal.

The RBS ER is provided in accordance with 10 CFR 54.23, which requires license renewal applicants to submit a supplement to the Operating License Stage Environmental Report that complies with the requirements of Subpart A of 10 CFR Part 51. This report also addresses the more detailed requirements of NRC environmental regulations in 10 CFR 51.45 and 10 CFR 51.53(c), as well as the National Environmental Policy Act (NEPA) [42 USC 4321 et seq.]. For major federal actions, NEPA requires federal agencies to prepare a detailed statement that evaluates environmental impacts, alternatives to the proposed action, and irreversible and irretrievable commitments of resources associated with the implementation of the proposed action.

Entergy used NRC Regulatory Guide 4.2, Supplement 1, Revision 1, *Preparation of Environmental Reports for License Renewal Applications*, as guidance on the format and content of this ER. In addition, Entergy utilized the *Generic Environmental Impact Statement (GEIS) for License Renewal for Nuclear Plants* (NUREG-1437, Revision 1) and 10 CFR Part 51, Subpart A, Appendix B in preparation of this report. The level of information provided on the various topics and issues in this ER are commensurate with the environmental significance of the particular topic or issue.

Based upon the evaluations discussed in this ER, Entergy concludes that the environmental impacts associated with renewal of the RBS OL would result in no significant adverse effects. No plant refurbishment or other license-renewal-related construction activities have been identified as necessary to support the continued operation of RBS beyond the end of the existing operating license term. Ongoing plant operational and maintenance activities will be performed during the license renewal period, but no significant environmental impacts associated with such activities are expected, because established programs and procedures are in place to ensure that proper environmental monitoring continues to be conducted throughout the renewal term as discussed in Chapter 9.

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# ABBREVIATIONS, ACRONYMS, AND SYMBOLS

| | |
|---|---|
| $ | dollar(s) (U.S.) |
| § | Section |
| % | percent |
| °F | degrees Fahrenheit |
| AADT | average annual daily traffic |
| AC | alternating current |
| AD | anno Domini—with respect to time period |
| ALARA | as low as reasonably achievable |
| amsl | above mean sea level |
| APE | area of potential effect |
| AQCR | air quality control region |
| ASCII | American Standard Code for Information Interchange |
| BC | before Christ—with respect to time period |
| bgs | below ground surface |
| BMP | best management practice |
| Btu | British thermal unit |
| BWR | boiling water reactor |
| CAA | Clean Air Act |
| CAES | compressed air energy storage |
| CCS | carbon capture and storage |
| CDF | core damage frequency |
| CEI | Coastal Environments, Inc. |
| CFR | Code of Federal Regulations |
| cfs | cubic feet per second |
| CO | carbon monoxide |

| | |
|---|---|
| $CO_2$ | carbon dioxide |
| $CO_2e$ | carbon dioxide equivalent |
| COL | combined license |
| CSP | concentrating solar power |
| CWA | Clean Water Act (Federal Water Pollution Control Act) |
| CWS | circulating water system |
| dBA | A-weighted decibel |
| DC | direct current |
| DECON | dismantling and decontamination, one of three NRC decommissioning strategies |
| DOE | U.S. Department of Energy |
| DSM | demand-side management |
| E | east |
| EAB | exclusion area boundary |
| ECCS | emergency core cooling system |
| EDG | emergency diesel generator |
| EF | enhanced Fujita (tornado scale ranging from 0 to 5) |
| EFH | essential fish habitat |
| EIA | Energy Information Administration |
| ELAP | extended loss of alternating current |
| ENE | east-northeast |
| ENTOMB | permanent entombment on site, one of three NRC decommissioning strategies |
| EOF | Emergency Operations Facility |
| EPA | U.S. Environmental Protection Agency |
| EPT | Ephemeroptera, Plecoptera, Tricoptera (species richness indicator) |
| ER | environmental report |

| | |
|---|---|
| ESA | Endangered Species Act |
| ESE | east-southeast |
| FAA | Federal Aviation Administration |
| FEMA | Federal Emergency Management Agency |
| FES | final environmental statement |
| FFS | free flow speed |
| FLEX | diverse and flexible strategies (in response to NRC Order EA-12-049) |
| FPPA | Farmland Protection Policy Act |
| fps | feet per second |
| $ft^3$ | cubic feet |
| FUTUREBR | FUTUREBR Comprehensive Plan (East Baton Rouge Parish) |
| FY | fiscal year |
| GEIS | NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* |
| GHG | greenhouse gas |
| gpd/ft | gallons per day per foot |
| GPI | Groundwater Protection Initiative |
| gpm | gallons per minute |
| GSU | Gulf States Utilities Company |
| $H_2$ | hydrogen |
| HAP | hazardous air pollutant |
| HCM | *Highway Capacity Manual* |
| HEPA | high-efficiency particulate absorption |
| HIC | high integrity container |
| hp | horsepower |
| HPCS | high-pressure core spray |
| HVAC | heating, ventilation, and air conditioning |

| | |
|---|---|
| I-10 | Interstate Highway 10 |
| I-12 | Interstate Highway 12 |
| IGCC | integrated gasification combined cycle |
| IPA | integrated plant assessment |
| IRP | integrated resource plan |
| ISFSI | independent spent fuel storage installation |
| kV | kilovolt |
| $kWh/m^2/day$ | kilowatt hour per square meter per day |
| LA-10 | Louisiana Highway 10 |
| LA-965 | Louisiana Highway 965 |
| LAC | Louisiana Administrative Code |
| LADOTD | Louisiana Department of Transportation & Development |
| LDEQ | Louisiana Department of Environmental Quality |
| LDHH | Louisiana Department of Health and Hospitals |
| LDHP | Louisiana Division of Historic Preservation |
| LDOA | Louisiana Division of Archaeology |
| LDWF | Louisiana Department of Wildlife and Fisheries |
| LLD | lower limit of detection |
| LLMW | low-level mixed wastes |
| LLRW | low-level radwaste |
| LMR | Lower Mississippi River |
| LOCA | loss of coolant accident |
| LOS | level of service |
| LPCS | low-pressure core spray |
| LPDES | Louisiana Pollutant Discharge Elimination System |
| LRA | license renewal application |
| $m^3$ | cubic meter |

| | |
|---|---|
| mA | milliampere |
| MACR | maximum averted cost-risk |
| Mb | body-wave magnitude (earthquakes) |
| MBTA | Migratory Bird Treaty Act |
| mg/L | milligrams per liter |
| MGD | million gallons per day |
| MISO | Midcontinent Independent Transmission System Operator, Inc. |
| MM | modified Mercalli intensity (seismic intensity scale) |
| MMBtu | million British thermal units |
| MO-DAD | MO-DAD sanitary wastewater treatment system |
| mph | miles per hour |
| MRAA | Mississippi River Alluvial Aquifer |
| mrad | milliradiation absorbed dose |
| mrem | millirem |
| MRLC | Multi-Resolution Land Characteristics Consortium |
| MSA | metropolitan statistical area |
| mSv | millisievert |
| MSW | municipal solid waste |
| MW | monitoring well (in conjunction with a number, e.g., MW-01) |
| MW | megawatt |
| MWd/MTU | megawatt-days per metric tonne uranium |
| MWe | megawatts electric |
| MWh | megawatt hour |
| N | north |
| NA | not available / not applicable |
| NAAQS | National Ambient Air Quality Standards |

| | |
|---|---|
| NE | northeast |
| NEI | Nuclear Energy Institute |
| NEPA | National Environmental Policy Act |
| NESC | National Electrical Safety Code |
| NETL | National Energy Technology Laboratory |
| NGCC | natural gas combined-cycle |
| NHPA | National Historic Preservation Act |
| NMFS | National Marine Fisheries Service |
| NNE | north-northeast |
| $NO_2$ | nitrogen dioxide |
| $NO_x$ | nitrogen oxides |
| NPDES | National Pollutant Discharge Elimination System |
| NPS | National Park Service |
| NRC | U.S. Nuclear Regulatory Commission |
| NREL | National Renewable Energy Laboratory |
| NRHP | National Register of Historic Places |
| NSWS | normal service water system |
| NW | northwest |
| NWI | National Wetlands Inventory |
| $O_2$ | oxygen |
| ODCM | Offsite Dose Calculation Manual |
| OL | operating license |
| OSHA | Occupational Safety and Health Administration |
| Pb | lead |
| pc/h/ln | passenger cars per hour per lane |
| PCB | polychlorinated biphenyl |

| | |
|---|---|
| pCi/l | picoCuries per liter |
| PILOT | payments in lieu of tax |
| $PM_{2.5}$ | particulate matter less than 2.5 micrometers in diameter |
| $PM_{10}$ | particulate matter less than 10 micrometers in diameter |
| PRA | probabilistic risk assessment |
| PV | photovoltaic |
| RBS | River Bend Station Unit 1 |
| RBS3 | River Bend Station Unit 3 |
| RCGA | R. Christopher Goodwin & Associates |
| RCRA | Resource Conservation and Recovery Act |
| rem | roentgen equivalent man |
| REMP | radiological environmental monitoring program |
| RHR | residual heat removal |
| RM | river mile (Mississippi River) |
| ROW | right-of-way |
| S | south |
| SAFSTOR | safe storage, one of three NRC decommissioning strategies |
| SAMA | severe accident mitigation alternative |
| SCPC | supercritical pulverized coal |
| SCR | selective catalytic reduction |
| SE | southeast |
| SHPO | state historic preservation office (or officer) |
| SJAE | steam jet air ejector |
| SMCL | Secondary Maximum Contaminant Level (EPA designation) |
| SMITTR | surveillance, monitoring, inspections, testing, trending, and recordkeeping |
| $SO_2$ | sulfur dioxide |
| $SO_x$ | sulfur oxides |

| | |
|---|---|
| SPCC | spill prevention, control and countermeasure |
| SSE | south-southeast |
| SSW | south-southwest |
| SU | standard units |
| SURA | Surveys Unlimited Research Associates, Inc. |
| SW | sentinel well (in conjunction with a number, e.g., SW-01) |
| SW | southwest |
| SWCS | service water cooling system |
| SWPPP | stormwater pollution prevention plan |
| TEDE | total effective dose equivalent |
| THPO | tribal historic preservation office (or officer) |
| TIGER/Line | Topologically Integrated Geographic Encoding and Referencing/Line (U.S. Census Bureau spatial data files) |
| UHS | ultimate heat sink |
| US-61 | U.S. Highway 61 |
| USACE | U.S. Army Corps of Engineers |
| USAR | updated safety analysis report |
| USC | U.S. Code |
| USCB | U.S. Census Bureau |
| USDA | U.S. Department of Agriculture |
| USFWS | U.S. Fish and Wildlife Service |
| USGS | U.S. Geological Survey |
| UTA | Upland Terrace Aquifer |
| VOC | volatile organic compound |
| W | west |
| WinMACCS | Windows Melcor Accident Consequences Code System |
| WMA | wildlife management area |

| | |
|---|---|
| WNW | west-northwest |
| WSW | west-southwest |

## 1.0 PURPOSE OF AND NEED FOR ACTION

The U.S. Nuclear Regulatory Commission (NRC) licenses the operation of domestic nuclear power plants in accordance with the Atomic Energy Act of 1954, as amended, and NRC implementing regulations. Nuclear power plants are initially licensed by the NRC to operate up to 40 years, and the licenses may be subsequently renewed for periods up to 20 years. River Bend Station Unit 1's (RBS's) operating license (OL) NPF-47 expires at midnight on August 29, 2025. The original RBS Unit 2 was cancelled on January 5, 1984 (RBS 2015, Section 1.1).

Entergy has prepared this environmental report (ER) in conjunction with its application to renew the OL, as provided by the following NRC regulations:

- Title 10, Energy, Code of Federal Regulations (CFR), Part 54, Requirements for Renewal of Operating Licenses for Nuclear Power Plants, Section 54.23, Contents of Application—Environmental Information [10 CFR 54.23], and
- Title 10, Energy, CFR, Part 51, Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions, Section 51.53, Postconstruction Environmental Reports, Subsection 51.53(c), Operating License Renewal Stage [10 CFR 51.53(c)].

For license renewal, the NRC has adopted the following definition of purpose and need, stated in Regulatory Guide 4.2, Supplement 1, Revision 1, *Preparation of Environmental Reports for Nuclear Power Plant License Renewal Applications* (NRC 2013a, page 10):

> The purpose and need for the proposed action (i.e., issuance of a renewed nuclear plant operating license) is to provide an option that allows for baseload power generation capability beyond the term of the current nuclear power plant operating license to meet future system generating needs. Such needs may be determined by other energy-planning decisionmakers, such as State, utility, and, where authorized, Federal agencies (other than the NRC). Unless there are findings in the safety review required by the Atomic Energy Act or the National Environmental Policy Act (NEPA) environmental review that would lead the NRC to deny a license renewal application, the NRC does not have a role in the energy-planning decisions of whether a particular nuclear power plant should continue to operate.

The proposed action is to renew the RBS OL, which would preserve the option for Entergy to continue to operate RBS to provide reliable base-load power throughout the 20-year license renewal period. For RBS (Facility OL NPF-47), the requested renewal would extend the existing license expiration date from midnight on August 29, 2025, to midnight on August 29, 2045.

## 1.1 Environmental Report

NRC regulation 10 CFR 51.53(c) requires that an applicant for license renewal submit with its application a separate document (Appendix E of the application) entitled, "Applicant's Environmental Report—Operating License Renewal Stage." This appendix to the RBS license renewal application (LRA) fulfills that requirement. In determining what information to include in the RBS license renewal applicant's ER, Entergy has complied with NRC regulations and relied upon the following supporting documents that provide additional insight into the regulatory requirements:

- *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), Revision 1 (NRC 2013b), and referenced information specific to transportation (64 FR 48496)
- GEIS, Addendum 1, Section 6.3—Transportation (NRC 1999)
- NRC supplemental information in the *Federal Register* (78 FR 37282)
- Regulatory Guide 4.2, Supplement 1, Revision 1, *Preparation of Environmental Reports for Nuclear Power Plant License Renewal Applications* (NRC 2013a)

Entergy has prepared Table 1.1-1 to document, in checklist form, that the 10 CFR Part 51 requirements for information to be provided in an ER in support of an LRA have been met. The requirements regarding information to be included in an ER are codified at 10 CFR 51.45 and 51.53(c). Table 1.1-1 provides the 10 CFR Part 51 regulatory language and regulatory citation, along with a citation to the ER section(s) that satisfy the 10 CFR Part 51 requirements.

**Table 1.1-1**
**Environmental Report Responses to License Renewal Environmental Regulatory Requirements**

| Description | Requirement | ER Section(s) |
|---|---|---|
| ***Environmental Report—General Requirements [10 CFR 51.45]*** | | |
| Description of the proposed action | 10 CFR 51.45(b) | 2.1 |
| Statement of the purposes of the proposed action | 10 CFR 51.45(b) | 1.0 |
| Description of the environment affected | 10 CFR 51.45(b) | 3.0 |
| Impact of the proposed action on the environment | 10 CFR 51.45(b)(1) | 4.0 |
| Adverse environmental effects which cannot be avoided should the proposal be implemented | 10 CFR 51.45(b)(2) | 6.3 |
| Alternatives to the proposed action | 10 CFR 51.45(b)(3) | 2.6, 7.0, and 8.0 |
| Relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity | 10 CFR 51.45(b)(4) | 6.5 |
| Irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented | 10 CFR 51.45(b)(5) | 6.4 |
| Analysis that considers and balances the environmental effects of the proposed action, the environmental impacts of alternatives to the proposed action, and alternatives available for reducing or avoiding adverse environmental effects | 10 CFR 51.45(c) | 2.6, 4.0, 7.0, and 8.0 |
| Federal permits, licenses, approvals, and other entitlements which must be obtained in connection with the proposed action and description of the status of compliance with these requirements | 10 CFR 51.45(d) | 9.0 |
| Status of compliance with applicable environmental quality standards and requirements which have been imposed by Federal, State, regional, and local agencies having responsibility for environmental protection, including, but not limited to, applicable zoning and land-use regulations, and thermal and other water pollution limitations or requirements | 10 CFR 51.45(d) | 9.0 |
| Alternatives in the report including a discussion of whether the alternatives will comply with such applicable environmental quality standards and requirements | 10 CFR 51.45(d) | 9.7 |

**Table 1.1-1 (Continued)**
**Environmental Report Responses to License Renewal Environmental Regulatory Requirements**

| Description | Requirement | ER Section(s) |
|---|---|---|
| Information submitted pursuant to 10 CFR 51.45(b) through (d) and not confined to information supporting the proposed action but also including adverse information | 10 CFR 51.45(e) | 4.0 and 6.3 |
| ***Operating License Renewal Stage [10 CFR 51.53(c)]*** | | |
| Description of the proposed action including the applicant's plans to modify the facility or its administrative control procedures as described in accordance with §54.21. The report must describe in detail the affected environment around the plant, the modifications directly affecting the environment or any plant effluents, and any planned refurbishment activities. | 10 CFR 51.53(c)(2) | 2.1, 2.3, 2.4, 3.0, and 4.0 |
| Analyses of the environmental impacts of the proposed action, including the impacts of refurbishment activities, if any, associated with license renewal and the impacts of operation during the renewal term, for applicable Category 2 issues, as discussed below | 10 CFR 51.53(c)(3)(ii) | 2.3 and 4.0 |
| ***Surface Water Resources*** | | |
| Surface water use conflicts (plants with cooling ponds or cooling towers using makeup water from a river) | 10 CFR 51.53(c)(3)(ii)(A) | 4.5.1.1 |
| ***Groundwater Resources*** | | |
| Groundwater use conflicts (plants that withdraw more than 100 gallons per minute [gpm]) | 10 CFR 51.53(c)(3)(ii)(C) | 4.5.2.1 |
| Groundwater use conflicts (plants with closed-cycle cooling systems that withdraw makeup water from a river) | 10 CFR 51.53(c)(3)(ii)(A) | 4.5.2.2 |
| Groundwater quality degradation (plants with cooling ponds at inland sites) | 10 CFR 51.53(c)(3)(ii)(D) | 4.5.2.3 |
| Radionuclides released to groundwater | 10 CFR 51.53(c)(3)(ii)(P) | 4.5.2.4 |

**Table 1.1-1 (Continued)
Environmental Report Responses to License Renewal
Environmental Regulatory Requirements**

| Description | Requirement | ER Section(s) |
|---|---|---|
| ***Aquatic Resources*** | | |
| Impingement and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds) | 10 CFR 51.53(c)(3)(ii)(B) | 4.6.1.1 |
| Thermal impacts on aquatic organisms (plants with once-through cooling systems or cooling ponds) | 10 CFR 51.53(c)(3)(ii)(B) | 4.6.1.2 |
| Water use conflicts with aquatic resources (plants with cooling ponds or cooling towers using makeup water from a river) | 10 CFR 51.53(c)(3)(ii)(A) | 4.6.1.3 |
| ***Terrestrial Resources*** | | |
| Effects on terrestrial resources (non-cooling system impacts) | 10 CFR 51.53(c)(3)(ii)(E) | 4.6.2.1 |
| Water use conflicts with terrestrial resources (plants with cooling ponds or cooling towers using makeup water from a river) | 10 CFR 51.53(c)(3)(ii)(A) | 4.6.2.2 |
| ***Special Status Species and Habitats*** | | |
| Threatened, endangered, and protected species and essential fish habitat | 10 CFR 51.53(c)(3)(ii)(E) | 4.6.3.1 |
| ***Historic and Cultural Resources*** | | |
| Historic and cultural resources | 10 CFR 51.53(c)(3)(ii)(K) | 4.7 |
| ***Human Health*** | | |
| Microbiological hazards to the public (plants with cooling ponds or canals or cooling towers that discharge to a river) | 10 CFR 51.53(c)(3)(ii)(G) | 4.9.1 |
| Electric shock hazards | 10 CFR 51.53(c)(3)(ii)(H) | 4.9.2 |
| ***Environmental Justice*** | | |
| Minority and low-income populations | 10 CFR 51.53(c)(3)(ii)(N) | 3.10.2 and 4.10.1 |
| ***Cumulative Impacts*** | | |
| Cumulative impacts | 10 CFR 51.53(c)(3)(ii)(O) | 4.12 |

**Table 1.1-1 (Continued)**
**Environmental Report Responses to License Renewal Environmental Regulatory Requirements**

| Description | Requirement | ER Section(s) |
|---|---|---|
| ***Postulated Accidents*** | | |
| Severe accidents | 10 CFR 51.53(c)(3)(ii)(L) | 4.15.1 |
| ***All Plants*** | | |
| Consideration of alternatives for reducing adverse impacts for all Category 2 license renewal issues | 10 CFR 51.53(c)(3)(iii) | 4.0 and 6.2 |
| New and significant information regarding the environmental impacts of license renewal of which the applicant is aware | 10 CFR 51.53(c)(3)(iv) | 4.0 and 5.0 |

## 1.2 Licensee and Ownership

Entergy Louisiana, LLC, a subsidiary of Entergy Corporation, is the owner of RBS, located in West Feliciana Parish, Louisiana. Entergy Operations, Inc., also a subsidiary of Entergy Corporation, is the licensed operator of RBS. Entergy Louisiana, LLC and Entergy Operations, Inc. (collectively referred to as "Entergy") are the holders of the RBS OL NPF-47 and, for purposes of this ER, are considered the applicant.

Based on 10 CFR Part 51, Subpart A, Appendix B, Table B-1, Footnote 4, transmission lines subject to evaluation of environmental impacts for license renewal are those that connect the nuclear power plant to the substation where electricity is fed into the regional power distribution system and transmission lines that supply power to the nuclear plant from the grid. The transmission lines subject to this evaluation (Figure 2.2-4), which are located within the RBS property, are listed below.

- One 230-kilovolt (kV) transmission line (three-phase) delivers the electrical output of RBS to the 230-kV/500-kV Fancy Point Substation. Fancy Point Substation is the connection point where electricity is fed into the regional grid (RBS 2015, Section 8.1.1).
- Two 230-kV transmission lines (three-phase) from the 230-kV/500-kV Fancy Point Substation provide offsite power for normal operation and safe shutdown of the plant. One of the transmission lines connects to RBS's transformer yard 1 located adjacent to the east wall of the turbine building, while the other transmission line connects to RBS's transformer yard 2A located outside the security fence (but inside the security owner-controlled area fence), southwest of the turbine building. (RBS 2015, Section 8.1.4)

Entergy Louisiana, LLC owns and operates the in-scope transmission lines that are subject to this environmental evaluation.

## 1.3 River Bend Station Unit 2

As stated in Section 1.0, the original RBS Unit 2 was cancelled on January 5, 1984. The excavation area for RBS Unit 2 is shown in Figure 3.0-1. The three, no-longer used RBS Unit 1 standby service water chemical-cleaning waste storage tanks (each 1.2 million gallons), currently in the former Unit 2 excavation area (EOI 2008a, Section 4.1), are empty.

## 1.4 River Bend Station Unit 3

On September 25, 2008, Entergy submitted to the NRC an application for a combined license (COL) for River Bend Station Unit 3 (RBS3). The application was based on the General Electric-Hitachi Economic Simplified Boiling Water Reactor technology. On January 9, 2009, Entergy requested the NRC suspend their review of the RBS3 COL until further notice pending Entergy's re-evaluation of alternative reactor technologies. As requested, the NRC suspended their review activities on January 12, 2009. On December 4, 2015, Entergy withdrew the RBS3 COL. (Entergy 2015a)

During preparation of the RBS LRA ER, Entergy utilized information from the RBS3 COL application where it represented current environmental characteristics at the site, or to substantiate that environmental impacts associated with RBS license renewal would have minimal environmental impacts. However, because the RBS3 COL application has been withdrawn and is no longer a reasonable foreseeable project, Entergy did not consider it as it relates to cumulative impacts.

# 2.0 PROPOSED ACTION AND DESCRIPTION OF ALTERNATIVES

## 2.1 Proposed Action

In accordance with 10 CFR 51.53(c)(2), the ER must contain a description of the proposed action. The proposed action is to renew the OL for RBS, which would preserve the option for Entergy to continue to operate RBS to provide reliable base-load power throughout the 20-year license renewal period to meet future power generating needs. For RBS (Facility OL NPF-47), the requested renewal would extend the license expiration date from midnight on August 29, 2025, to midnight on August 29, 2045.

In addition to continuing operation and maintenance activities associated with license renewal, activities to allow for extended plant operation may include refurbishment. However, refurbishment is not anticipated for RBS. The relationship of refurbishment to license renewal is described in Section 2.3.

During the license renewal term, changes to surveillance, monitoring, inspections, testing, trending, and recordkeeping (SMITTR) could be undertaken as a result of the 10 CFR Part 54 aging management review. Potential SMITTR activities are described in Section 2.4.

No other plant upgrades to support extended operations and that could directly affect the environment or plant effluents are planned.

## 2.2 General Plant Information

The ER must contain a description of the proposed action, including the applicant's plans to modify the facility or its administrative control procedures. This ER must describe in detail the affected environment around the plant and the modifications directly affecting the environment or any plant effluents. [10 CFR 51.53(c)(2)]

The principal buildings and structures at RBS consist of the primary containment structure, the shield building, the auxiliary building, the fuel building, the control building, the diesel generator building, auxiliary control building, the radwaste building, the turbine building, the water treatment building, the condensate demineralizer regeneration and offgas building, the makeup water pump structure, the circulating water pump structure, the normal service water cooling towers, the ultimate heat sink, the instrument air/service air building (RBS 2015, Section 1.2.2.2), circulating water cooling towers, independent spent fuel storage installation (ISFSI), and meteorological tower. Figure 3.0-1 shows the general features of the facility and the exclusion area boundary (EAB). No residences are permitted within the RBS EAB.

### 2.2.1 Reactor and Containment Systems

#### 2.2.1.1 Reactor System

RBS is a boiling-water reactor plant of the General Electric Type 6 design. The current licensed thermal power level is 3,091 megawatts thermal (NRC 2015a), with a net maximum output of approximately 967 megawatts electric (MWe) (Entergy 2015b, Attachment 9.1).

Preheated water, recycled from the condenser, enters the reactor vessel and flows through the reactor core, where the heat from fission reactions in the fuel causes it to boil. Steam mixed with water rises to the top of the core. Because the steam is formed within the reactor core, it contains radioactive impurities in the form of gases, termed offgases. The steam-water mixture leaves the top of the core and enters steam separators and then steam dryers, where water droplets are removed before the steam enters the steam line to the main turbine, causing it to turn the attached electrical generator. Upon exiting the turbine, the steam is sent to the condenser where it is condensed back into water as a result of heat removal by cooling water circulating in pipes that pass through the condenser shell. The condensate collects in the condenser hotwell at the bottom of the condenser shell and is pumped through feedwater heaters and back to the reactor vessel. Offgases collect in the condenser shell during plant operation and are continuously removed to the offgas treatment system by an air ejector and discharged to the environment via the station vent stack.

Fuel for RBS is low-enriched uranium dioxide (less than 5 percent by weight) in the form of ceramic pellets that are encapsulated in the standard Zircaloy-2 barrier cladding. Based on core design values, the average bundle exposure at time of discharge is 47,000 megawatt-days per metric tonne uranium (MWd/MTU). (Entergy 2015c) As discussed in Section 2.5, reactor refueling occurs on a 2-year cycle.

#### 2.2.1.2 Containment System

The primary containment system, a Mark III containment, is made up of the drywell, suppression pool, primary containment pressure vessel, and shield building. The drywell is a cylindrical, reinforced concrete structure with a removable steel head, which encloses the reactor pressure vessel. It is designed to withstand and confine reactor pressure vessel steam released during a pipe rupture inside the drywell and channel that steam into the suppression pool through the drywell/suppression pool horizontal vents. A suppression pool containing a large volume of water is used to condense steam from a safety relief valve blowdown or from a major pipe break. A leak-tight cylindrical steel containment vessel surrounds the drywell and the suppression pool to prevent gaseous and particulate fission products from escaping to the environment. A cylindrical reinforced concrete shield building completely encloses the containment vessel to protect it from adverse environmental conditions. (Entergy 2011a, pages 4 and 5)

### 2.2.2 Cooling and Auxiliary Water Systems

RBS utilizes a closed-cycle cooling heat dissipation system equipped with mechanical draft cooling towers. A schematic of water flow as it relates to RBS's operational use of the Mississippi River and the West Feliciana Parish water system is presented in Figure 2.2-1.

The cooling tower makeup water system is composed of three parts: two river intake screens and suction pipelines, a dry-pit pump house structure, and piping from the pump house structure to the clarifiers at the plant site. The system is designed to deliver a makeup water flow rate to the clarifiers of approximately 16,000 gallons per minute (gpm). (RBS 2015, Section 2.4.11.5)

The river intake screens and a barge slip are located in a manmade recession on the east bank of the Mississippi River (Figure 2.2-2) near River Mile (RM) 262. A 30-inch-diameter cooling tower blowdown discharge line is located 610 feet downstream of this recession (Figure 2.2-3) at elevation -3 feet above mean sea level (amsl) to avoid recirculation of the plant effluent to the intakes. The clarifier sludge blowdown outfall is located adjacent to and downstream of the cooling tower blowdown outfall. The recession is approximately 600 feet in length (along the river) by 450 feet in width. The entrance to the pump house structure (Figure 2.2-2) is at elevation 60 feet amsl to protect the pumps and motors from the Mississippi River Project Design Flood level (elevation 54.5 feet amsl) with wave runup. Two pumps, each sized for 16,000 gpm, are housed inside the structure. (RBS 2015, Section 2.4.11.5)

River water is conveyed to the makeup water pumps by two 36-inch-diameter suction pipelines, each 400 feet long leading to a common manifold within the pump house structure (Figure 2.2-3). A wedge-wire intake screen is mounted at the entrance to each suction pipeline. The intake suction pipelines are supported in the embayment area by 21-inch steel beams on 12-inch steel piles, driven to the stiff clay layer. At the embayment slope, the pipelines are covered by 2 feet of riprap over 1.5 feet of gravel to minimize erosion by river currents. (RBS 2015, Section 2.4.11.5)

The river intake screens are octagonal in shape, 11 feet wide diagonally and 4 feet high, and are sized so that the average intake flow velocity is less than 0.5 feet per second (fps). The velocity of the water flowing by the intake structure is approximately 0.1, 0.2, and 0.7 fps at low, average, and high water, respectively. These velocities do not affect operation of the pumps. If fouling occurs, the screens are cleaned by back-flushing. Each screen is equipped with a hinged panel that opens on a 5-foot differential pressure. This provides flow to the pumps at all times; therefore, fouling has no immediate effect on plant operation. The neck-shaped portion of bank along the upstream end of the embayment (Figure 2.2-2) minimizes the amount and rate of sediment deposition and trash carried into the recession. (RBS 2015, Section 2.4.11.5)

#### 2.2.2.1 Cooling Tower Makeup Water System

The cooling tower makeup water system supplies makeup water to the circulating water system (CWS) cooling tower discharge flume and to the service water cooling system cooling tower discharge flume to make up for losses resulting from evaporation and drift from the cooling towers. (RBS 2015, Section 9.2.11.1)

One 36-inch-diameter intake line for each intake screen conveys water to the makeup pump house (Figure 2.2-2). Within the pump house, two 36-inch-diameter intake lines manifold through a common header into two 24-inch-diameter lines, each directly connected to a makeup water pump. The intake screens can be backwashed one at a time by starting the second makeup water pump and diverting a portion of the combined flow back through the selected intake screen. The screens typically require backwashing once per day. (RBS 2015, Section 9.2.11.2)

The two cooling tower makeup water pumps located in the pump house at the Mississippi River operate in parallel. One pump is normally operated, and the second pump is reserved for standby operation. With one pump operating, the design intake flow is considered to be 23.0 million gallons per day (MGD) (Entergy 2016a), which is sufficient to deliver the maximum cooling tower makeup water requirement of 15,300 gpm (22.0 MGD). The pumps take suction from the Mississippi River and discharge through one 36-inch-diameter line to a flow splitter box feeding the two clarifiers. (RBS 2015, Section 9.2.11.2)

Two full-flow clarifiers remove suspended solids from the Mississippi River water. The clarified effluent is discharged over a weir into the circulating water flume. Each clarifier is designed to satisfactorily treat the entire requirement of makeup water for the normal cooling towers of RBS, in the event that one clarifier is out of service. Polyelectrolyte is added to the raw water to enhance flocculation and settling of suspended solids. A 5,000-gallon storage tank and three metering pumps are provided for storage and feeding of polyelectrolyte. A 5,000-gallon storage tank and two metering pumps are provided for storage and feeding of sodium hypochlorite. The chemical feed rate(s) may vary with changing influent conditions, and the metering pumps are provided with manual stroke control for maintaining a proper treatment rate. (RBS 2015, Section 9.2.11.2)

One sludge dilution tank is provided near the clarifiers to receive clarifier bottoms sludge blowdown. The blowdown from the clarifiers flows to the dilution tank where river water from the makeup water pipeline is fed and mixed in the sludge dilution tank; other sources of water can be fed to the sludge dilution tanks. The dilution tank is equipped with two full-capacity vertical mixers and two centrifugal pumps. The diluted clarifier blowdown is pumped through the clarifier sludge discharge pipeline where it is discharged via Louisiana Pollutant Discharge Elimination System (LPDES) permitted Outfall 006 to the Mississippi River (RBS 2015, Section 9.2.11.2).

#### 2.2.2.2 Circulating Water System

The CWS dissipates heat from the main condenser (RBS 2015, Section 10.4.5). The main condenser is a two shell, single pass, divided water box type heat exchanger (Entergy 2012a, page 11).

The CWS consists of four multicell cooling towers, four cooling tower outfall screens with large mesh, four circulating water pumps, and associated piping (RBS 2015, Section 10.4.5.1).

Circulating water is pumped from the circulating water pump structure, consisting of five concrete bays, through the condenser shells to the cooling towers via the 144-inch main condenser discharge header, subsequently flowing into the flume and back to the circulating water pump structure (Entergy 2012a, pages 11 and 12; RBS 2015, Section 10.4.5.2). Makeup water (approximately 23.0 MGD as shown in Figure 2.2-1) is pumped from the Mississippi River to offset the evaporation and drift losses from the CWS cooling towers and the blowdown quantities. The flow from the cooling towers is directed to circulating water pumps, which deliver water to the main condensers. The discharge from the main condensers is returned to the cooling towers for cooling prior to reuse. (RBS 2015, Section 10.4.5.2)

Blowdown water quantity is up to 6.3 MGD (Figure 2.2-1) and is extracted from the CWS to maintain an acceptable solids concentration in the CWS. Effluents from the sanitary wastewater treatment plant facility are mixed with the blowdown water and returned to the Mississippi River (RBS 2015, Section 10.4.5.2) via LPDES-permitted Outfall 001.

Four circulating water pumps provide a total design flow of 511,560 gpm. The temperature rise through the main condenser is 27 degrees Fahrenheit (°F) at 100-percent rated power of the turbine generator. Each of the four pumps is located in a separate screenwell bay, which has an inlet stop gate and primary stationary panel screen. A second panel screen is installed prior to removing the primary stationary panel screen for cleaning or maintenance. Both screens have small mesh for trash. (RBS 2015, Section 10.4.5.2)

Four multicell cooling towers are provided for a total design flow of approximately 565,000 gpm for the CWS. At 100-percent rated conditions, the temperature of cooled water from the towers is a maximum of 96°F. (RBS 2015, Section 10.4.5.2) The four multicell cooling tower basins are 200 feet in diameter with individual outlet flumes, which are open concrete trenches that lead to a main flume. The cooling tower outlets are 12 feet wide and 10 feet deep, and are equipped with individual outfall screens for removal of relatively large trash particles which discharge to the main CWS. The main CWS flume is about 600 feet in length and expands gradually in width from 22 feet at the cooling tower end to 36 feet at the circulating water pump structure. It has a maximum depth of 21 feet. (Entergy 2012a, page 11)

The water quality of the CWS is controlled to minimize scaling, corrosion, and biological fouling. This is accomplished by injecting multifunctional chemicals. One of the chemicals injected is a sodium hypochlorite/sodium bromide solution. The solution is periodically injected into the circulating water flume to inhibit biological growth in the CWS. An alternate method to inhibit biological growth is the injection of granules into the flume water by the Towerbrom® subsystem. Sulfuric acid is also injected into the flume to control cooling water pH so that scaling and corrosion in the system are minimized. Additionally, a corrosion inhibitor and a dispersant are injected into the CWS to maintain proper residual concentrations based upon the cycles of concentration and water quality. (RBS 2015, Section 10.4.5.3)

As discussed in Section 3.5.1.1.1, chemical additives are approved by the Louisiana Department of Environmental Quality (LDEQ), and discharges containing water treatment additives at or below LDEQ-approved concentrations are monitored and discharged to the Mississippi River in accordance with the site's LPDES Permit No. LA0042731.

Thermal Discharges

Blowdown water that has been de-chlorinated (ammonium bisulfite) is continuously discharged from the CWS to the Mississippi River via a 36-inch-diameter blowdown line to control the cooling tower water levels and the total dissolved solids concentration. The 36-inch-diameter blowdown line outfall is located 610 feet downstream of the intake structure (Figure 2.2-3).

As discussed above, the temperature rise through the main condenser is 27°F at 100-percent rated power of the turbine generator. Thermal discharges to the Mississippi River are continuously monitored by a recorder and plant monitoring computer that are located approximately 0.9 miles from the Mississippi River. Therefore, the temperature of the thermal discharge at the point it enters into the Mississippi River is anticipated to be less than recorded measurements.

The thermal plume in the Mississippi River associated with RBS's thermal discharges is expected to be minimal because RBS utilizes a closed-cycle cooling heat dissipation system. Additionally, the thermal discharge point into the river is more than a mile away from the plant, and the discharge flow rate would be minor when compared with river flows exhibited by the Mississippi River. The thermal discharge limitations specified in RBS's LPDES Permit No. LA0042731 are a monthly average of 105°F with a daily maximum temperature of 110°F (Attachment A). No exceedances of these thermal limitations have occurred over the previous 5 years (2012–2016).

2.2.2.3 Service Water Cooling System

The service water cooling system (SWCS) provides cooling water to remove heat from the normal service water system (RBS 2015, Section 9.2.12). The SWCS utilizes three pumps with a capacity of approximately 31,500 gpm. SWCS water is pumped from the SWCS cooling tower pump pit. Each pump discharges into the SWCS pump discharge header/common SWCS heat exchanger supply header. (RBS 2015, Section 9.2.12.2)

The SWCS common heat exchanger outlet/cooling tower supply header is routed to the SWCS cooling tower. Five risers carry the water to the top of the cooling tower where it is cooled before recirculation through the system. During normal operation and unit cool down, two of the three SWCS pumps are required to dissipate the auxiliary heat loads. The third is a spare to accommodate maintenance or failure of either of the two operating pumps. (RBS 2015, Section 9.2.12.2) Evaporation and drift losses associated with the SWCS cooling tower are approximately 0.38 MGD as shown in Figure 2.2-1.

The water quality of the SWCS is controlled to minimize scaling, corrosion, and biological fouling. This is accomplished by injecting multifunctional chemicals. A sodium hypochlorite/sodium bromide solution is periodically injected into the service water cooling tower basin to inhibit biological growth in the SWCS. An alternate method to inhibit biological growth is the injection of granules into the flume water by the Towerbrom® subsystem. Sulfuric acid is also injected into the basin to control cooling water pH so that scaling and corrosion in the system are minimized. At this pH range, the water is nonscaling and noncorrosive. Additionally, a corrosion inhibitor and a dispersant are injected into the service water cooling tower basin to maintain proper water quality. (RBS 2015, Section 9.2.12.2)

### 2.2.2.4 Normal Service Water System

The normal service water system (NSWS) provides cooling water to remove heat from turbine and reactor plant auxiliary systems and components during all modes of plant operation. It is cooled by the SWCS. (RBS 2015, Section 9.2.1)

Normal service water is pumped from the service water system heat exchangers. Three NSWS pumps (each approximately 31,500 gpm) take suction from the service water system heat exchanger common discharge header/pump suction header and discharge into the NSWS pump discharge header/common system supply header. (RBS 2015, Section 9.2.1.2)

The normal service water supply header is routed to a point outside the turbine building where the main header branches into two supply headers. One supply header branch is routed to the turbine building, while the other supply header branch is routed to the radwaste building and auxiliary building, control building, standby diesel generator building, and reactor building. (RBS 2015, Section 9.2.1.2)

During normal plant operation, the treated normal service water flows at a nominal rate of approximately 50 gpm from the normal service supply and return headers (located in the piping tunnels) up to within close proximity of the standby cooling tower and then back into the NSWS return headers to inhibit corrosion and organic fouling within the standby service water headers which are normally on standby. (RBS 2015, Section 9.2.1.2)

### 2.2.2.5 Ultimate Heat Sink

The standby cooling tower and water storage basin forms a part of the standby service water system which functions as the ultimate heat sink (UHS) (RBS 2015, Section 9.2.5). The standby cooling tower is of counter-flow, induced mechanical draft design. The basin holds approximately 6,625,314 gallons of usable water at the normal water level, which is available to make up for drift and evaporative losses over 30 days of operation. Design temperature for cold water leaving the tower is 93°F, corresponding to a design tower inlet water temperature of 116°F. (RBS 2015, Section 9.2.5.2)

A hypochlorite feed system is provided to inhibit biological growth in the UHS water storage basin. This system consists of a 1,000-gallon feed tank, a metering pump, a recirculation pump, and a network of distribution piping to allow treatment of separate compartments within the basin from the surface to the bottom elevation. Sodium hypochlorite or alternative biocides or corrosion inhibitors may periodically be added to the UHS basin, as needed, based on sampling and analysis performed by the chemistry department. (RBS 2015, Section 9.2.5.2)

The standby service water system operates under emergency conditions, in conjunction with the UHS, to remove heat from those plant components required for the safe shutdown and cool down of the unit (RBS 2015, Section 9.2.7).

2.2.2.6 Makeup Water Treatment System

The makeup water treatment system consists of two trains each having one cation exchange unit, one vacuum deaerator, two demineralizer forwarding pumps (one for standby operation), one anion exchange unit, and one mixed bed exchange unit. Each train provides the normal makeup water requirement for RBS. (RBS 2015, Section 9.2.3.2)

Associated with the makeup water treatment system are a 100,000-gallon well water storage tank which supplies water to the makeup demineralizer system and two 350,000-gallon demineralized water storage tanks which receive water from the makeup demineralizers (RBS 2015, Section 9.2.3.2). Raw water obtained from two deep wells (P-1A and P-1B) maintain the level in the 100,000-gallon well water storage tank. Water from the two 350,000-gallon demineralized water storage tanks is distributed to various services, including makeup to the condensate storage tank (RBS 2015, Section 9.2.3.2).

2.2.2.7 Potable Water System

The West Feliciana Parish Consolidated Water District No. 13 Water Supply System (RBS 2015, Section 9.2.4.2) furnishes potable water to various site areas and buildings for drinking water, bathroom facilities, decontamination showers, emergency showers, and yard hydrants (hose connections). (Entergy 2008a)

2.2.2.8 Fire Protection Water System

Fire water supply is from two ground-level tanks. Each tank has a maximum working capacity of 265,000 gallons. These tanks are filled automatically by the shallow well (P-05) makeup water pump when the water level in the tanks falls 2 feet below the overflow level. Additional makeup water is available from two deep wells. (RBS 2015, Section 9.5.1.2.1)

### 2.2.3 Radioactive Waste Management

2.2.3.1 Liquid Radwaste System

The liquid radwaste system consists of one major subsystem (waste and floor drain collector) plus one minor subsystem (phase separator/backwash). Major equipment associated with the waste and floor drain collector subsystem consists of the following (RBS 2015, Section 11.2.2):

- Four waste collector tanks and two pumps.
- Three floor drain collector tanks, two pumps, and one plate-type oil separator.
- Two radwaste filters.
- Two trains of radwaste.
- Four recovery sample tanks and three pumps.
- Two chemical regenerant tanks/chemical waste tanks and one pump.

Major equipment associated with the phase separator/backwash tank subsystem consists of the following (RBS 2015, Section 11.2.2):

- Two phase separator tanks and two pumps.
- One backwash tank and two pumps.

2.2.3.1.1 Waste and Floor Drain Collector Subsystem

Relatively low conductivity and variable activity level wastes are stored in the waste collector tanks. The tank influents include low conductivity drains from piping and equipment that cannot be returned directly to the condenser hotwell, wastes from the reactor coolant, condensate and feedwater systems, and other associated auxiliaries. Influents to the tanks also include decanted liquids from the phase separator tanks, condensate demineralizers resin rinse water, condensate storage tank overflow, decontamination and chemistry laboratory drain and ultrasonic resin cleaner wastes. (RBS 2015, Section 11.2.2.2)

Radioactive materials are removed from the input wastes by filtration (insolubles and organic removal) and ion exchange (soluble and colloidal removal). Radwaste treatment train effluent is then routed to the recovery sample tanks for transfer to the condensate storage tank, the waste collector tank inlet header for reprocessing through the radwaste treatment train, or the cooling tower blowdown line for discharge. Prior to discharge into the cooling tower blowdown line, this waste is checked for activity by a radiation monitor. Liquids with radioactivity levels exceeding specified limits or with unacceptable chemistry may be recycled back to the waste collector tanks for further processing. The radwaste deep bed filters are provided for removal of insolubles. (RBS 2015, Section 11.2.2.2)

The radwaste treatment train includes three pressure (treatment) vessels with effluent retention elements in series. Depleted treatment media are flushed out of the pressure vessel with air and water and directed, via the phase separator/backwash tank subsystem, to the radioactive solid waste system. Mobile, portable filter/demineralizers may be used whenever necessary for special applications or temporary replacement of an installed process train. (RBS 2015, Section 11.2.2.2)

Potentially high-conductivity liquid wastes from the radwaste building sumps, reactor building floor drain sumps, auxiliary building floor drain sump, fuel building floor drain sumps, turbine building floor drain sumps, and shop floor drain sumps are collected in the floor drain collector tanks. Influent to the tanks also includes the waste solidification/dewatering stream. The liquid waste is treated, as necessary, using either filter with either process train and then recovered, discharged, or returned to the waste collectors' subsystem for reprocessing. (RBS 2015, Section 11.2.2.2)

#### 2.2.3.1.2 Phase Separator/Backwash Tank Subsystem

Filter sludges, slurries, and spent resins are collected, decanted, and conveyed to the radioactive solid waste system by the phase separator/backwash tank subsystem. The phase separator tank influents include filter sludges (powdered resin and crud) produced during the operation of the reactor water cleanup system filter/demineralizers. The backwash tank influent, discussed below, can also be diverted to either of the phase separator tanks and to the waste sludge tank. (RBS 2015, Section 11.2.2.3)

Normally, one phase separator tank is in service and one is isolated to permit the short-lived isotopes to decay prior to processing through the radioactive solid waste system. Sufficient time exists between influent batches entering the in-service phase separator for the batch to settle and the decant to be drawn off. The phase separation tank pump transfers the liquid phase to the waste collector subsystem, and the concentrated sludge and expended resin is pumped directly to the radioactive solid waste system. (RBS 2015, Section 11.2.2.3)

The backwash tank accepts filter backwashes from the waste collector and floor drain influent strainers and filters, as well as the spent fuel pool and suppression pool cleanup filters, and spent resins from the condensate, radwaste, suppression pool cleanup, and fuel pool treatment vessels. These influents can be diverted from the backwash tank to either of the phase separator tanks via three-way valves in the backwash tank inlet header. Operation of the backwash tank is similar to the phase separator tanks in that solids are allowed to settle between influent batches to the tank and the decant transferred to the floor drain and waste collector subsystem. The concentrated sludge and expended media are sent directly to the radioactive solid waste system for processing. (RBS 2015, Section 11.2.2.3)

### 2.2.3.2 Gaseous Radwaste System

Components of the gaseous waste management system consist of preheaters (two), recombiners (two), offgas condenser, water separator, holdup line, cooler condensers (two), moisture separators (two), pre-filters (two), desiccant dryers (two/train), gas coolers (one/ adsorber train), adsorber beds (eight), after-filters (two), and a system isolation valve. These components make up two trains (A and B) of the offgas system. During operation, one train is in service. The train consists of one preheater and its associated recombiner, the offgas condenser and water separator, one cooler condenser and its associated moisture separator, one pre-filter, one desiccant dryer, both trains of adsorber beds (eight total), and one after-filter. (Entergy 2013a, page 7)

The offgas is removed from the main condenser by the steam jet air ejector (SJAE). Main steam provides the driving force for the offgas in the SJAE. It also dilutes the offgas to a mixture of 4 percent hydrogen or less so that a combustible concentration does not occur in the offgas line. The diluted offgas exits the SJAE and enters the preheater, where it is superheated to approximately 350°F. This 350°F-offgas mixture enters the catalytic recombiner, where the hydrogen and oxygen are recombined by an exothermic reaction induced by the platinum-palladium catalyst. The vapor exiting the recombiner is in the form of superheated steam at about 750°F. The removal of the hydrogen and oxygen yields a reduction in offgas volume and reduces the downstream hydrogen concentration. (Entergy 2013a, page 7)

The gas mixture leaving the recombiner enters the shell side of the offgas condenser. The condensate system provides the cooling medium on the tube side of the offgas condenser, condensing the dilution steam and water content produced by the recombination of $H_2$ and $O_2$ in the recombiner. Most of the process flow leaving the offgas condenser is non-condensables and air from in-leakage into the main condenser or service air addition. (Entergy 2013a, page 8)

When the gas mixture is cooled and water vapor is condensed in the offgas condenser, some water droplets are carried over in the process flow. The gas mixture passes through the water separator to remove these droplets. The process flow enters the water separator near the bottom, passes through a wire mesh, which removes the water droplets, and then exits near the top. The water droplets are directed through a drain line at the bottom of the water separator back to the offgas condenser. (Entergy 2013a, page 8)

The gas mixture is then sampled for hydrogen and oxygen en route to the holdup line. Between the water separator and the holdup line, two hydrogen analyzers and two oxygen analyzers sample the gas mixture. They provide indication of hydrogen and oxygen concentration, and provide inputs into the control system for the hydrogen water chemistry system. Additionally, a pre-treatment radiation monitor samples the offgas process flow prior to the holdup line. (Entergy 2013a, page 8)

The offgas then enters a large diameter pipe, known as the holdup line. This yields an additional delay time, approximately 10 minutes at rated flow, to give the shorter-lived radioisotopes time to decay. Moisture collects on the walls of the holdup line as the gases cool. This condensate is drained from the holdup line through a loop seal to the recovered water sump. (Entergy 2013a, page 8)

Leaving the holdup line, the gas enters the shell side of the in-service cooler condenser. An ethylene-glycol solution from the glycol cooling system is pumped through the tube side of the in-service cooler condenser as the cooling medium, and cools the offgas mixture to approximately 45°F. (Entergy 2013a, page 8) The 45°F offgas then passes through the in-service moisture separator, which removes any water droplets entrained in the process flow. The moisture separator uses a wire mesh, much like the water separator, to remove the water droplets from the offgas. The moisture separator drain line joins the cooler condenser drain line. (Entergy 2013a, page 9)

After exiting the moisture separator, the offgas enters the pre-filter. The pre-filters are high-efficiency particulate absorption (HEPA) filter elements that remove particulate daughters of fission product gases 0.3 microns and larger with an efficiency of 99.97 percent. The gas mixture then enters the gas dryer, consisting of two separate trains, one in service and the other in standby. Each train contains two desiccant dryers, one in service and the other one being regenerated or in standby. Regeneration of a saturated bed takes approximately 12 hours. Completion of regenerating a dryer is determined by measuring the dryer exhaust temperature. Once this temperature reaches 350°F, the dryer subsystem is realigned and the desiccant dryer is allowed to cool to 100°F to 120°F, at which time the regeneration process is secured and the desiccant dryer is placed in standby. When startup is in progress, the process steam is directed through one desiccant bed until dew point is high and swapping to the standby dryer is required. (Entergy 2013a, page 9)

From here, the offgas stream is either directed around or through the charcoal adsorbers. During normal operation, the flow is directed through the adsorbers; however, during startup, when high moisture conditions exist and gas activity is low, the adsorbers are bypassed. When the offgas is directed through the adsorbers, it first passes through the gas coolers. The vault refrigeration machines cool the gas coolers and maintain the vault at approximately 0°F. The offgas enters the gas coolers at a maximum of 90°F and enters the adsorbers at about -3°F. The offgas process flow is cooled and the charcoal beds are maintained cold to maximize the adsorption efficiency of the charcoal beds. In their passage through charcoal beds, the fission products, especially xenon and krypton, are adsorbed (i.e., delayed, relative to the bulk air flow) allowing them to decay. As they decay, heat is given off. The significant particulate daughters of these radioisotopes (Strontium-89, Strontium-90, Barium-140, and Cesium-137) are held in the charcoal beds. The charcoal also retains almost all iodine present in the gas stream. (Entergy 2013a, pages 9 and 10)

At this point, the offgas coming through or around the adsorbers is sampled by the post-treatment radiation monitors. After the post-treatment radiation monitors, the offgas passes through one of two after-filters. These filters are HEPA filters. They collect particulates from the offgas to prevent particulate release into the plant exhaust. (Entergy 2013a, page 10)

#### 2.2.3.2.1 Plant Exhaust Duct System

The plant airborne radioactive releases to the environs are from three monitored roof-vent locations or points. These points are the plant exhaust duct, the fuel building exhaust duct, and the radwaste building exhaust duct. (RBS 2015, Section 11.3.3.1)

The plant exhaust duct is above the reactor building dome, which is the tallest structure in the power block. The main plant exhaust duct releases ventilation air from the following plant areas and systems (RBS 2015, Section 11.3.3.1):

- Reactor building
- Auxiliary building
- Turbine building
- Plant piping and electrical tunnels
- Backwash receiving tank vent
- Sample station vents
- Turbine gland seal exhaust steam system
- Offgas system
- Mechanical vacuum pump exhaust

The fuel and radwaste buildings exhaust ducts release ventilation air from their respective ventilation systems. These ventilation systems include sample station vents, tank vents, spent fuel pool sweep gas system, and building area ventilation exhaust. (RBS 2015, Section 11.3.3.1)

#### 2.2.3.3 Solid Radwaste System

The solid radwaste system consists of the following (RBS 2015, Section 11.4.2.1):

- One waste sludge tank, complete with level-detection devices and mixing and flushing equipment.
- One waste sludge pump with associated controls and instrumentation.
- One indoor, electric, overhead, single-trolley bridge crane.
- One waste compactor.

The waste sludge tank provides the capability for mixing various types of wastes prior to processing. An agitator provides a homogeneous waste slurry for feeding to the portable waste solidification/dewatering system. The tank is vented to the radwaste building ventilation system. An overflow from the tank is returned to the liquid radwaste backwash tank for reprocessing. The waste sludge pump transports the homogeneous waste slurry from the waste sludge tank to the processing equipment. The bridge crane is the primary means of moving waste 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. The waste compactor is designed to reduce the volume of compressible dry radioactive wastes. The compactor is vented through a hooded exhaust fan and filter to control airborne particles during dry waste compaction. (RBS 2015, Section 11.4.2.2)

Wastes consisting of spent resin beads, resin fines, filter sludges, and other processing media from the liquid radwaste system are collected and mixed in the waste sludge tank or may be delivered directly to the portable processing system. If the waste is to be solidified, the solids are mixed for uniform dispersion of activity and analyzed. If the wastes are to be dewatered, a representative sample can be obtained and analyzed for waste characterization. The waste sludge system is presently being bypassed, and all solid waste is being pumped to the processing unit where it is sampled and analyzed prior to shipping. (RBS 2015, Section 11.4.2.1)

#### 2.2.3.3.1 Dry Waste Disposal

The solid waste system disposes of dry wastes consisting of dry filter media, contaminated clothing, small tools, rags, miscellaneous paper, glassware, wood, and equipment and miscellaneous wastes which cannot be effectively decontaminated prior to packaging. The segregation and removal of clean waste is usually performed to minimize the volume of waste to be buried. This may be performed on or off site. Temporary vendor services or Entergy facilities may be used to accomplish this. (RBS 2015, Section 11.4.2.3.3)

Compressible waste may be compacted, using a compactor, into metal drums or boxes on or off site to reduce its volume. Compressible wastes are compacted by a compactor into 52- or 55-gallon drums to reduce their volume. The compactor exhaust is filtered to minimize airborne contamination during compaction. Noncompressible wastes are packaged manually in appropriate containers. The packaging of large waste materials and equipment that have been activated during reactor operation is handled on a case-by-case basis. Storage space for approximately 26,800 cubic feet of miscellaneous dry active waste in drums and boxes is provided. This waste is stored in the radwaste building, the low-level radwaste (LLRW) storage facility, or approved temporary storage facilities. These facilities are used to store radioactive material, compacted waste, and packaged non-compatible waste. Dry active wastes, which cannot be packaged into drums or boxes, may be stored in a temporary dry active waste storage area of the radwaste building until transfer to one of the temporary dry active waste storage facilities. Segregation, packaging, and compacting of loose radwaste is performed prior to transfer of the waste to these facilities. (RBS 2015, Section 11.4.2.3.3)

#### 2.2.3.3.2 Low-Level Radwaste Storage Facility

The LLRW storage facility has the capacity to store Sea-Land containers (8 feet x 20 feet x 8 feet high) and 96 high integrity containers (HICs). The facility contains 12 concrete cubicles to store HICs. Each cubicle has the capacity to hold eight HICs, (i.e., four stacked two high). (RBS 2015, Section 11.4.2.7.1)

#### 2.2.3.4 Radwaste Storage—License Renewal Term

RBS has developed long-term plans which would ensure that radwaste generated during the license renewal term would be sent directly for disposal, 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 the need to construct additional onsite storage facilities to accommodate generated radwaste.

LLRW is classified as Class A, Class B, or Class C (minor volumes are classified as greater than Class C). Class A includes both dry active waste and processed waste (e.g., dewatered resins). Classes B and C normally include processed waste and irradiated hardware. The majority of LLRW generated at RBS would be Class A waste and can typically be shipped to licensed processors, such as the EnergySolutions facilities (Bear Creek and Gallaher) in Oak Ridge, Tennessee, or the Studsvik facility in Erwin, Tennessee, for reduction and repackaging, and then shipped to a Class A disposal facility such as the EnergySolutions facility in Clive, Utah. Classes B and C wastes constitute a low percentage by volume of the total LLRW generated, and they are currently stored at the RBS LLRW storage facility. Classes B and C wastes could potentially be shipped to the Waste Control Specialist facility in Texas, which is licensed for disposal of Classes A, B, and C wastes. Disposal of waste classified greater than Class C is the responsibility of the federal government.

#### 2.2.3.5 Low-Level Mixed Waste

The generation of low-level mixed waste (LLMW) at RBS occurs on an infrequent basis and in small quantities. Typical LLMW that is generated consists of non-bulk products such as solvents, coatings, and off-specification materials. When generated, this waste is managed in accordance with appropriate site and company procedures (Entergy 2015d), and shipped to an offsite licensed facility such as the Permi-Fix facility in Gainesville, Florida, for final disposition. RBS does not currently claim the Low-Level Mixed Waste Storage and Treatment Conditional Exemption in 40 CFR Part 266, Subpart N, for storage of LLMW. However, RBS is planning to claim the exemption in the future to allow flexibility in managing LLMW generated and stored at the site.

#### 2.2.3.6 Spent Fuel Storage

The RBS ISFSI is located within the plant protected area (Figure 3.0-1) and is designed to store 2,720 spent fuel assemblies in 40 casks (68 assembles per cask). The RBS ISFSI operates under the conditions of the general license in accordance with 10 CFR Part 72 regulations. (Entergy 2008b)

NUREG-2157, *Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel,* generically determines the environmental impacts of continued storage, including those impacts identified in the remand by the Court of Appeals in the *New York v. NRC* decision, and provides a regulatory basis for a revision to 10 CFR 51.23 that addresses the environmental impacts of continued storage for use in future NRC environmental reviews. In this context, "the environmental impacts of continued storage" means those impacts that could occur as a result of the storage of spent nuclear fuel at at-reactor and away-from-reactor sites after a reactor's licensed life for operation and until a permanent repository becomes available. NUREG-2157 evaluates potential environmental impacts to a broad range of resources. Cumulative impacts are also analyzed. (NRC 2014a, page iii)

#### 2.2.3.7 Transportation of Radioactive Materials

RBS radioactive waste shipments are packaged in accordance with NRC [10 CFR Part 71] and U.S. Department of Transportation [49 CFR Parts 173 and 178] requirements. The type and quantities of solid radioactive waste generated at and shipped from RBS vary from year to year, depending on plant activities. RBS currently transports radioactive waste to a licensed processing facility in Tennessee such as EnergySolutions in Oak Ridge (Bear Creek and Gallaher) or the Studsvik Processing Facility LLC in Erwin, where it is further processed prior to being sent to a facility such as EnergySolutions in Clive, Utah.

### 2.2.4 Nonradioactive Waste Management

The Resource Conservation and Recovery Act (RCRA) governs the disposal of solid waste. The LDEQ has received U.S. Environmental Protection Agency (EPA) authorization to administer and enforce the hazardous waste management program in Louisiana. As a generator of hazardous wastes, RBS is required to maintain a hazardous waste generator identification number (Table 9.1-1). There are no nonradioactive hazardous waste storage or treatment permits related to RBS's operations.

RBS generates nonradioactive waste as a result of plant maintenance, cleaning, and operational processes that occur at the site. Because RBS is classified as a small quantity generator, hazardous wastes routinely make up only a small percentage of the total wastes generated, consisting of paint wastes, spent and off-specification (e.g., shelf-life expired) chemicals, and occasional project-specific wastes. Universal wastes generated typically consist of fluorescent lamps, batteries, mercury devices, electronics (state-specific), and antifreeze (state-specific). Recycled wastes typically consist of scrap metal, batteries, and used oil.

Nonradioactive wastes are collected in central collection areas and managed in accordance with appropriate regulatory requirements and Entergy's waste management procedure (Entergy 2015d). Waste 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 hazardous waste quantities generated at the facility are shown in Table 2.2-1.

Entergy Corporation maintains a list of waste vendors that are approved for use across the entire company. Based on 2011–2015 waste shipments from RBS, the following Entergy-approved waste vendors were utilized to manage hazardous and nonhazardous wastes, and recyclable wastes generated at the site:

- Clean Harbors Deer Park, LLC in La Porte, Texas, for treatment and disposition of hazardous wastes.
- Clean Harbors Eldorado, LLC in El Dorado, Arkansas, for treatment and disposition of hazardous wastes.
- Safety-Kleen Systems, Inc. in Smithfield, Kentucky, for treatment and disposition of hazardous wastes.
- BFI Colonial Landfill in Sorrento, Louisiana, for landfill burial of nonhazardous wastes.
- Woodside Landfill in Walker, Louisiana, for landfill burial of nonhazardous wastes.
- FCC Environmental, LLC (now Heritage-Crystal Clean, LLC) in New Orleans, Louisiana, for recycling used oil, filters, oily wastewater, and oily absorbents.
- Lamp Environmental Industries in Hammond, Louisiana, for recycling polychlorinated biphenyl (PCB) ballasts and mercury devices.
- Lamp Environmental Industries in Independence, Louisiana, for recycling batteries, electronics, fluorescent lamps, and non-PCB ballasts.
- Aaron Oil in Berwick, Louisiana, for recycling used oil.
- Lard Oil Company in Denham Springs, Louisiana, for recycling empty drums.
- Louisiana Scrap Metal in Port Allen, Louisiana, for recycling drums and lead-acid batteries.
- Acadian Recovery in Lafayette, Louisiana, for recycling tote bins.
- Eastside Recyclers in Denham Springs, Louisiana, for recycling lead-acid batteries.
- Exide Battery in Baton Rouge, Louisiana, for recycling batteries.
- Biomedical Waste Solutions in Port Arthur, Texas, for treatment and disposition of medical wastes.

Although waste quantities generated each year may vary due to outages or specific project activities, RBS has successfully minimized waste generation. Waste minimization measures such as material control, process control, waste management, and feedback are considerations that are an integral part of all work planning and implementation at the facility to reduce, to the extent feasible, waste generated, accumulated, or disposed (Entergy 2015e). Entergy's fleet waste management and chemical control programs (Entergy 2015d; Entergy 2015f) also work in conjunction with site waste minimization efforts to minimize waste generation to the maximum extent practicable.

Entergy's chemical control program is designed to minimize the amount of chemicals brought on site by requiring personnel requesting a new chemical product to review the existing stock system to determine if a similar product already exists. If so, personnel are directed to utilize the similar product already in stock. In addition, the chemical control program encourages departments with surplus chemicals in usable condition to transfer these chemicals, unless restricted by plant procedures, to other Entergy organizations; sell as surplus; or to maintain the chemicals in good condition to perform their intended use. Entergy's waste management program encourages finding alternate uses also. In addition, for some products, the expiration dates can be extended in accordance with Entergy's shelf life program (Entergy 2013b).

### 2.2.5 Power Transmission Systems

#### 2.2.5.1 In-Scope Transmission Lines

Based on 10 CFR Part 51, Subpart A, Appendix B, Table B-1, Footnote 4, transmission lines subject to evaluation of environmental impacts for license renewal are those that connect the nuclear power plant to the substation where electricity is fed into the regional power distribution system, and transmission lines that supply power to the nuclear plant from the grid. As discussed in Section 1.2, the following transmission lines associated with RBS, designated as in-scope transmission lines for the environmental review, are subject to evaluation (Figure 2.2-4):

- One 230-kV transmission line (three-phase) delivers the electrical output of RBS to the 230-kV/500-kV Fancy Point Substation. Fancy Point Substation is the connection point where electricity is fed into the regional grid.

- Two 230-kV transmission lines (three-phase) from the 230-kV/500-kV Fancy Point Substation provide offsite power for normal operation and safe shutdown of the plant. One of the transmission lines connects to RBS's transformer yard 1 located adjacent to the east wall of the turbine building, while the other transmission line connects to RBS's transformer yard 2A located outside the security fence (but inside the security owner-controlled area fence), southwest of the turbine building.

All in-scope transmission lines are owned and operated by Entergy Louisiana, LLC and are located completely within the RBS property.

#### 2.2.5.2 Vegetation Management Practices

There is a limited amount of right-of-way (ROW) associated with the two in-scope transmission lines, because the lines cross the RBS industrial area, where vegetation is sparse. For the approximately 8 acres where a transmission line ROW exists, Entergy Louisiana, LLC maintains the ROW by applying spot herbicide treatments to treat undesirable brush and woody vegetation on a 2-year cycle (Entergy 2011b; Entergy 2012b). Herbicide application volumes typically range from 10 to 25 gallons per brush acre (Entergy 2012b). Based on Entergy's vegetation management practices, typical herbicides applied in the ROW away from areas near aquatic sites include Milestone®, while Rodeo® and Garlon® 3A are utilized in areas near aquatic sites. All chemical herbicide mixtures/formulations are applied according to label directions and/or manufacturer recommendations by licensed companies with qualified applicators (Entergy 2012b), which ensures that proper protocols are followed when applying herbicides near streams or wetlands.

As discussed in Section 2.2.5.1, all in-scope transmission lines are located completely within the RBS property. Based on a 2015 Phase 1A cultural resources survey of the RBS property, no historic or prehistoric sites were identified along the transmission lines that extend between the plant and the 230-kV/500-kV Fancy Point Substation (CEI 2015). However, any land disturbance activities in the transmission line corridor would be subject to review in accordance with Entergy's fleet administrative procedural controls discussed in Sections 9.5.20 and 9.6. These procedural controls would ensure that environmentally sensitive areas at RBS such as cultural resources, if present, are adequately protected.

#### 2.2.5.3 Avian Protection

Although no active monitoring program is in place or required, based on a review of condition report records over the previous 5 years (2011–2015) that would have typically documented bird deaths, no bird deaths related to RBS's onsite transmission lines were observed and recorded. Because no adverse trend has been noted, there has not been a need to implement avian protection measures associated with the in-scope transmission lines.

#### 2.2.5.4 Induced Shock Hazards

Public

As stated in Section 2.2.5.1, all in-scope transmission lines are located completely within RBS property. Therefore, the public does not have access to this area and, as a result, no induced shock hazards would exist for the public.

Plant Workers

Section 4.2.7 of the RBS *Final Environmental Statement* (FES) states the transmission lines were constructed in accordance with the National Electric Safety Code (NESC). Section 5.5.1.2 of the RBS FES, which assessed the induced shock impacts of two units and their associated 230-kV and 500-kV transmission lines, concluded that the transmission lines would not exceed the NESC 5-milliampere (mA) Rule. Based on the RBS FES, it was anticipated that the electric field strength under the power lines would conform to the NESC guidelines (less than 7.5 kV/m maximum within the ROW, and less than 2.6 kV/m maximum at the edge of the ROW). (NRC 1985)

The Occupational Safety and Health Administration (OSHA) governs the occupational safety and health of the RBS operations staff. It was determined in NUREG-1437 that occupational safety and health hazard issues are generic to all types of electricity generating stations, including nuclear power plants, and are of small significance if the workers adhere to safety standards and use protective equipment (NRC 2013b, Section 3.9.5.1).

Operational requirements associated with OSHA are incorporated into RBS's occupational health and safety program. Specifically, as it relates to transmission lines and acute shock hazards, RBS has implemented the following practices which limit the potential for workers to receive an "induced" current from an object becoming capacitively charged:

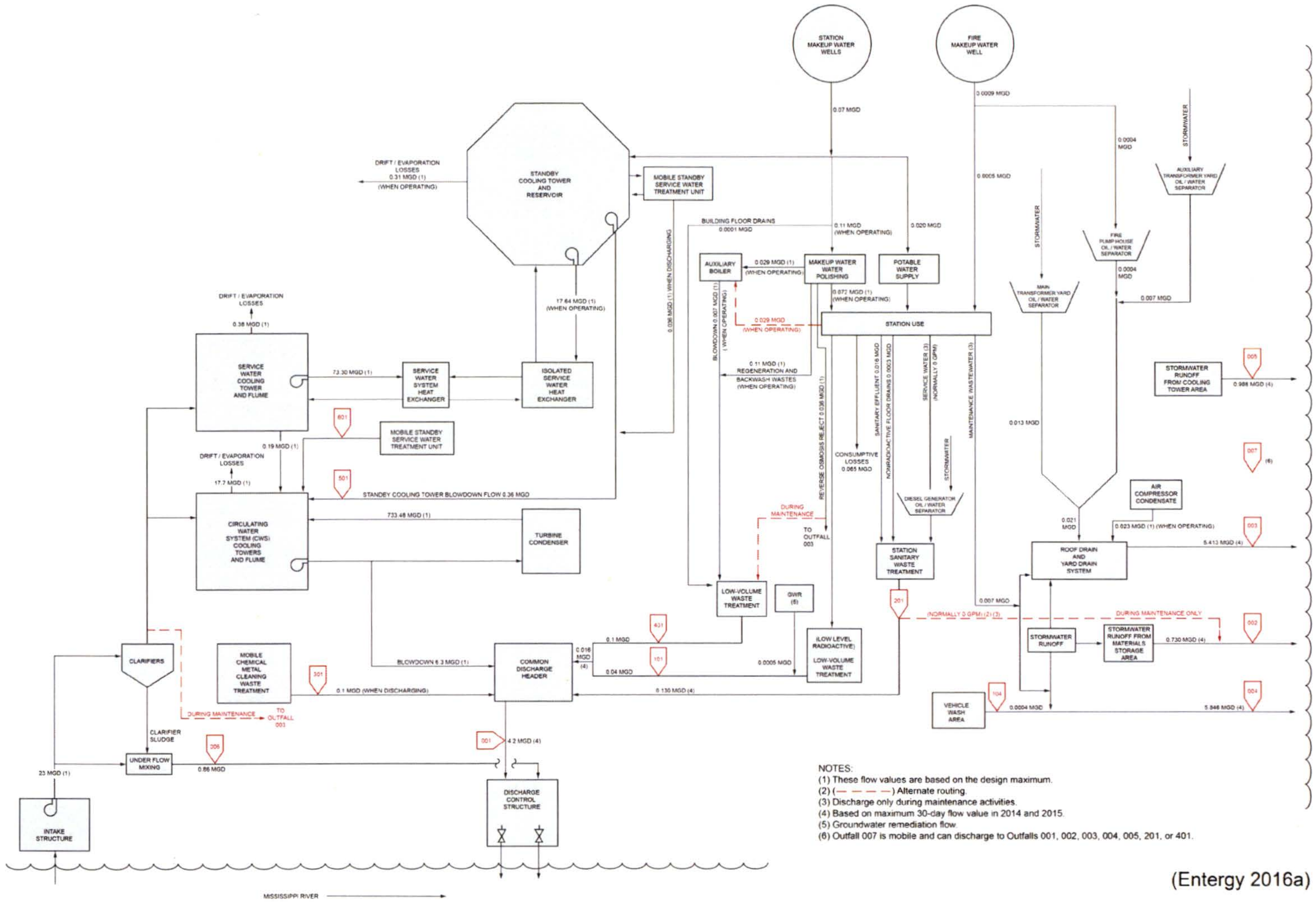
- When a truck, mobile crane, or other equipment is flagged and considered energized, employees standing on the ground must avoid contacting the truck, crane, or equipment unless suitable protective clothing is used. In addition, an insulated access must be used for persons getting on and off the truck, crane, or equipment. (Entergy 2015g, Section 5.3)
- Mobile cranes or other lifting equipment are grounded where the possibility of static buildup is present. (Entergy 2015g, Section 5.3)
- Briefings are conducted and a safety checklist.completed on approach distances for vehicles, cranes, and personnel when working near energized conductors. (Entergy 2015h, Section 5.10)
- Personnel are required to wear appropriate protective equipment. (Entergy 2015h, Section 5.10)
- Overhead hazards located over a roadway are identified by one or all of the following methods: (1) orange aviation balls or flags on power lines ≤ 100 feet from the ground, (2) roadway signs indicating "Overhead Hazard," and (3) painted warnings no closer than 30 feet from the approach points to the overhead hazard on paved/finished roadways. (Entergy 2015g, Section 5.3)

**Table 2.2-1**
**RBS Hazardous Waste Generation, 2011–2015**

| Year | Pounds |
|---|---|
| 2011 | 958 |
| 2012[a] | 6,659 |
| 2013[a] | 4,204 |
| 2014 | 832 |
| 2015 | 1,170 |

(Entergy 2016b)

a. Increase due to disposition of expired warehouse and laboratory products. Refer to Section 2.2.4 for programs utilized to manage RBS's chemical inventory to avoid excess volume of unused or expired chemicals.

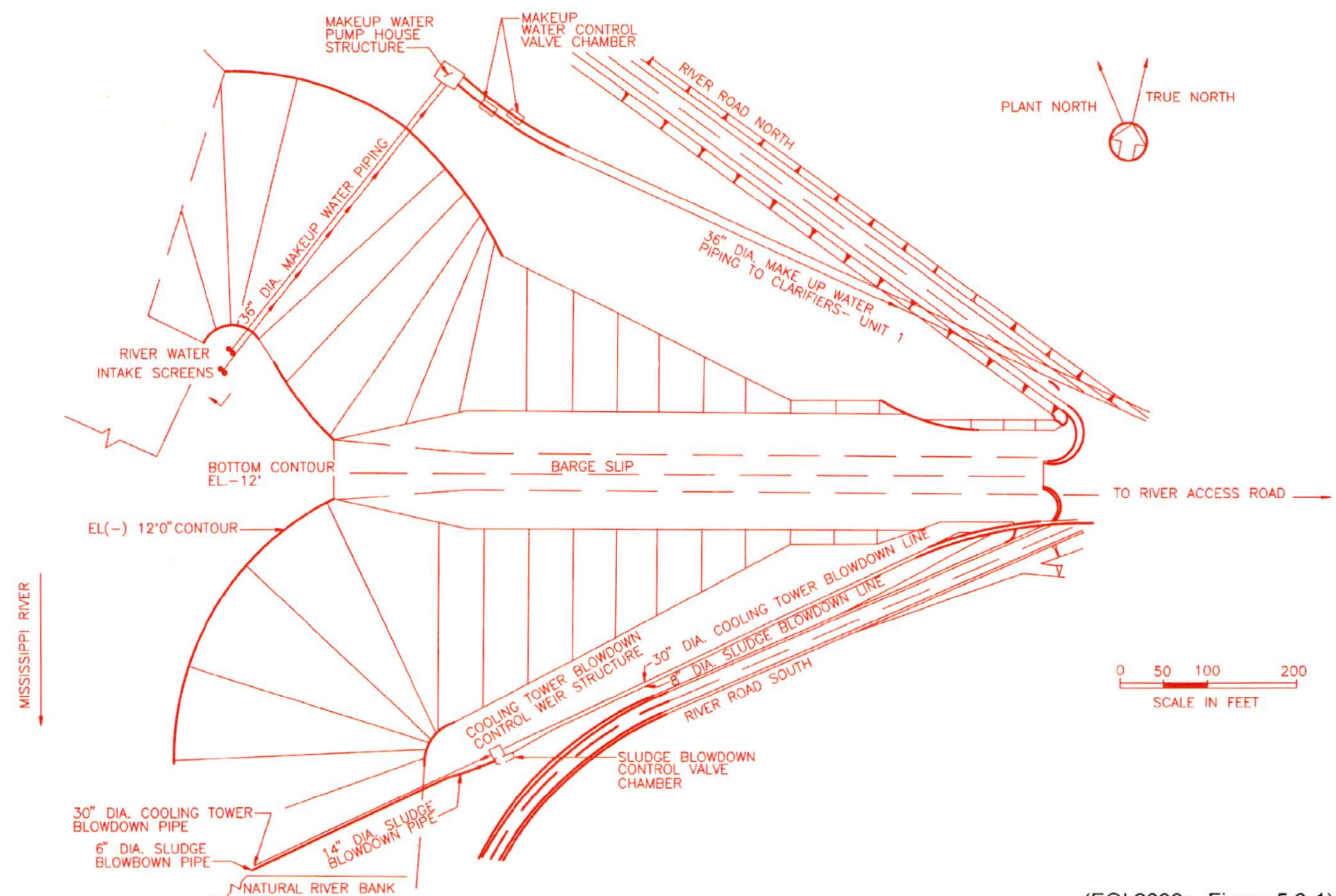



(Entergy 2016a)

**Figure 2.2-1**
**RBS LPDES Permit Schematic Flow Diagram**


(ESRI 2015; GSU 1981)

**Figure 2.2-2**
**RBS Intake and Discharge Structures Location**




(EOI 2008a, Figure 5.3-1)

Note: Elevations are at amsl.

**Figure 2.2-3**
**RBS Intake-Discharge Embayment Area**


**Figure 2.2-4**
**RBS In-Scope Transmission Lines**

## 2.3 Refurbishment Activities

In accordance with 10 CFR 51.53(c)(2), the environmental report must contain a description of the applicant's plans to modify the facility or its administrative control procedures as described in accordance with § 54.21. This report must describe in detail any planned refurbishment activities. In accordance with 10 CFR 51.53(c)(3)(ii), the environmental report must also contain analyses of the impacts of refurbishment activities, if any, associated with license renewal.

The incremental aging management activities implemented to allow operation of a nuclear power plant beyond the original 40-year license term were assumed to fall under one of two broad categories: (1) SMITTR actions, most of which are repeated at regular intervals, and (2) categories involving refurbishment actions, which usually occur infrequently and possibly only once in the life of the plant for any given item. (NRC 2013b, Section 2.1.1)

NRC requirements governing the renewal of operating licenses for nuclear power plants include preparation of an integrated plant assessment (IPA) [10 CFR 54.21]. The IPA must identify systems, structures, and components subject to an aging management review. Items that are subject to aging and might require refurbishment include, for example, reactor vessel head and steam generator replacement.

The RBS IPA that Entergy conducted under 10 CFR Part 54, which is described in Appendix A (Updated Safety Analysis Report Supplement) of the RBS LRA, has identified no refurbishment or replacement actions needed to maintain the functionality of important systems, structures, and components during the period of extended operation. 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 LRA.

## 2.4 Programs and Activities for Managing the Effects of Aging

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

The incremental aging management activities implemented to allow operation of a nuclear power plant beyond the original 40-year license term were assumed to fall under one of two broad categories: (1) SMITTR actions, most of which are repeated at regular intervals . . . . (NRC 2013b, Section 2.1.1)

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 Appendix B (Aging Management Programs and Activities) of the RBS LRA. The evaluation of structures and components required by 10 CFR 54.21 identified the activities necessary to manage the effects of aging on structures and components during the period of extended operation beyond the initial license term. Other than implementation of the programs and activities identified in the IPA, there are no planned modifications of RBS's administrative control procedures associated with license renewal.

## 2.5 Employment

The non-outage work force at the site consists of approximately 680 full-time workers (Table 2.5-1). There are no plans to add workers to support plant operations during the license renewal period and, as discussed in Section 2.3, no license-renewal-related refurbishment activities have been identified. During refueling outages, which occur on a 2-year cycle and historically have lasted approximately 25–30 days, there are typically an additional 700–900 contractor workers on site. 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.

**Table 2.5-1**
**RBS Employee Residence Information, October 2016**

| Parish/County | City/Town | Permanent Full-Time Employees |
|---|---|---|
| **LOUISIANA** | | |
| **Ascension** | | **17** |
| | Geismar | 2 |
| | Gonzales | 6 |
| | Prairieville | 9 |
| **Avoyelles** | | **2** |
| | Plaucheville | 2 |
| **Concordia** | | **1** |
| | Ferriday | 1 |
| **East Baton Rouge** | | **339** |
| | Baker | 14 |
| | Baton Rouge | 119 |
| | Central | 2 |
| | Greenwell Springs | 20 |
| | Pride | 7 |
| | Zachary | 177 |
| **East Feliciana** | | **38** |
| | Clinton | 9 |
| | Ethel | 6 |
| | Jackson | 10 |
| | Norwood | 2 |
| | Slaughter | 9 |
| | Wilson | 2 |
| **Iberville** | | **4** |
| | Gross Tete | 3 |
| | Plaquemine | 1 |

**Table 2.5-1 (Continued)**
**RBS Employee Residence Information, October 2016**

| Parish/County | City/Town | Permanent Full-Time Employees |
|---|---|---|
| **Lafayette** | | **1** |
| | Lafayette | 1 |
| **Livingston** | | **47** |
| | Denham Springs | 35 |
| | French Settlement | 1 |
| | Holden | 2 |
| | Livingston | 1 |
| | Walker | 8 |
| **Pointe Coupee** | | **20** |
| | Batchelor | 1 |
| | Fordoche | 1 |
| | Glynn | 1 |
| | Jarreau | 2 |
| | Livonia | 1 |
| | Morganza | 2 |
| | New Roads | 9 |
| | Ventress | 3 |
| **St. Bernard** | | **1** |
| | St. Bernard | 1 |
| **St. Charles** | | **2** |
| | Destrehan | 1 |
| | Paradis | 1 |
| **St. Helena** | | **2** |
| | Greensburg | 2 |
| **St. Landry** | | **1** |
| | Opelousas | 1 |

**Table 2.5-1 (Continued)**
**RBS Employee Residence Information, October 2016**

| Parish/County | City/Town | Permanent Full-Time Employees |
|---|---|---|
| **Tangipahoa** | | **2** |
| | Amite | 2 |
| **West Baton Rouge** | | **7** |
| | Addis | 2 |
| | Port Allen | 5 |
| **West Feliciana** | | **127** |
| | St. Francisville | 125 |
| | Tunica | 1 |
| | Wakefield | 1 |
| **FLORIDA** | | |
| **Bay** | | **1** |
| | Panama City Beach | 1 |
| **ILLINOIS** | | |
| **De Witt** | | **1** |
| | Farmer City | 1 |
| **INDIANA** | | |
| **Marion** | | **1** |
| | Indianapolis | 1 |
| **MICHIGAN** | | |
| **Berrien** | | **1** |
| | Benton Harbor | 1 |
| **MISSISSIPPI** | | |
| **Adams** | | **5** |
| | Natchez | 5 |

**Table 2.5-1 (Continued)**
**RBS Employee Residence Information, October 2016**

| Parish/County | City/Town | Permanent Full-Time Employees |
|---|---|---|
| **Amite** | | **6** |
| | Gloster | 4 |
| | Liberty | 2 |
| **Franklin** | | **2** |
| | Roxie | 2 |
| **Jefferson** | | **1** |
| | Fayette | 1 |
| **Madison** | | **4** |
| | Auburn | 1 |
| | Madison | 2 |
| | Ridgeland | 1 |
| **Warren** | | **1** |
| | Vicksburg | 1 |
| **Wilkinson** | | **42** |
| | Centreville | 10 |
| | Crosby | 4 |
| | Woodville | 28 |
| **NEBRASKA** | | |
| **Nemaha** | | **1** |
| | Auburn | 1 |
| **OHIO** | | |
| **Lucas** | | **1** |
| | Oregon | 1 |
| **PENNSYLVANIA** | | |
| **Chester** | | **1** |
| | West Chester | 1 |

**Table 2.5-1 (Continued)**
**RBS Employee Residence Information, October 2016**

| Parish/County | City/Town | Permanent Full-Time Employees |
|---|---|---|
| **TEXAS** | | |
| **Liberty** | | **1** |
| | Cleveland | 1 |
| **TOTAL** | | **680** |

(Entergy 2016c)

## 2.6 Alternatives to the Proposed Action

Section 2.1 describes the proposed action, which is for the NRC to renew the RBS OL for an additional 20 years beyond the current expiration date. Because the decision before the NRC is to renew or not renew the licenses, there is only one fundamental alternative to the proposed action: the no-action alternative. However, the no-action alternative would presumably result in a need for new electricity-generating capacity in the region served by RBS.

The no-action alternative refers to a scenario in which the NRC does not renew the RBS OL. Unlike the proposed action of renewing the OL, denying license renewal does not provide a means of meeting future electric system needs. Therefore, unless replacement generating capacity is provided as part of the no-action alternative, a large amount of base-load generation would no longer be available, and the alternative would not satisfy the purpose and need for the proposed action (Section 1.0). For this reason, the no-action alternative has two components: replacing the generating capacity of RBS and decommissioning the RBS facility.

### 2.6.1 Alternatives Evaluation Process

The "no-action alternative" to the proposed action is to not renew the RBS OL. In this alternative, it is expected that RBS would continue to operate up through the end of the existing OL, at which time plant operations would cease and decommissioning would begin (Section 7.3.3). Because RBS constitutes reliable long-term base-load capacity, it is reasonable to assume that a decision to not renew the RBS OL would necessitate the replacement of its approximately 967 net MWe capacity with another generation source capable of providing equivalent base-load power. The environmental impacts of the no-action alternative would be from decommissioning RBS as discussed in Chapter 7 and providing a replacement power source or sources.

In reviewing alternative energy sources, Entergy utilized the following criteria to determine a reasonable set of alternatives for purposes of evaluating the no-action alternative under NEPA requirements and NRC environmental regulations.

- The purpose of the proposed action (license renewal) is the continued production of approximately 967 net MWe of reliable base-load generation.
- The time frame for the needed generation is 2025–2045.
- Alternatives considered must be available (constructed, permitted, and connected to the grid) by the time the current RBS OL expires in 2025.
- Alternatives must be electricity generating sources that are technically feasible and commercially viable.

- An annual capacity factor of approximately 90 percent based on nuclear generation technology is assumed (EIA 2015a), and 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 on a timetable supporting new generation in 2025.

### 2.6.2 Alternatives Considered

Chapter 7 presents, in some detail, the methodology of identifying actions that could be taken to replace the base-load generating capacity of RBS in the region. Alternative generating technologies were evaluated to identify candidate technologies that would be capable of replacing the RBS generating capacity by the end of the licensed unit's term in 2025.

Entergy's 2015 Integrated Resource Plan (IRP) is the long-range strategy for meeting customers' power needs. The IRP is intended to provide guidelines for resource planning and decisions, and includes a 5-year action plan that allows Entergy to provide safe, reliable, and economic services to all customers, existing and new. (Entergy 2015j)

Entergy's IRP determined that the following alternatives were found appropriate for further analysis (Entergy 2015j):

- Pulverized coal—supercritical pulverized coal with carbon capture.

- Natural gas-fired alternatives (simple-cycle combustion turbines, combined-cycle gas turbines, small-scale aeroderivatives, and large-scale aeroderivatives).

- Nuclear—Generation III technology.

- Renewables (biomass, onshore wind power, and solar photovoltaic).

Based on the IRP analysis, gas-fired combustion turbines and combined-cycle gas turbines were selected as the preferred technologies for new build resources. The remaining alternatives (new nuclear, new coal, solar photovoltaic, and biomass) were not selected in any of the scenarios. Wind had a significant role in only one of the scenarios that involves high gas and carbon prices. (Entergy 2015j)

Entergy has determined that the most likely alternative that would replace RBS due to economic reasons, and relatively short development and construction time (approximately 2 to 3 years), would be a natural gas combined-cycle (NGCC) plant at the RBS site. However, for the sole purpose of this NEPA analysis and to assist the NRC staff with the preparation of the RBS-specific supplemental environmental impact statement, the hypothetical alternatives considered reasonable and discussed in greater detail in Chapter 7 are as follows:

- NGCC plant at the RBS site, consisting of three, parallel, 400-gross-MWe units to produce net electrical power approximately equivalent to the net 967 MWe generated by RBS.

- Supercritical pulverized coal (SCPC) plant at the RBS site consisting of two, 600-gross-MWE units to produce net electrical power approximately equivalent to the net 967 MWe generated by RBS.

- New nuclear plant at the RBS site with a net electricity generation approximately equivalent to the net 967 MWe generated by RBS.

- Combination of hypothetical alternatives consisting of an NGCC plant and biomass plants at the RBS site, and demand-side management (DSM) approximately equivalent to the net 967 MWe generated by RBS.

Entergy determined that the following alternatives were not considered as a reasonable replacement in comparison to renewal of the RBS OL. The bases for these determinations are discussed in Section 7.1.2.

- Purchased power
- Plant reactivation or extended service life
- Conservation or DSM
- Wind
- Solar technologies: photovoltaic cells and solar thermal power
- Hydropower
- Geothermal
- Wood waste
- Municipal solid waste
- Other biomass-derived fuels
- Fuel cells
- Oil
- Ocean wave and current energy
- Coal-fired integrated gasification combined cycle (IGCC)

# 3.0 AFFECTED ENVIRONMENT

The RBS property is located on approximately 3,342 acres of Entergy Louisiana, LLC-owned land (RBS 2015, Section 2.1.1.2) (Figure 3.0-1). For purposes of this ER, the term "property boundary" refers to the entire RBS site.

## 3.0.1 Location and Features

The RBS property is located on the east bank of the Mississippi River in the southern portion of West Feliciana Parish, Louisiana. (RBS 2015, Section 2.1.1.1) As shown in Table 3.10-1, St. Francisville, Louisiana, is approximately 3 miles west-northwest of RBS and is the community closest to the site. In nearby East Baton Rouge Parish, the city of Baton Rouge, Louisiana, is the largest population center in the region and is approximately 24 miles south-southeast of RBS (RBS 2015, Section 2.1.1.1). Figure 3.0-1 shows the property boundary, facility structures, and the EAB. The RBS property falls within the Public Land Survey System and is located in Sections 41, 44, 45, 57, 58, 59, 60, 62, 63, and 65, Township 3S, Range 2W; and Sections 44, 45, and 66, Township 4S, Range 2W (Entergy 2015k), as shown in Figure 3.0-2.

## 3.0.2 Vicinity and Region

The vicinity is defined as the area within a 6-mile radius from the center of the RBS containment structure and includes segments of West Feliciana, East Feliciana, East Baton Rouge, and Pointe Coupee parishes (Figure 3.0-3). As described in Section 3.1, land within the vicinity of the site is rural and sparsely populated. The RBS property is located adjacent to the Mississippi River, at about RM 262 (Figure 3.0-2). The Mississippi River is the most prominent natural feature in the region. The river at nearby St. Francisville (RM 266) has a contributing drainage area of about 1,129,400 square miles. This area includes 41 percent of the conterminous United States. (RBS 2015, Section 2.4.1.2.1)

The region is defined as the area within a 50-mile radius (Figure 3.0-4) centered on the RBS containment structure. The region includes either all or portions of the following 18 parishes in the state of Louisiana: Ascension, Assumption, Avoyelles, Catahoula, Concordia, East Baton Rouge, East Feliciana, Iberia, Iberville, Lafayette, Livingston, Pointe Coupee, St. Helena, St. Landry, St. Martin, Tangipahoa, West Baton Rouge, and West Feliciana. The region also includes either all or portions of the following five counties in the state of Mississippi: Adams, Amite, Franklin, Pike, and Wilkinson.

As shown in Table 3.10-1, West Feliciana Parish, where the RBS property is located, had a 2010 population of 15,625, up from 15,111 in 2000. West Feliciana Parish and the three neighboring parishes that are partially located within a 6-mile radius (East Baton Rouge, East Feliciana, and Pointe Coupee) are also designated as part of the Baton Rouge Metropolitan Statistical Area (MSA) (USCB 2015a). East Baton Rouge Parish had a 2010 population of 440,171, up from 412,852 in 2000. East Feliciana Parish had a 2010 population of 20,267, down from 21,360 in 2000. Pointe Coupee Parish had a 2010 population of 22,802, up from 22,763 in 2000. West Baton Rouge Parish had a 2010 population of 23,788, up from 21,601 in 2000. (USCB 2015b)

Table 3.10-1 provides 2010 U.S. Census Bureau (USCB) data for communities that are located wholly or partially within a 50-mile radius of the RBS site. Important population centers in the region include Baton Rouge, with a 2010 population of 229,493, up from a population of 227,818 in 2000; and Lafayette (approximately 55 miles southwest), with a 2010 population of 120,623, up from a population of 110,257 in 2000. The only incorporated community within West Feliciana Parish is St. Francisville (approximately 3 miles west-northwest), with a reported 2010 population of 1,765, up from a population of 1,712 in 2000. Within the region, there are four communities with a 2010 population greater than 25,000, and two of these (Baton Rouge and Lafayette) have a 2010 population greater than 100,000. (USCB 2015c)

The region has a highly developed roadway network and rail system (Figures 3.0-3 and 3.0-4). Interstate Highway 10 (I-10) parallels the Mississippi River from New Orleans to Baton Rouge, where it travels west to Lafayette. Interstate Highway 12 (I-12) runs east-west and is located north of Lake Pontchartrain. U.S. Highway 61 (US-61) is the nearest major north-south route to the plant (RBS 2015, Section 2.1.1.2). The recently completed Audubon Bridge on Louisiana Highway 10 (LA-10) crosses the Mississippi River between West Feliciana and Pointe Coupee parishes and has replaced the ferry service between the communities of New Roads and St. Francisville, Louisiana. (RBS 2015, Section 2.2.1) While there is rail service within the vicinity that supports specific industrial facilities, rail service has been abandoned within the RBS property boundary (USDOT 2015). The Mississippi River passes near the plant and is a major route for waterborne commerce. The nearest major river facility to RBS is the port of Baton Rouge, located approximately 32 river miles downstream. (RBS 2015, Section 2.2.1)

The natural gas pipelines closest to the RBS property are located approximately 2.1 miles east, and the closest petroleum products pipeline storage facility is located approximately 4.3 miles southeast of the RBS property. Two natural gas wells are located 3.4 miles south-southeast and 4.5 miles southwest, respectively, of the RBS property. (RBS 2015, Section 2.2.1) There are no pipelines crossing the RBS property (RBS 2015, Section 2.1.1.2).

As shown in Figures 3.0-3 and 3.0-4, there are six private heliports, three private airfields, and one general aviation airport (False River Regional Airport) open to the public that are located within 10 miles of RBS. Five private heliports (RBS, West Feliciana Parish Hospital, Tembec, West Feliciana Sheriff's Office, and The Bluffs) and one private air field (Nauga Field Airport) are located within the vicinity. The Baton Rouge Metropolitan Airport (Ryan Airport) is a full-service commercial airport located approximately 19 miles from RBS. (AirNav 2015)

### 3.0.3 Station Features

The principal structures at RBS are identified in Section 2.2. The RBS protected area is completely enclosed by security fencing, with access to the area controlled through a security access portal system. A plant security system monitors the protected area, as well as the buildings within the station. The protected area, along with principal station structures and nearby features, is shown in Figure 3.0-1. The residence nearest to RBS is located approximately 0.8 miles northwest (Entergy 2016d, Table 2-1).

The RBS EAB is designated as a 3,000-foot-radius circle drawn about the reactor center (Figure 3.0-1). The EAB is located entirely within RBS property. (RBS 2015, Section 2.1.1.3) There are no residences located within the exclusion area (RBS 2015, Section 2.1.2.1).

The restricted area within the RBS property is shown in Figure 3.0-1. The restricted area property is entirely owned by Entergy Louisiana, LLC except for a 1.7-acre parcel owned by PolAris for the Starhill Radio Tower (EOI 2008a, Section 2.2.1.10), which is located outside the EAB (west-northwest of the heliport). The boundary of the restricted area is denoted by a series of posted signs to assure public awareness of access restrictions during an emergency. The North Access Road traverses the exclusion area and the restricted area boundary north of the RBS protected area. (RBS 2015, Section 2.1.1.3) This road serves as the principal station access and connects US-61 (north of the RBS property) and Louisiana Highway 965 (LA 965). LA-965 is a paved, two-lane secondary road that traverses north and south into the center of the RBS property. (RBS 2015, Section 2.1.1.2) After Police Jury Road, LA-965 becomes Powell Station Road and continues south, then east, and then north connecting with US-61. Police Jury Road is an onsite route leading to the RBS Fancy Point Substation. River Access Road is an onsite route leading to the RBS water intake structure located on the Mississippi River. As shown in Figure 3.0-3, LA-10 parallels the southern edge of the RBS property; however, this state route is located outside of the RBS property.

The RBS property is situated on two elevation levels: an alluvial floodplain along the east bank of the Mississippi River at an elevation of about 35 feet amsl, and an upper terrace with an average elevation of more than 100 feet amsl. As shown in Figure 3.0-1, the RBS property is drained by Grants Bayou on the east and Alligator Bayou on the west. Numerous unnamed, intermittent streams cross the site and drain to either Grants Bayou or Alligator Bayou. Just south of the RBS property boundary, Grants Bayou enters Alligator Bayou, which flows south into Thompson Creek and eventually empties into the Mississippi River approximately 7 miles downstream of the RBS embayment area. The RBS property is heavily wooded; however, several open fields dot the landscape. (RBS 2015, Section 2.1.1.2)

### 3.0.4 Federal, Native American, State, and Local Lands

A number of public lands are located within the vicinity of RBS, as listed in Table 3.0-1 and illustrated in Figure 3.0-5. The federal parcel nearest to the site is the Cat Island National Wildlife Refuge, approximately 6 miles west of the plant. Cat Island National Wildlife Refuge was established to conserve, restore, and manage native forested wetland habitats for migratory birds, aquatic resources, and endangered and threatened plants and animals. It is one of the few remaining unleveed sections of floodplain along the Lower Mississippi River (LMR) and remains influenced by the natural flooding of the river. (EOI 2008a, Section 2.2.1.5)

The vicinity contains seven state-managed parcels, including Audubon State Historic Site, Rosedown Plantation State Historic Site, Port Hudson State Historic Site, and Locust Grove State Historic Site, as shown in Table 3.0-1. Of these state-managed parcels, the Audubon State Historic Site is nearest to RBS, located 3 miles north-northeast of the plant. There are also several locally managed parks and gardens in West Feliciana Parish. The locally managed parks nearest to RBS are located approximately 3 miles northwest and west-northwest, and they include St. Francisville Recreational Park (Jane Butterworth Memorial Park), Parker Memorial Park, and Garden Symposium Park near the town of St. Francisville, Louisiana.

There are a variety of national wildlife refuges, designated forest lands, state parks, and wildlife management areas (WMAs) located throughout the region, as shown in Figure 3.0-6. No military installations are located within a 50-mile radius. Located in Avoyelles Parish, the Tunica-Biloxi Tribe Reservation is approximately 49 miles west-northwest of RBS.

### 3.0.5 Known or Reasonably Foreseeable Projects in Site Vicinity

RBS has an ISFSI used to safely store spent fuel in licensed and approved dry-cask storage containers on site. This ISFSI is licensed separately from the RBS operating unit and would remain in place until the U.S. Department of Energy (DOE) takes possession of the spent fuel and removes it from the site for permanent disposal or processing. Expansion of the ISFSI to add a new pad is planned for the period 2019–2021. The impacts associated with this expansion would be assessed under a separate NRC licensing and review process.

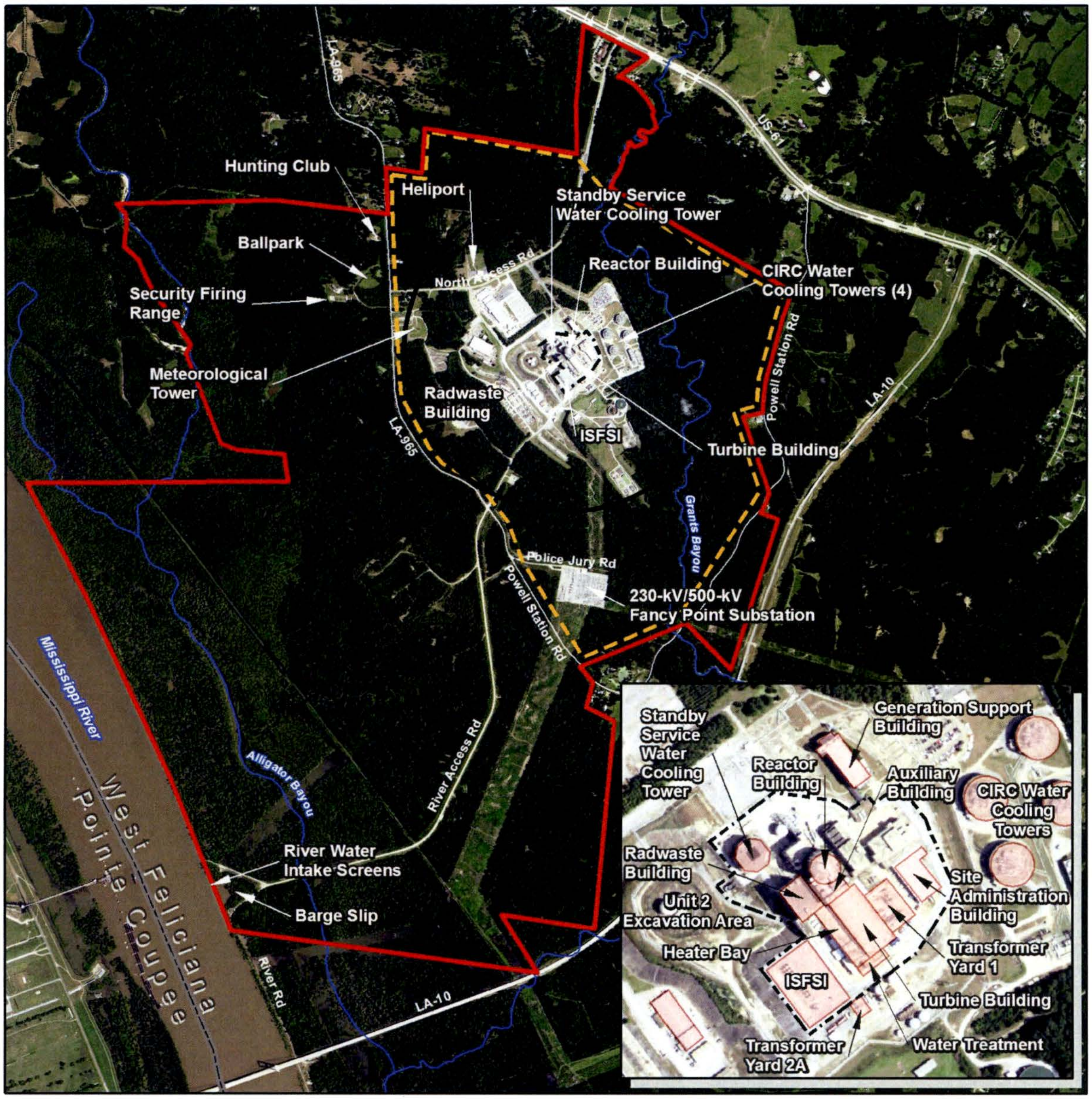
To date, no future federal or non-federal projects have been identified as taking place in the vicinity of the RBS property during the license renewal term. Also, no new business developments or current business expansions have been announced for the RBS vicinity during the license renewal term.

**Table 3.0-1**
**Federal, State, and Local Lands, 6-Mile Radius of RBS**

| Name[a] | Management | Distance[b] | Direction | Nearest Place | Parish |
|---|---|---|---|---|---|
| **LOUISIANA** | | | | | |
| St. Francisville Recreational Park (Jane Butterworth Memorial Park) | Local | 3 | NW | St. Francisville | West Feliciana |
| Parker Memorial Park | Local | 3 | WNW | St. Francisville | West Feliciana |
| Audubon State Historic Site | State | 3 | NNE | St. Francisville | West Feliciana |
| Former Office of Family Service | State | 3 | WNW | St. Francisville | West Feliciana |
| Garden Symposium Park | Local | 3 | WNW | St. Francisville | West Feliciana |
| Rosedown Plantation State Historic Site | State | 4 | NW | St. Francisville | West Feliciana |
| Feliciana Free Ferry Landing Lease | State | 4 | W | St. Francisville | West Feliciana |
| New Roads/St. Francisville Ferry Landing | State | 4 | W | St. Francisville | Pointe Coupee |
| West Feliciana Sports and Recreational Park | Local | 4 | NW | St. Francisville | West Feliciana |
| West Feliciana Parish Railroad Park | Local | 4 | WNW | St. Francisville | West Feliciana |
| Port Hudson State Historic Site | State | 5 | SSE | Zachary | East Feliciana/ East Baton Rouge |
| Locust Grove State Historic Site | State | 6 | N | St. Francisville | West Feliciana |
| Mary Ann Brown Preserve | Local | 6 | NE | St. Francisville | West Feliciana |
| Cat Island National Wildlife Refuge[c] | Federal | 6 | W | St. Francisville | West Feliciana |

(LDOA 2015; SFWF 2015; USDA 2015b)

a. Only locally operated lands within a 6-mile radius are included, and their distances are based on best available public information.
b. Distances are listed in approximate miles (rounded to the nearest whole number and based on RBS location and land centroid data).
c. Distance reported for the Cat Island National Wildlife Refuge is rounded and based on the closest point of the property boundary to RBS.




(Entergy 2015l; Entergy 2016e; EOI 2008a, Figure 2.1-3; GSU 1996; USDA 2016)

**Legend**

Property Boundary

Protected Area

Restricted Area

Exclusion Area Boundary

N W E S

0 0.5 1 Miles

**Figure 3.0-1**
**RBS Plant Layout**

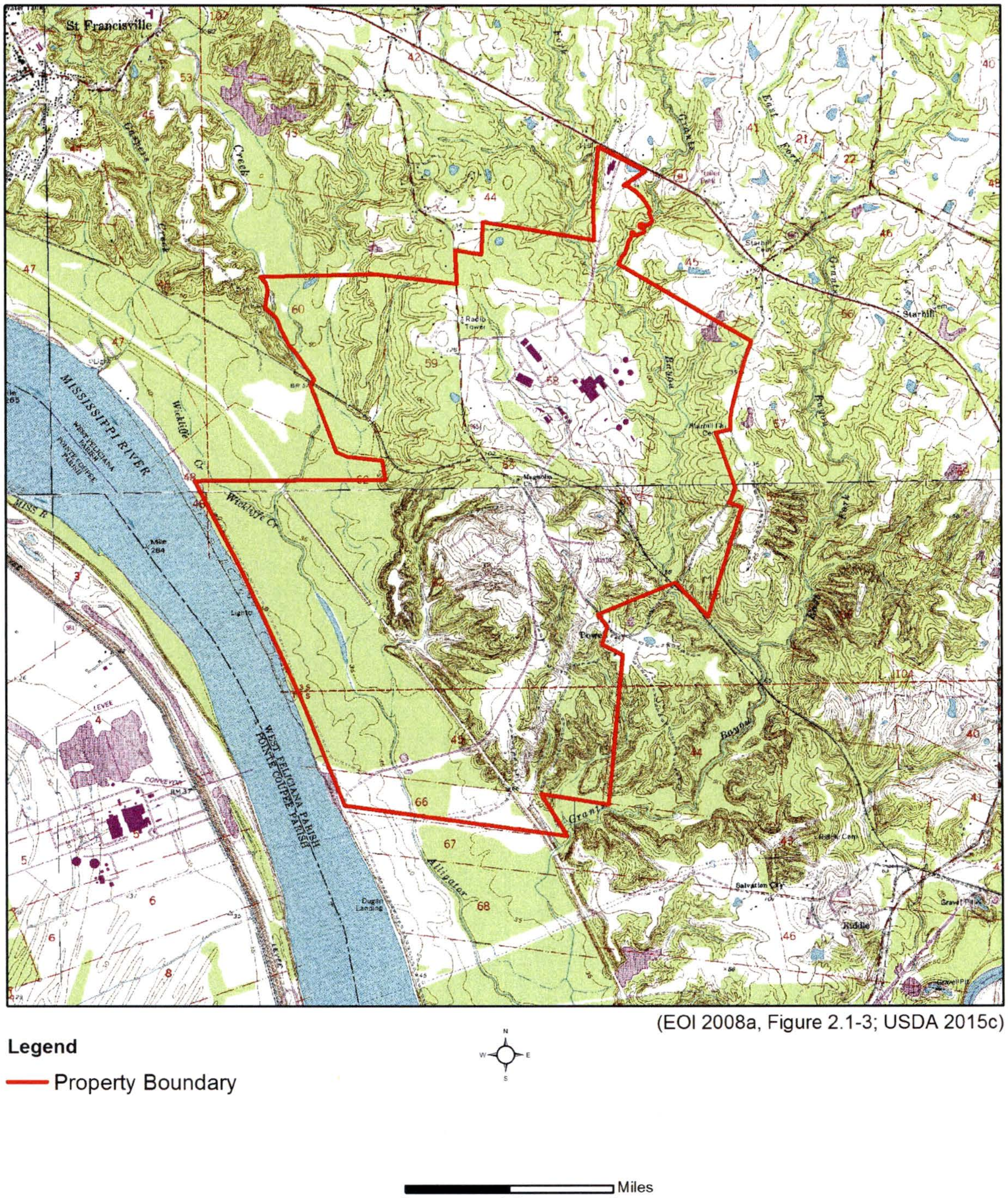
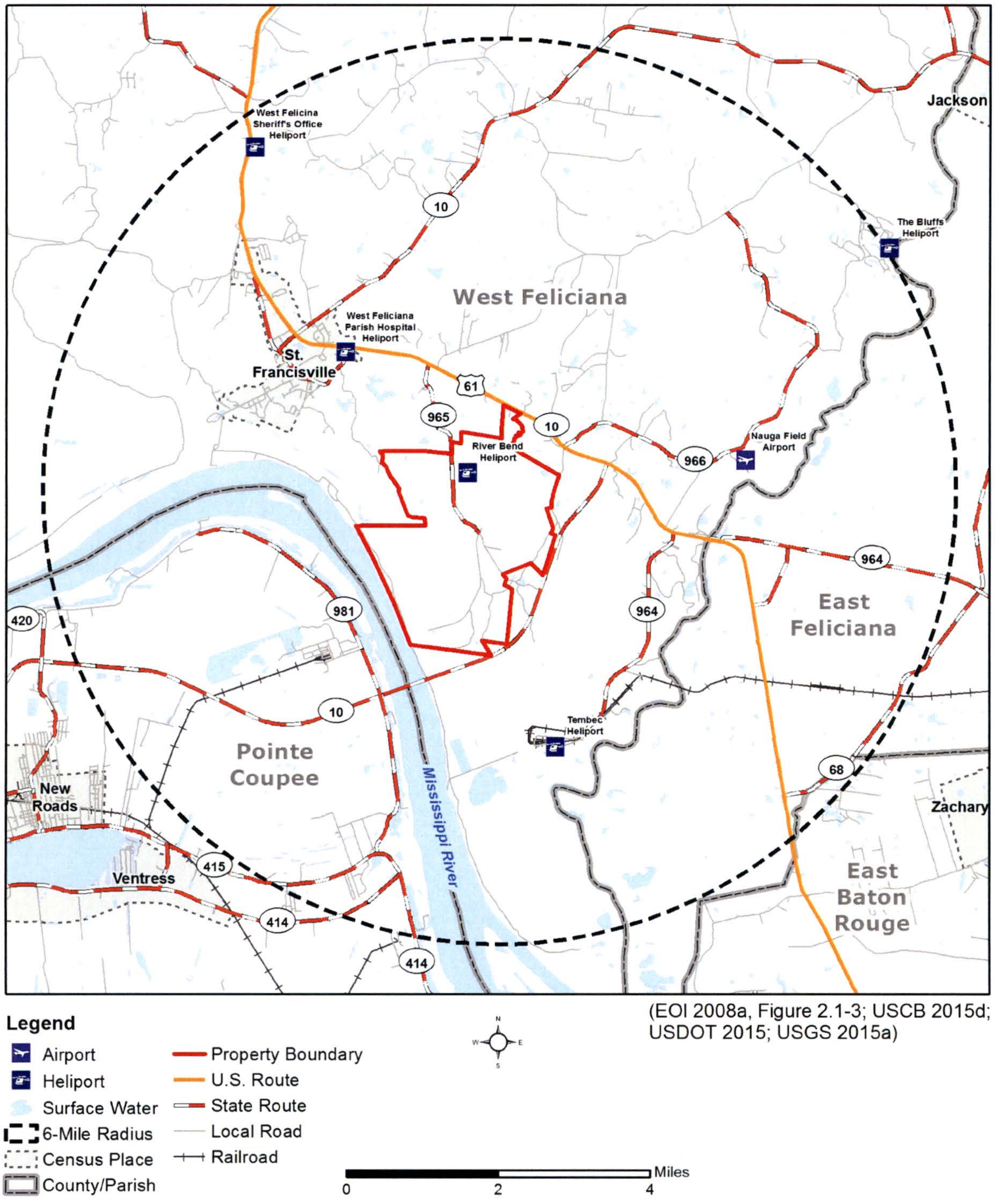
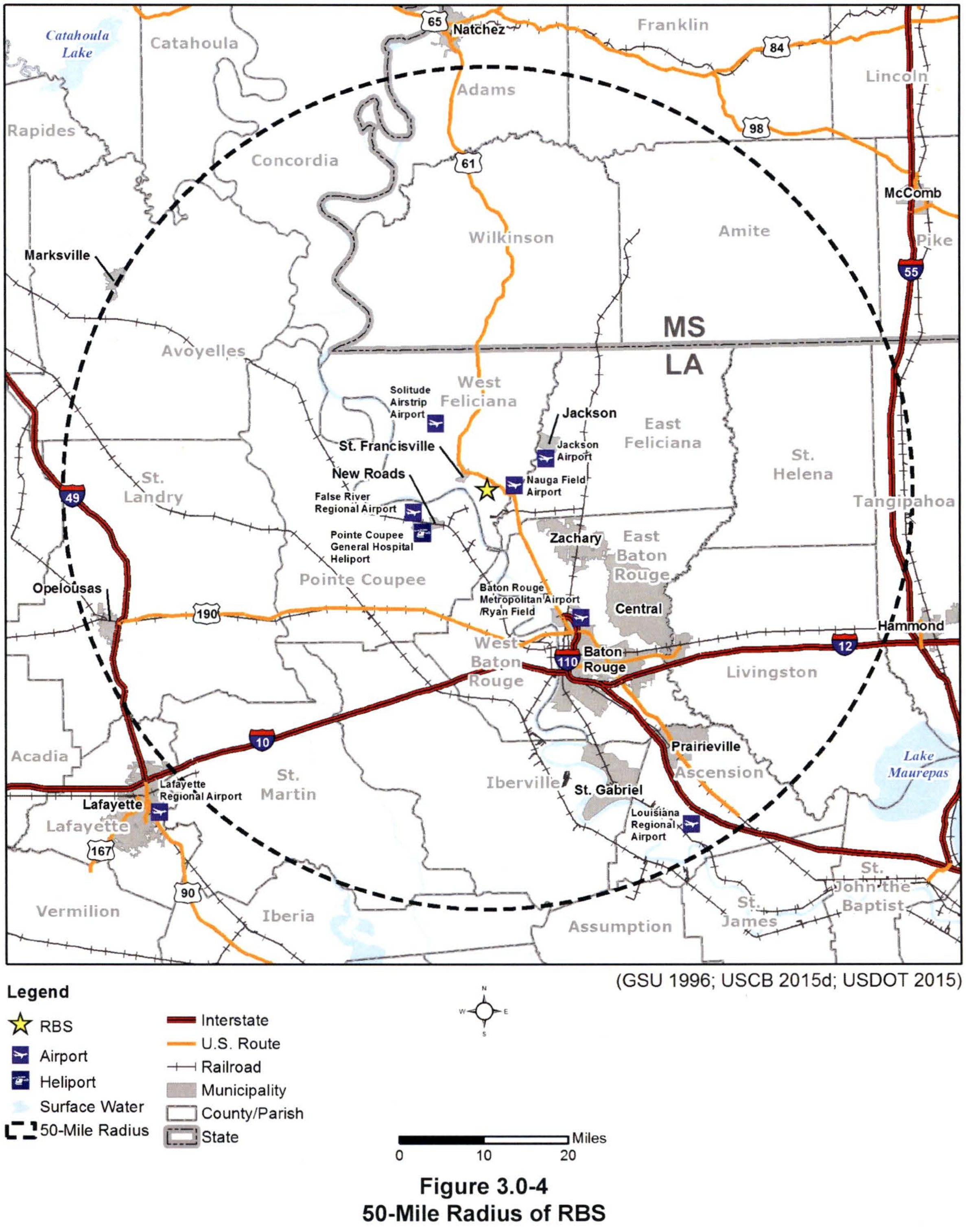



**Figure 3.0-2**
**RBS Property and Area Topography**



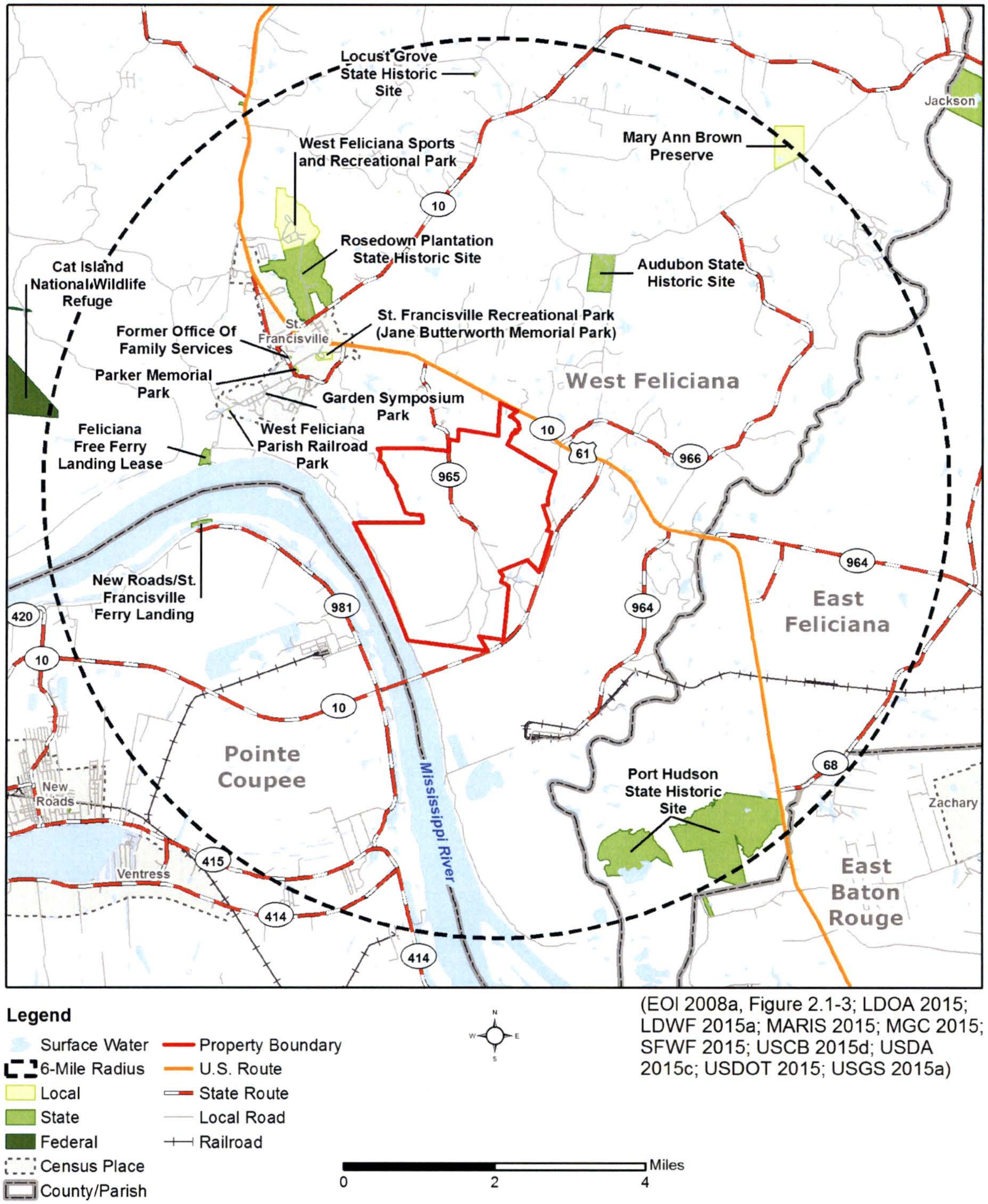

(EOI 2008a, Figure 2.1-3; USCB 2015d; USDOT 2015; USGS 2015a)

**Figure 3.0-3**
**6-Mile Radius of RBS**



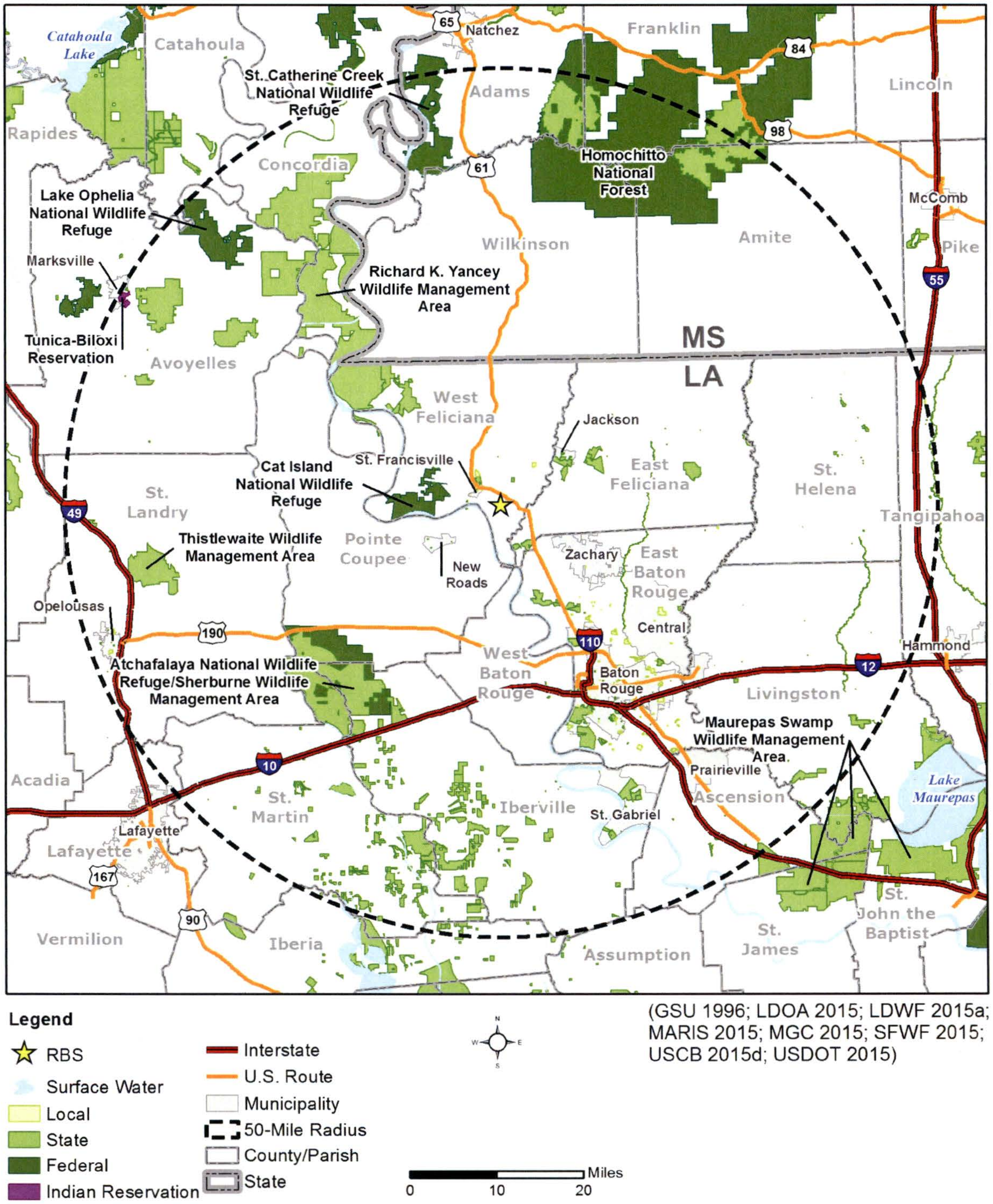

(GSU 1996; USCB 2015d; USDOT 2015)

**Figure 3.0-4**
**50-Mile Radius of RBS**




(EOI 2008a, Figure 2.1-3; LDOA 2015; LDWF 2015a; MARIS 2015; MGC 2015; SFWF 2015; USCB 2015d; USDA 2015c; USDOT 2015; USGS 2015a)

**Figure 3.0-5**
**Federal, State, and Local Lands, 6-Mile Radius of RBS**




(GSU 1996; LDOA 2015; LDWF 2015a; MARIS 2015; MGC 2015; SFWF 2015; USCB 2015d; USDOT 2015)

**Figure 3.0-6**
**Federal, State, and Local Lands, 50-Mile Radius of RBS**

## 3.1 Land Use and Visual Resources

Land use descriptions are focused on East Baton Rouge and West Feliciana parishes in Louisiana because (1) RBS is located in West Feliciana Parish; (2) approximately 69 percent of RBS employees reside in these two parishes (Table 2.5-1); and (3) RBS is one of Entergy Louisiana, LLC's assets on which property taxes are paid to West Feliciana Parish. The remaining RBS employees reside in 14 surrounding Louisiana parishes and nine other states.

### 3.1.1 Onsite Land Use

RBS is located on approximately 3,342 acres of Entergy Louisiana, LLC-owned land (RBS 2015, Section 2.1.1.2). Entergy currently controls the entire RBS site for the purpose of generating electricity; however, some of the area within the boundary is also used for other purposes, such as the Sportsman's Club (hunting club for past and current Entergy employees), recreational fishing, selective timber harvesting by Entergy's real estate group, and occasional ecological studies by state agencies or other parties. (EOI 2008a, Section 2.2.1)

As shown in Table 3.1-1 and illustrated in Figure 3.1-1, land use on the RBS site falls primarily within four land use/land cover categories: deciduous forest (24.2 percent), woody wetlands (22.5 percent), mixed forest (18.6 percent), and shrub/scrub (13.1 percent). These four categories account for approximately 78 percent of the RBS site land use. The remaining 10 categories found on site compose less than 22 percent of the RBS site.

Land on the RBS site is zoned as an industrial area (M2—General Industry District) by West Feliciana Parish. Maps from the *West Feliciana Parish Comprehensive Plan* (a 30-year vision adopted in December 2008) and the West Feliciana Parish Planning and Zoning Department, which depict future land use, indicate these uses are anticipated to continue on the RBS site. (WFP 2015a; WFP 2015b)

Entergy Louisiana, LLC owns all of the RBS property, with the exception of the 1.7-acre Starhill Microwave Radio Tower parcel, which is located outside the EAB (west-northwest of the heliport) and owned by PolAris. The exclusion area is subject to no easements/servitudes except such easements/servitudes that grant Entergy Louisiana, LLC the right to exclude or remove persons or property from the exclusion area consistent with the safety and security requirements of Entergy Louisiana, LLC. (EOI 2008a, Section 2.2.1.10) Entergy Louisiana, LLC also owns and/or controls 100 percent of the mineral rights within the RBS plant exclusion area, subject to reservations of mineral rights by predecessors-in-title, but controls the right to use the surface of the exclusion area for the extraction or development of minerals (EOI 2008a, Section 2.2.1.9).

### 3.1.2 Offsite Land Use

As shown in Table 3.10-2, West Feliciana Parish and East Baton Rouge Parish have seen an increase in population since 2000, with 2010 populations of 15,625 and 440,171, respectively. This trend is projected to continue for both parishes through 2045.

The vicinity (6-mile radius) surrounding the RBS site is predominantly rural and lies primarily within West Feliciana Parish; however, small portions include land area in East Baton Rouge Parish, East Feliciana Parish, and Pointe Coupee Parish (Figure 3.0-3). The land use/land cover categories located within a 6-mile radius of RBS are illustrated in Figure 3.1-2. As shown in Table 3.1-2, wetlands are the largest land cover category, covering approximately 20.3 percent of the area: woody wetlands (approximately 19.6 percent) and emergent herbaceous wetlands (approximately 0.7 percent). Deciduous forest (approximately 16.5 percent) is the next largest category, followed by pasture/hay (approximately 12.1 percent) and shrub/scrub (approximately 11.9 percent). Developed land, which includes open space, low-intensity, medium-intensity, and high-intensity development, totals approximately 4,729 acres (approximately 6.5 percent) of the vicinity.

The 2012 census of agriculture reported that West Feliciana Parish occupies approximately 258,061 acres, of which 101,261 acres were proportioned to farmland. The parish had a total of 163 farms in 2012, with an average farm size of 621 acres. A total of 98 farms were reported as cropland, with primary crops reported as forage (8,489 acres) and soybeans (11,810 acres). Livestock is another important agricultural product, with the primary commodity being beef cattle (71 farms). (USDA 2012)

East Baton Rouge Parish occupies approximately 291,425 acres of land, of which 57,542 acres were proportioned to farmland. In 2012, it was reported that the parish had a total of 432 farms, with an average farm size of 133 acres. A total of 232 farms produced crops, with the primary crop inventoried as forage (7,068 acres). Livestock is also an important agricultural product in the parish, with the primary commodity being beef cattle (214 farms). (USDA 2012)

The Louisiana Revised Statutes Title 33, Municipalities and Parishes, Part IV, Physical Development of Parishes and Municipalities, grants the power (to every parish and municipality) to create a planning commission and an official master plan. The legislation defines master plan as a statement of public policy for the physical development of a parish or municipality adopted by a parish or municipal planning commission. Further, it states that a parish or municipal planning commission shall make and adopt a master plan for the physical development of the unincorporated parish territories and municipality. The plan should include the following (LA 2014):

- Location, character, and extent of transportation routes, public park spaces, aviation fields, and other public ways, grounds, and open spaces;
- General location of public buildings, schools, and other public property;
- General character, extent and layout of public housing and the re-planning of blighted districts and slum areas;
- General location and extent of public utilities and terminals for water, light, sanitation, communication, power, transportation, and other purposes; and

- The removal, relocation, widening, narrowing, vacating, abandonment, change of use, or extension of any of the foregoing ways, grounds, open spaces, buildings, property, utilities, or terminals.

Both West Feliciana and East Baton Rouge parishes have comprehensive plans with active zoning regulations.

West Feliciana Parish is located in eastern Louisiana and is bordered on the north by Wilkinson County, Mississippi; on the west and south by Pointe Coupee Parish, Louisiana; and on the east by East Feliciana Parish (Figure 3.0-4). The Mississippi River forms the western boundary of the parish. Less than 10 percent of West Feliciana Parish is developed or in use. Single-family homes make up the largest portion at 8,037 acres (3 percent). Agricultural use and forests make up approximately 15 percent and 33 percent, respectively. The West Feliciana Parish Comprehensive Plan indicates approximately 53 percent of the total land area is not suitable for development because it is either water or riparian areas, land adjacent to wetlands (e.g., within 50 feet), floodplains, or steep slopes. The remaining developable land area is equivalent to roughly 100,000 acres, of which most is forested (55 percent). (WFP 2015a)

The *West Feliciana Parish Comprehensive Plan* is reported as the blueprint for long-term (30-year) future development. It was developed based on guiding principles that incorporated citizen input. The principles are divided into four categories (WFP 2015a):

<u>Livable Community</u>

- Retain the rural and historic character and focus on attracting new housing and jobs into existing developed areas already served by infrastructure;
- Emphasize mixed-use sustainable development and focus on providing attractive and safe neighborhoods and commercial areas;
- Provide convenient access to stores and services;
- Provide a transportation option for people without cars; and
- Direct new development toward areas where adequate roads exist.

<u>Opportunity and Equity</u>

- Develop clear and objective land use regulations and apply them fairly and consistently; and
- Increase housing opportunities in the parish and accommodate a variety of housing types for all income levels.

Healthy Environment

- Preserve the natural beauty of the parish and its assets through the use of incentives and conservation development practices; and

- Provide more walkable connections, trains, bike paths, and diverse recreational opportunities.

Prosperous Economy

- Plan for and develop infrastructure to encourage future growth;

- Emphasize tourism and eco-tourism; and

- Attract new economic development.

East Baton Rouge Parish is the central parish within the Greater Baton Rouge metropolitan area, home to the City of Baton Rouge, Louisiana's state capital. The parish is the most populous parish in Louisiana; however, due to out-migration it has experienced an overall net loss of 2,700 residents per year on average. To counter this decrease, East Baton Rouge has developed the FUTUREBR Comprehensive Plan (FUTUREBR) that will guide and inform the decision-making process and direct resources accordingly. (EBR 2015)

The goals of the land use element of FUTUREBR (EBR 2015) are as follows:

- To develop and define the distinct neighborhoods and districts. A parish concept of foundational, cohesive districts will match existing developments and guide new recommended additions.

- To develop a more resilient, pedestrian-friendly, prosperous East Baton Rouge Parish. This will lead to more self-contained districts, where the residents' or workers' daily needs are within 20 minutes.

These goals are anticipated to be achieved through effective land use planning. As reported in the FUTUREBR, East Baton Rouge Parish encompasses approximately 470 square miles. The planning area, which encompasses the city of Baton Rouge and unincorporated portions of the parish, is approximately 240,000 acres. While the majority of this land is already developed, it is reported there is still a significant supply of land (approximately 129,106 acres) available for growth in the next 30 years. While there are environmental constraints on development of a portion of this land, the developable portion accounts for roughly one-third of the parish. Approximately 35 percent of that developable land is within the reach of existing urban services (e.g., water and sewer lines). Approximately 17,623 acres of this land is where new development and redevelopment will be focused. By 2030, the FUTUREBR anticipates the addition of approximately 48,000 new households and 135,000 new jobs. This addition is expected to account for approximately 12,500 acres of land, of which redevelopment accounts for about 10 percent of the new growth. (EBR 2015)

### 3.1.3 Visual Resources

As discussed in Section 3.0.1, the RBS site is located on the east bank of the Mississippi River in the southern portion of West Feliciana Parish, Louisiana. Figure 3.0-1 shows the plant layout and the property boundary in association with the Mississippi River. As discussed in Section 3.1.1, the largest land use categories on the site are deciduous forest at approximately 24.2 percent and woody wetlands at approximately 22.5 percent.

Several recreation areas and tourist attractions, such as Cat Island National Wildlife Refuge and Audubon State Commemorative Area are located within the vicinity and near St. Francisville (EOI 2008a, Section 2.2.1.4). Natural features in the vicinity include Thompson Creek to the east and southeast of RBS; the Mississippi River and Bayou Sara to the west and northwest; False River southwest in New Roads; Wickliffe Creek, Alexander Creek, and Alligator Bayou in the western portion of the RBS property; Grants Bayou East Fork in the southern part of the RBS property; and oxbow lake remnants to the south. These oxbow lakes appear to be part of the former Thompson Creek channel. In addition, the RBS site is part of the Louisiana Department of Wildlife and Fisheries (LDWF) designated RBS Natural Area (Figure 3.1-3), a 550-acre portion of the site that contains one of the most species-rich, upland hardwood forests in the nation. (EOI 2008a, Section 2.2.1.5)

A number of recreational, conservation, and commemorative areas within the vicinity of the site, including several plantations of historic interest and various WMAs, provide hunting, fishing, and other recreational opportunities. Notable plantations in the vicinity of RBS, generally to the northwest in the St. Francisville area, include The Myrtles, Butler Greenwood, and Greenwood Plantations, as well as the Rosedown Antebellum Home. The Oakley House is part of the Audubon State Commemorative Area and is located northeast of RBS. (EOI 2008a, Section 2.2.1.5)

RBS is located approximately 2 miles from the Mississippi River. The finished station grade is approximately 100 feet amsl (varies from 95 to 105 feet amsl). The Mississippi River supplies the cooling tower makeup water requirements. Four mechanical-draft cooling towers are used for heat dissipation. The towers are approximately 56 feet above grade elevation and are not visible above the trees. (EOI 2008a, Section 3.1.1) The RBS site is heavily wooded with several unnamed, intermittent streams crossing and draining to either Grants Bayou on the east or Alligator Bayou on the west (RBS 2015, Section 1.2.2.1.2). As noted in Section 3.0.3, the residence nearest to RBS is located approximately 0.8 miles northwest.

RBS has minimal visual impact on neighboring properties. From US-61, the power block and cooling towers are not visible, due to a significant tree buffer around the site. From the highway entrance, only the RBS Training Center Building is visible, and it has the appearance of an office building. From other nearby public roads, the tree buffer and changes in elevation also conceal the RBS power plant facilities. (EOI 2008a, Section 2.5.2.7) As discussed in Section 2.2.5.1, all in-scope transmission lines are located completely within the RBS property; therefore, they are not visible to neighboring properties.

**Table 3.1-1**
**Land Use/Land Cover, RBS Property**

| Category | Acres | Percent |
|---|---|---|
| Open water | 25.13 | 0.8 |
| Developed | 417.21 | 12.7 |
| Open space | 184.14 | 5.6 |
| Low intensity | 81.84 | 2.5 |
| Medium intensity | 97.19 | 3.0 |
| High intensity | 54.04 | 1.6 |
| Barren land (rock/sand/clay) | 3.78 | 0.1 |
| Deciduous forest | 796.62 | 24.2 |
| Evergreen forest | 150.56 | 4.6 |
| Mixed forest | 611.59 | 18.6 |
| Shrub/scrub | 430.56 | 13.1 |
| Grassland/herbaceous | 43.14 | 1.3 |
| Pasture/hay | 41.37 | 1.3 |
| Woody wetlands | 738.57 | 22.5 |
| Emergent herbaceous wetlands | 27.58 | 0.8 |
| **Total** | **3,286.11**[(a)] | **100.0** |

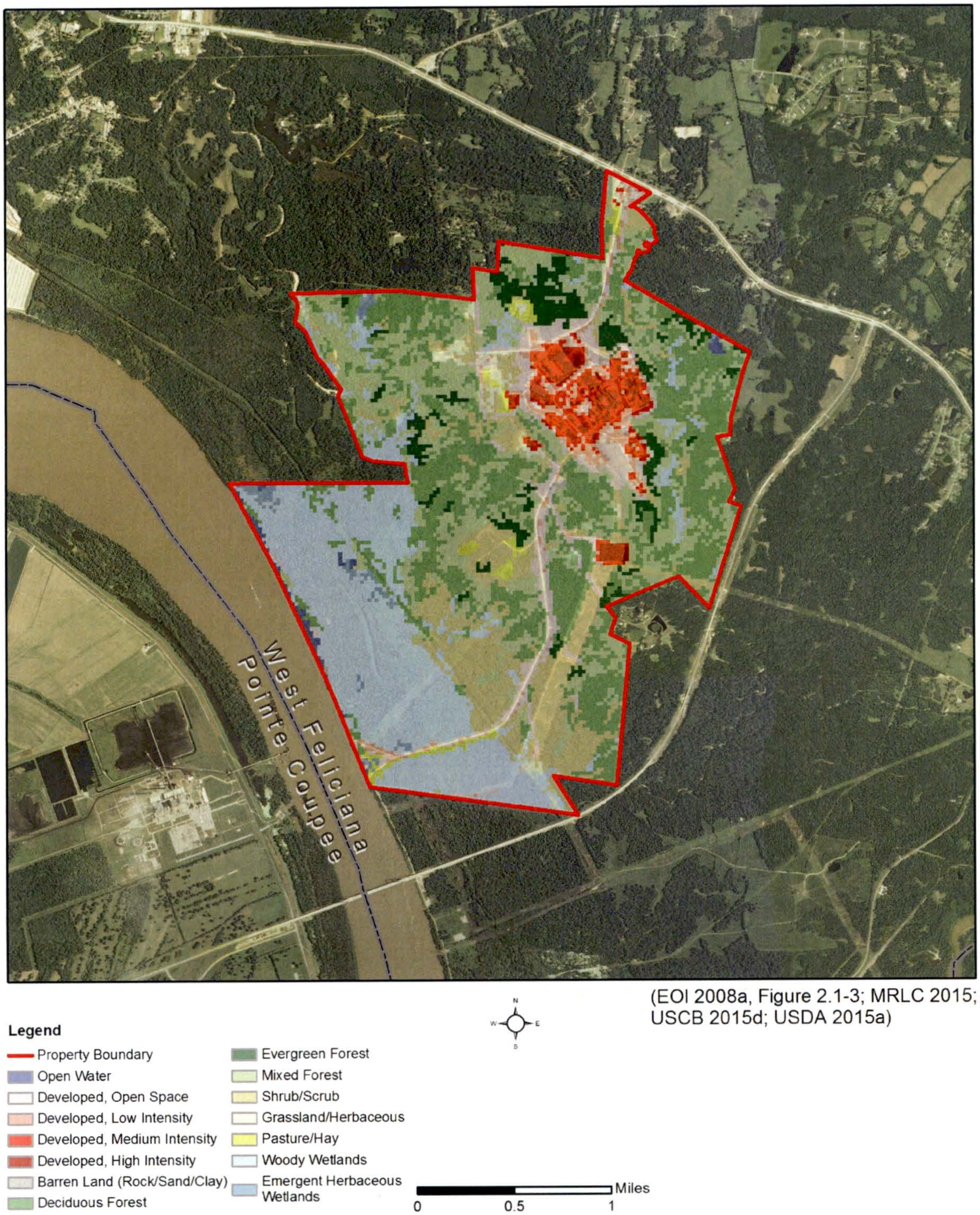
(MRLC 2015)

a. The acreages presented in this table are based on the Multi-Resolution Land Characteristics Consortium (MRLC) land use/land cover data. These data are presented in a raster (pixel-based) format, and because of their square geography they do not exactly match the RBS property boundary. This geography variation creates a small difference between the total acreage reported in Table 3.1-1 compared to the RBS property acreage stated throughout the ER.

**Table 3.1-2**
**Land Use/Land Cover, 6-Mile Radius of RBS**

| Category | Acres | Percent |
|---|---|---|
| Open water | 4,786.38 | 6.62 |
| Developed | 4,729.00 | 6.54 |
| Open space | 2,938.50 | 4.07 |
| Low intensity | 989.21 | 1.37 |
| Medium intensity | 422.11 | 0.58 |
| High intensity | 379.18 | 0.52 |
| Barren land (rock/sand/clay) | 928.72 | 1.28 |
| Deciduous forest | 11,902.56 | 16.47 |
| Evergreen forest | 3,585.45 | 4.96 |
| Mixed forest | 7,854.76 | 10.87 |
| Shrub/scrub | 8,634.69 | 11.95 |
| Grassland/herbaceous | 1,633.27 | 2.26 |
| Pasture/hay | 8,727.66 | 12.07 |
| Cultivated crops | 4,827.30 | 6.68 |
| Woody wetlands | 14,142.30 | 19.56 |
| Emergent herbaceous wetlands | 534.41 | 0.74 |
| **Total** | **72,286.50** | **100.00** |

(MRLC 2015)




(EOI 2008a, Figure 2.1-3; MRLC 2015; USCB 2015d; USDA 2015a)

**Figure 3.1-1**
**Land Use/Land Cover, RBS Property**

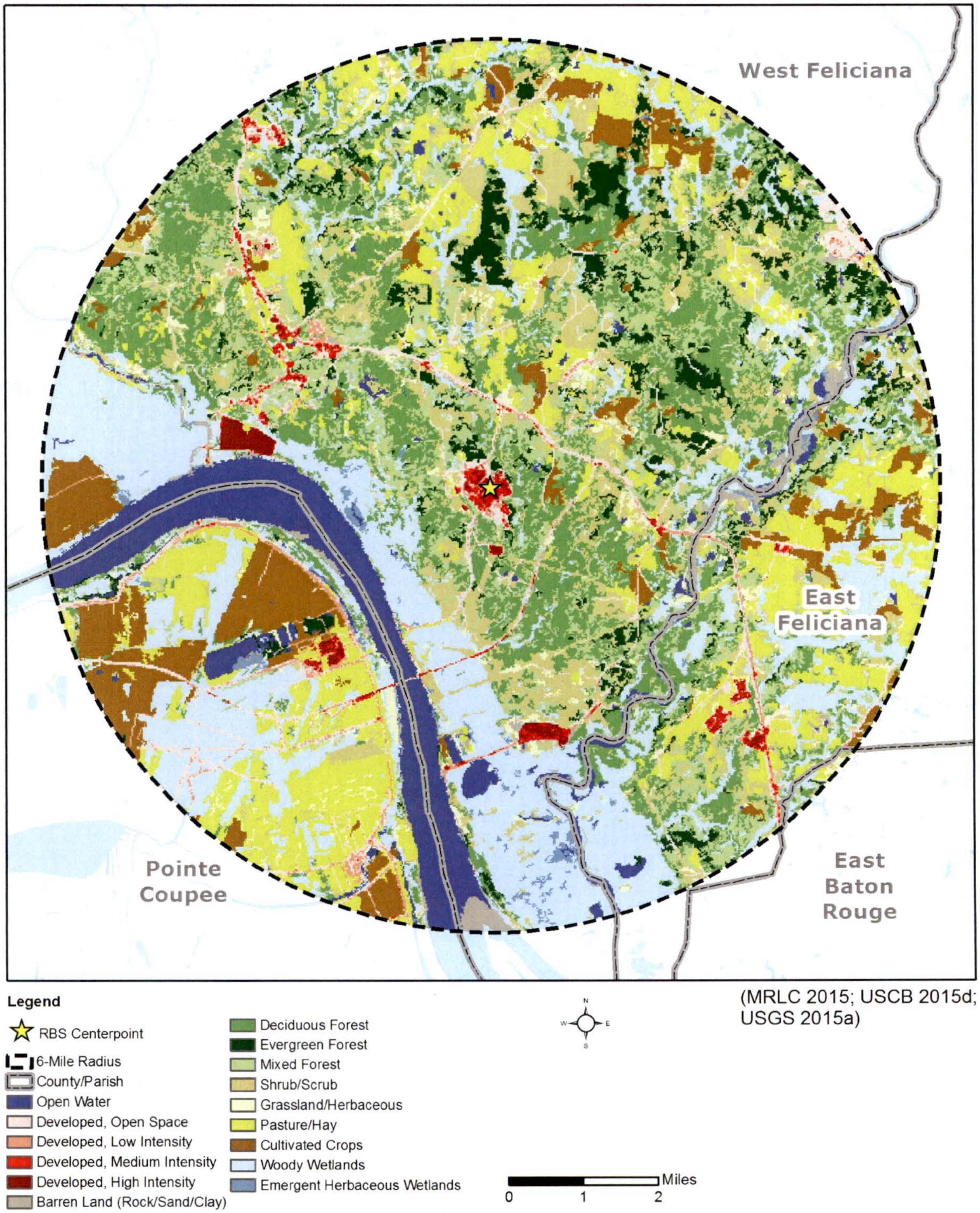
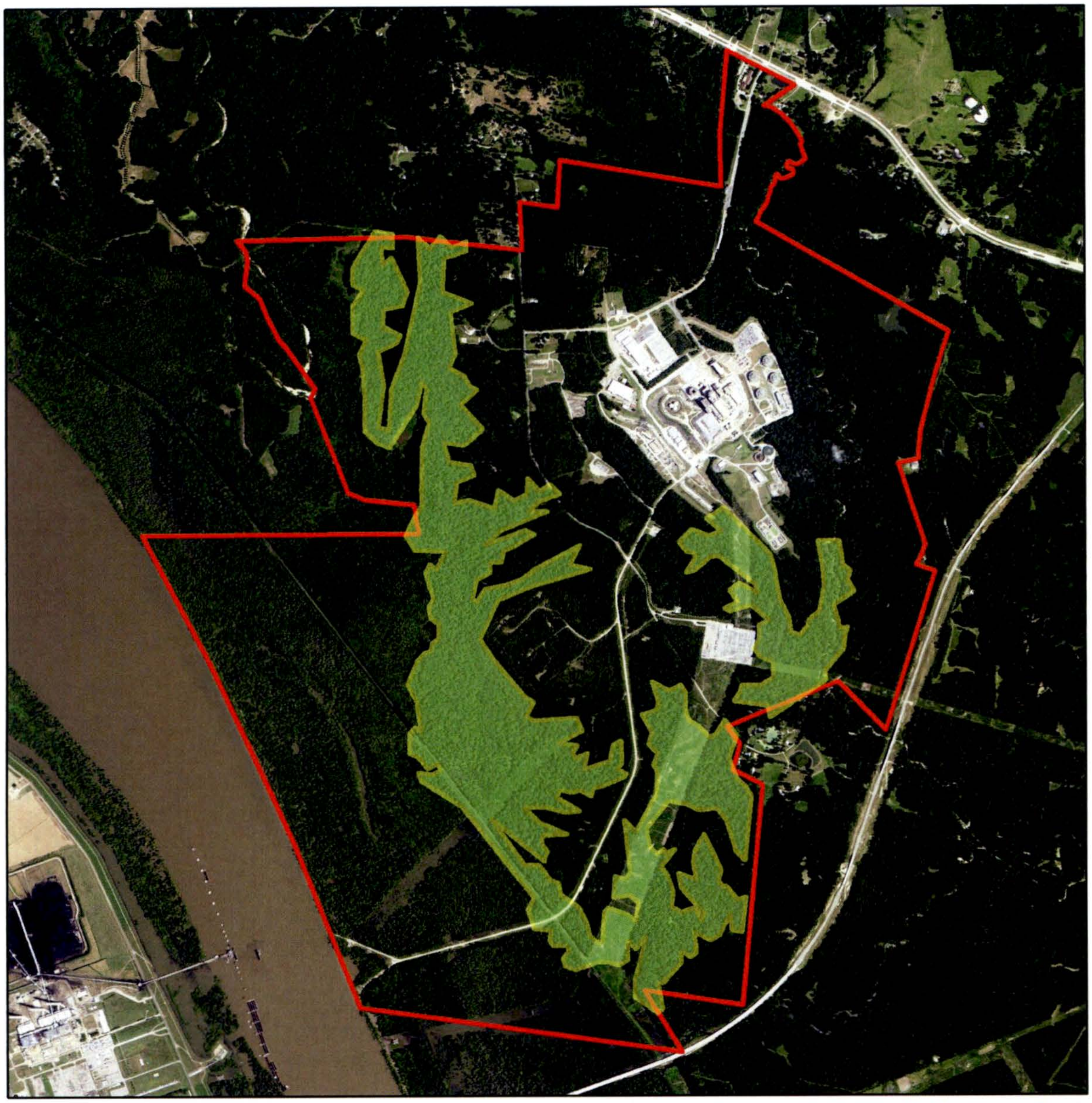



**Figure 3.1-2**
**Land Use/Land Cover, 6-Mile Radius of RBS**



(Entergy 2016f; EOI 2008a, Figure 2.1-3; USDA 2016)

**Legend**

Property Boundary

RBS Natural Area

Miles
0 0.5 1

**Figure 3.1-3**
**RBS Natural Area**

## 3.2 Meteorology and Air Quality

### 3.2.1 General Climate

The general climate can be described as humid subtropical with summers dominated by the Bermuda High, a semi-permanent anticyclone that is an extension of the Azores High Pressure System. The Bermuda High can remain intact into the spring and fall, and occasionally even into the winter season. The prevailing southeasterly winds combined with an abundant moisture supply from the warm waters of the Gulf of Mexico provide mild and rather humid weather throughout most of the year. The Bermuda High historically can lead to very light winds or even calm weather conditions, thus creating air stagnation problems in the region at times during the summer and early fall. Air from higher latitudes in the north-central United States occasionally brings drier and cooler conditions to the area, but mainly for only brief periods of time during the winter months. (EOI 2008a, Section 2.7.1)

The summer climate is warm and humid, characterized by relatively light winds. Afternoon showers and thunderstorms, which account for much of the summer rainfall, occur nearly one-half of the days during June, July, and August. (EOI 2008a, Section 2.7.1)

The winter climate is characterized by mild temperatures due to the influence of the maritime air. The main continental storm track also migrates south into portions of northern Louisiana, but typically remains far enough north of RBS and the surrounding region so that convective showers and storms are the primary source of precipitation events, even during winter months. Snow and other freezing precipitation events are rare, with annual totals for snowfall and ice accretion events averaging only a fraction of an inch in the RBS region. (EOI 2008a, Section 2.7.1)

Early spring is the season with the highest frequency of tornadoes and large hail events; however, even these occurrences are rare. Tropical cyclone frequency is climatologically highest in early autumn, but statistically only one hurricane makes landfall along the coastline of Louisiana approximately every 4 years. The most pleasant weather usually occurs during late September into October when temperatures are cooler, average monthly precipitation totals are lower, and average monthly cloudiness decreases. The threat of heavy rainfall is present in all seasons, attributed to the year-round potential for convective rainfall activity. (EOI 2008a, Section 2.7.1)

### 3.2.2 Meteorology

The National Weather Service station nearest to RBS is Baton Rouge Metropolitan Airport (Ryan Airport), which is located 19 miles southeast of RBS, with a similar elevation and relative proximity to the Mississippi River.

#### 3.2.2.1 Wind Direction and Speed

A 44-year period of record at Ryan Airport shows the annual prevailing wind direction is northeast. Based on a 32-year period of record, the annual mean wind speed at Ryan Airport is

6.3 miles per hour (mph). The highest seasonal mean wind speed is during the winter and spring. The lowest seasonal mean wind speed for Baton Rouge occurs during the summer months. (NCDC 2016a)

#### 3.2.2.2 Temperature

Based on a 30-year period of record at Ryan Airport, the annual normal daily mean temperature is approximately 69.0°F, with the highest monthly normal daily mean temperatures occurring during the summer months (June, July, and August). The monthly normal daily minimum and maximum temperatures at Baton Rouge during the summer months range from approximately 81.0°F to 83.0°F, respectively. The mean number of days with a maximum temperature of 90°F or greater is 89. Monthly normal daily mean minimum and maximum temperatures during the winter months (December, January, and February) at Baton Rouge range from approximately 52°F to 55°F, respectively. The mean number of days with a minimum temperature of 32°F or less is 20. (NCDC 2016b)

#### 3.2.2.3 Precipitation

Based on a 30-year period of record, the normal annual precipitation at Ryan Airport is approximately 61.0 inches. Normal monthly precipitation amounts in Baton Rouge range between 4.96 and 6.41 inches during the summer months (June, July, and August); 4.10 and 4.70 inches during the fall months (September, October, and November); 5.04 and 5.72 inches during the winter months (December, January and February); and 4.41 and 4.89 inches during the spring months (March, April, and May). The normal maximum monthly rainfall occurs in June (6.41 inches), while the lowest normal monthly rainfall occurs in November (4.10 inches). (NCDC 2016b) Snowfall is very infrequent across central and southern Louisiana. Normal annual snowfall values at Baton Rouge are 0.1 inches (NCDC 2016b).

#### 3.2.2.4 Severe Weather

##### 3.2.2.4.1 Hurricanes

RBS is located approximately 75 miles from the nearest point on the Gulf Coast. However, the potential still exists for strong winds associated with hurricanes and tropical storms to make it as far inland as RBS. The intensity and forward speed of hurricanes largely determines how far inland hurricane speeds are realized. Additionally, all hurricanes and tropical storms bring the threat of extremely heavy rainfall intensities and amounts as the center of the storm passes near RBS. (EOI 2008a, Section 2.7.2.2.5) Based on National Climatic Data Center records, there have been two recorded storm events for West Feliciana Parish over the previous 35 years as shown below (NCDC 2016c):

- Hurricane Lili (October 2002)
- Hurricane Katrina (August 2005)

#### 3.2.2.4.2 Thunderstorms

Thunderstorms are a common occurrence at RBS and in the surrounding region throughout the year. The highest seasonal rate of occurrence for thunderstorms is in the summertime (June to August), when about 53 percent of all thunderstorm days occur. July has the highest occurrence of thunderstorms. The mean number of thunderstorm days per month is lowest during the mid-fall and winter seasons. (EOI 2008a, Section 2.7.2.2.1)

#### 3.2.2.4.3 Tornadoes

Tornadoes are generated in Louisiana either due to severe thunderstorms or hurricanes that occur in the area. Based on National Climatic Data Center data for the period 1991-2010, the average annual number of tornadoes that occur in Louisiana was 37; the average annual number of enhanced Fujita (EF) 0-EF5 tornadoes per 10,000 square miles was 8.5; the average annual number of EF3-EF5 tornadoes was 0.9; and the average annual number of EF3-EF5 tornadoes per 10,000 square miles was 0.2 (NCDC 2015). From 1985 through 2015, a total of 3 tornadoes were reported in West Feliciana Parish, occurring in the spring and fall months, with a peak of 2 tornadoes in April. Two tornadoes were classified as EF1, while the remaining tornado was classified as an EF2. (NCDC 2016d)

#### 3.2.2.4.4 Rainfall

In August 2016, the combination of an incredibly moist air mass and a slow-moving storm system resulted in feet of rain in southern Louisiana. The epic rains caused devastating flooding, which led to the evacuation of tens of thousands, killed at least 13 people, and paralyzed the region. (NOAA 2016a)

Rains began on August 9th as scattered thunderstorms in advance of a slow-moving storm system to the east. As the storm moved closer to Louisiana and Mississippi, rainfall totals increased dramatically. On August 11th, parts of southern Louisiana and Mississippi observed more than 6 inches of rain. On August 12th, Baton Rouge observed a non-stop battering of thunderstorms resulting in 11.24 inches of rain. On the same day, an observer in Livingston, Louisiana, recorded 17.09 inches of rain between midnight and 3:00 p.m. The next day (August 13th) brought another round of heavy rain, from 3 to more than 10 inches in some places, albeit a bit farther west than the day before. (NOAA 2016a)

Watson, Louisiana, about 20 miles northeast of Baton Rouge, experienced 31.39 inches of rain from the storm; White Bayou, Louisiana, saw 26.14 inches; Livingston, Louisiana, ended up with 25.52 inches; and Baton Rouge received more than 19 inches of rain. (NOAA 2016a)

Rains of this magnitude falling in this short amount of time are exceedingly rare. From August 12th to August 13th, the 2-day rainfall amounts in the hardest hit areas have only about a 0.2 percent chance of occurring in any given year: a 1 in 500-years event. (NOAA 2016a)

With rains of this magnitude, devastating flooding was sure to follow. In southeastern Louisiana, towns and interstates flooded, cars were underwater, and lives were uprooted. The Amite River at Denham Springs crested at 46.2 feet, breaking the 1983 record by almost 5 feet. Record river crests also occurred along the Comite River at Olive Branch (29.96 feet) and Joor Road (34.22 feet), and along the Tickfaw River and the Tangipahoa River. (NOAA 2016a)

Twelve parishes in Louisiana (Acadia, Ascension, East Baton Rouge, East Feliciana, Iberia, Lafayette, Livingston, Pointe Coupee, St. Helena, St. Landry, Tangipahoa, and Vermillion) were declared major federal disaster areas. (NOAA 2016a)

Rainfall at the RBS site (located approximately 24 miles north-northeast of Baton Rouge) totaled 24.28 inches during the period August 10, 2016, to August 17, 2016. This event exceeded the water processing ability and storage capacity of the treated sanitary wastewater system, which resulted in a sewage overflow as shown in Table 9.5-1. No other portions of the RBS site were affected by this event.

### 3.2.3 Onsite Meteorological System

The onsite meteorological tower is located approximately 2,210 feet west-northwest of the reactor containment and has a height of 150 feet above plant grade. The meteorological parameters are measured by instrumentation mounted at two levels (30 and 150 feet) of the tower. The meteorological sensors are mounted on booms that are greater than one tower width away from the tower. The booms are attached to a tower elevator system used for raising and lowering the instruments during routine calibration. (EOI 2008a, Section 6.4.1.1)

The tower is situated in a flat fenced-off area that is covered with crushed rocks and grass. A small instrument building and a utility shed housing a standby propane generator are located approximately o the west-southwest of the meteorological tower. (EOI 2008a, Section 6.4.1.1)

The meteorological tower instrumentation consists of the following: wind speed and wind direction sensors at the 30- and 150-foot levels, a 30-foot ambient temperature sensor, and a 30- to 150-foot vertical temperature difference system. A dew point temperature sensor was initially installed at the 30- and 150-foot levels prior to operation of RBS, but has since been removed due to constant dust contamination that caused excessive maintenance. In addition, a heated tipping bucket rain gauge was located approximately 15 feet above the ground on top of the instrument building during the operation of RBS. However, the rain gauge is no longer in operation. Instrumentation on the tower also includes redundant wind speed and wind direction sensors at the 30- and 150-foot levels, a redundant 30-foot ambient temperature sensor, and a redundant vertical temperature difference system. A sun shield is placed on the temperature sensors to minimize solar effects. (EOI 2008a, Section 6.4.1.2) RBS onsite meteorological sensors are characterized in Table 3.2-1.

#### 3.2.3.1 Wind Sensors

Wind speed and direction are measured on the meteorological tower at 30- and 150-foot levels. Redundant wind sensors are also located at the 30- and 150-foot levels. (EOI 2008a, Section 6.4.1.2.1)

#### 3.2.3.2 Temperature Sensors

Sensors on the meteorological tower measure ambient temperature at the 30-foot level, as well as the differential temperature between the 30- and 150-foot levels. A sun shield is located on each of the upper and lower temperature sensors to minimize solar effects. The upper-level temperature sensor, in combination with the lower-level sensor, calculates the differential temperature. The backup sensors for the ambient upper and lower temperature sensors are located on the meteorological tower at the same levels as the primary sensors. (EOI 2008a, Section 6.4.1.2.2)

#### 3.2.3.3 Dew Point and Precipitation Sensors

As previously discussed, the dew point sensor on the meteorological tower suffered from constant dust contamination, resulting in excessive maintenance. It was removed in 1998. RBS can obtain hourly dew point data electronically from Ryan Airport when needed, which records hourly dew point temperature. (EOI 2008a, Section 6.4.1.2.3) Precipitation data for RBS can also be obtained from Ryan Airport when needed. (EOI 2008a, Section 6.4.1.2.4)

#### 3.2.3.4 Meteorological Sensor Calibration and Maintenance

Procedures are in place to conduct preventive maintenance and semiannual calibrations to ensure 90-percent joint data recovery of the parameters required for offsite dose assessment (e.g., wind speed, wind direction, and delta temperature or sigma theta). (EOI 2008a, Section 6.4.1.3)

RBS verifies proper operation of the meteorological monitoring system by performing routine channel checks. Two sensors of each parameter (wind speed, wind direction, and temperature) are available to minimize loss of continuous data. The meteorological system is equipped with a lightning protection system and propane generator with an uninterruptible power supply to prevent data loss. (EOI 2008a, Section 6.4.1.3)

#### 3.2.3.5 Recording of Meteorological Sensor Output

The meteorological data from the tower are collected via two digital recorders (primary and secondary recording systems). After the meteorological data are recorded, they are converted into American Standard Code for Information Interchange (ASCII) text and sent electronically to the RBS control room for display, and printing. (EOI 2008a, Section 6.4.1.4)

The parameters of wind speed and direction, ambient temperature, and differential temperature are sampled from the sensors every 5 seconds. Every 10 minutes, a blocked average of the past 15 minutes of data is calculated for each parameter. From the 10-minute averages, an hourly blocked average is then calculated. A minimum of 15 minutes of data are used to derive hourly averages for each of the parameters. (EOI 2008a, Section 6.4.1.4)

#### 3.2.3.6 Meteorological Data Quality Assurance and Processing

After data have been collected by the meteorological sensors, the data are sent to the plant computer collection system. The plant computer collection system screens data for validity and quality, performs meteorological calculations, and updates the data archive. Data considered suspect are flagged for each parameter and evaluated to determine if at least one of the primary or secondary sensor's data can be used. After the validation process is completed, the processed data are archived and permanently stored electronically. (EOI 2008a, Section 6.4.1.5)

If the meteorological system is damaged, a procedure to obtain relevant meteorological information (e.g., wind speed, wind direction, cloud cover, cloud ceiling) from Ryan Airport in Baton Rouge is in place. In addition, a letter of agreement between RBS and the National Weather Service assures meteorological data availability to RBS on a 24-hours per day basis. (EOI 2008a, Section 6.4.1.5)

#### 3.2.3.7 Data Recovery

Based on the previous 5 years (2011–2015), the meteorological data recovery rate at the RBS site has been greater than 90 percent (Entergy 2012c; Entergy 2013c; Entergy 2014a; Entergy 2015m; Entergy 2016g).

### 3.2.4 Air Quality

The Clean Air Act (CAA) was established in 1970 [42 U.S.C. § 7401 *et seq.*] to reduce air pollution nationwide. The EPA has developed primary and secondary National Ambient Air Quality Standards (NAAQS) under the provisions of the CAA. The EPA classifies the air quality within an air quality control region (AQCR) according to whether the region meets or exceeds federal primary and secondary NAAQS. An AQCR or a portion of an AQCR may be classified as being in attainment or nonattainment, or it may be unclassified for each of the six criteria pollutants: carbon monoxide (CO), lead (Pb), nitrogen dioxide ($NO_2$), particulate matter ($PM_{2.5}$, particulate matter $\leq$ 2.5 microns in diameter; and $PM_{10}$, particulate matter > 2.5 microns and $\leq$ 10 microns in diameter), ozone, and sulfur dioxide ($SO_2$).

The RBS site, located in West Feliciana Parish, Louisiana, along with 34 other parishes in Louisiana and 15 counties in Texas, is part of the Southern Louisiana-Southeast Texas Interstate AQCR (eCFR 2015a). For Louisiana, five parishes (Ascension, East Baton Rouge, Iberville, Livingston, and West Baton Rouge) make up the nonattainment areas for the 2008 8-hour ozone standard (EPA 2015a). In addition, these same five parishes are classified as maintenance areas under the 1997 8-hour ozone standard (EPA 2015b). One parish, St. Bernard, is in nonattainment for the 2010 $SO_2$ primary NAAQS. All remaining parishes and counties within the Southern Louisiana-Southeast Texas Interstate AQCR are in attainment for all criteria pollutants. (eCFR 2015b)

Only one other state, Mississippi, is located within a 50 mile radius of RBS. The portion of Mississippi within a 50-mile radius includes Adams, Amite, Franklin, Pike, and Wilkinson counties in Mississippi, all of which are in attainment for all criteria pollutants (eCFR 2015c).

Figure 3.2-1 illustrates nonattainment and maintenance areas defined under the CAA, as amended, within a 50 mile radius of RBS. There are no mandatory Class I federal areas on the mainland of Louisiana. The closest Class I Area is the Breton National Wildlife Refuge located offshore on the Chandeleur Islands. The Breton National Wildlife Refuge is located 154 miles east-southeast of the RBS site. Given the minor nature of air emissions associated with operations of RBS, this distance is sufficiently far as to not warrant concern. (EOI 2008a, Section 2.7.3.1)

### 3.2.5 Air Emissions

RBS is classified as a minor air emission source. Although RBS may periodically utilize portable diesel generator(s) during outages, nonradioactive gaseous effluents result primarily from the testing of emergency diesel generators. RBS also has several mechanical draft cooling towers as shown in Table 3.2-2 that are utilized for reactor cooling, service water, and UHS purposes. Annual $PM_{10}$ emissions associated with these cooling towers range from 0.10 to 0.60 tons per year (RBS 2009). Therefore, $PM_{10}$ emissions associated with the cooling towers are minimal.

To protect Louisiana's ambient air quality and ensure that impacts from facilities that generate air emissions are maintained at acceptable levels, the LDEQ governs the discharge of regulated pollutants by establishing specific conditions in the air permit. Permitted emission sources and conditions established in RBS Air Permit 3160-00009-04 are shown in Table 3.2-2. Annual emissions for the previous 5 years (2011–2015) are shown in Table 3.2-3.

During Entergy's review, no license-renewal-related refurbishment or construction activities were identified. In addition, Entergy's review did not identify any future upgrade or replacement activities necessary for plant operations (e.g., as related to diesel generators) that would affect RBS's current air emissions program. Therefore, no increase or decrease of air emissions is expected over the license renewal period.

Studies have shown that the amount of ozone generated by even the largest lines in operation (765 kV) would be insignificant (NRC 2013b, Section 4.3.1.1). As discussed in Section 2.2.5.1, RBS's in-scope transmission lines are 230 kV. Therefore, the amount of ozone generated from the in-scope transmission lines is anticipated to be minimal.

Because RBS is not required to inventory and report greenhouse gases (GHGs), data do not exist for mobile sources such as visitors and delivery vehicles. Therefore, Entergy calculated GHG emissions on those direct (stationary and portable combustion sources reported in Table

3.2-2) and indirect (workforce commuting) plant activities where information was readily available. GHG emissions generated at RBS are presented in Table 3.2-4. These GHG emissions are not associated with RBS's fuel source that is used for generating electricity. As discussed in Section 7.3.2 and shown in Table 7.3-1, GHG emissions associated with nuclear power for generating electricity are similar to the life-cycle GHG emissions from renewable energy sources.

RBS has no electrical equipment on site that contains sulfur hexafluoride or perfluorocarbons. Although ozone-depleting substances such as chlorofluorocarbons and hydrochlorofluorocarbons are present at RBS and can potentially be emitted, estimating GHG emissions from these substances is complicated due their ability to deplete ozone, which is also a GHG, making their global warming potentials difficult to quantify. These ozone-depleting substances are regulated by the CAA under Title VI. As discussed in Section 9.5.3.3, Entergy maintains a program to manage stationary refrigeration appliances at RBS to recycle, recapture, and reduce emissions of ozone-depleting substances and is in compliance with Section 608 of the CAA. Therefore, Entergy did not include potential emissions as result of leakage, servicing, repair, and disposal of refrigerant equipment at RBS.

**Table 3.2-1**
**RBS Onsite Meteorological Tower Sensor Characteristics**

| Parameter | Sensor Characteristics |
|---|---|
| Wind speed | Threshold Speed: 0.75 mph (transmitter)<br>Accuracy: ±1% or 0.15 mph (whichever is greater)<br>Range: 0 to 50 mph |
| Wind direction | Threshold Speed: 0.93 mph at 10 degrees (transmitter)<br>Accuracy: ±2 degrees<br>Range: 0 to 540 degrees |
| Temperature | Accuracy: ±0.2°F<br>Range: 0°F to 120°F |
| Temperature difference | Accuracy: ±0.2°F<br>Range: ±12°F |
| Dew point[a] | Accuracy: NA<br>Range: NA |
| Precipitation[a] | Accuracy: NA |

(EOI 2008a, Table 6.4-1)

NA: Not available.

a. Obtained from Ryan Airport when needed.

**Table 3.2-2**
**Permitted Air Emission Points**

| Emission Point[a] | Description | Capacity Rating | Permit Condition |
|---|---|---|---|
| 2-83 | Standby Diesel Generator Engine No. 1 | 36.1 MMBtu/hour | CO, $NO_x$, $PM_{10}$, $SO_2$, and VOC emission limitations<br>Opacity (≤ 20%)<br>Fuel usage and operational run times |
| 3-83 | Standby Diesel Generator Engine No. 2 | 36.1 MMBtu/hour | |
| 4-83 | High Pressure Core Spray Diesel Engine | 28 MMBtu/hour | |
| 26-01 | Portable Outage/Maintenance Diesel Engines | 100,000 gallons/year | |
| 7-83 | Diesel Fuel Oil Storage Tank (50,000 gallons) | 50,000 gallons/year | VOC emission limitations |
| 8-83 | Diesel Fuel Oil Storage Tank (50,000 gallons) | 50,000 gallons/year | |
| 9-83 | Diesel Fuel Oil Storage Tank (50,000 gallons) | 50,000 gallons/year | |
| 14-91 | Gasoline Fuel Storage Tank (6,000 gallons) | 6,000 gallons/year | VOC emission limitations |
| 20-83 | Mechanical Draft Cooling Tower A | 141,250 gpm | $PM_{10}$ emission limitations |
| 21-83 | Mechanical Draft Cooling Tower B | 141,250 gpm | |
| 22-83 | Mechanical Draft Cooling Tower C | 141,250 gpm | |
| 23-83 | Mechanical Draft Cooling Tower D | 141,250 gpm | |
| 24-83 | Service Water Cooling Tower | 62,490 gpm | |
| 25-83 | Standby Cooling Tower (UHS) | 33,000 gpm | |
| 10-09 | Air Compressor | 22.69 gallons/hour | CO, $NO_x$, $PM_{10}$, $SO_2$, and VOC emission limitations<br>Opacity (≤ 20%) |
| 17-09 | Station Blackout Diesel Generator No. 2 | 1.9 MMBtu/hour | |
| 09-01 | EOF Emergency Generator | 1,950 standard cubic feet/hour | |

(RBS 2009)

a. Stationary combustion sources also subject to 40 CFR Part 63, Subpart ZZZZ—National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines.

**Table 3.2-3**
**Annual Air Emissions Inventory Summary, 2011–2015**

| Annual Emissions (tons/year)[a][b] | | | | | | |
|---|---|---|---|---|---|---|
| Year | $SO_x$ | $NO_x$ | CO | $PM_{10}$[c] | VOCs[d] | HAPs |
| 2011 | 0.4 | 15.9 | 4.0 | 3.5 | 1.7 | 0.01 |
| 2012 | 0.1 | 9.0 | 2.4 | 3.1 | 1.2 | 0.01 |
| 2013 | 0.3 | 14.9 | 3.8 | 3.4 | 1.6 | 0.01 |
| 2014 | 0.2 | 8.9 | 2.3 | 3.3 | 1.3 | 0.01 |
| 2015 | 0.6 | 20.5 | 5.1 | 3.8 | 1.9 | 0.02 |

(Entergy 2016h)

a. Emissions for diesel combustion sources based on calculated gallons of fuel usage shown below.

| Equipment | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|
| Stationary and portable diesels (> 600 hp) | 44,828 | 37,185 | 44,176 | 22,934 | 49,656 |
| Stationary/portable diesels (≤ 600 hp) | 18,761 | 1,918 | 15,890 | 12,006 | 30,192 |

b. Emissions for natural gas combustion source based on 1.989 MMBtu/hour rating and operational hours shown below.

| Emission Point | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|
| 09-01 (EOF Emergency Generator) | 39.3 | 34.5 | 23.4 | 21.7 | 31.3 |

c. Emissions include permitted tons per year for the cooling towers shown in RBS Air Permit 3160-00009-04.

d. Emissions include permitted tons per year for the diesel fuel oil and gasoline storage tanks shown in RBS Air Permit 3160-00009-04.

## Table 3.2-4
## Annual Greenhouse Gas Emissions Inventory Summary, 2011–2015

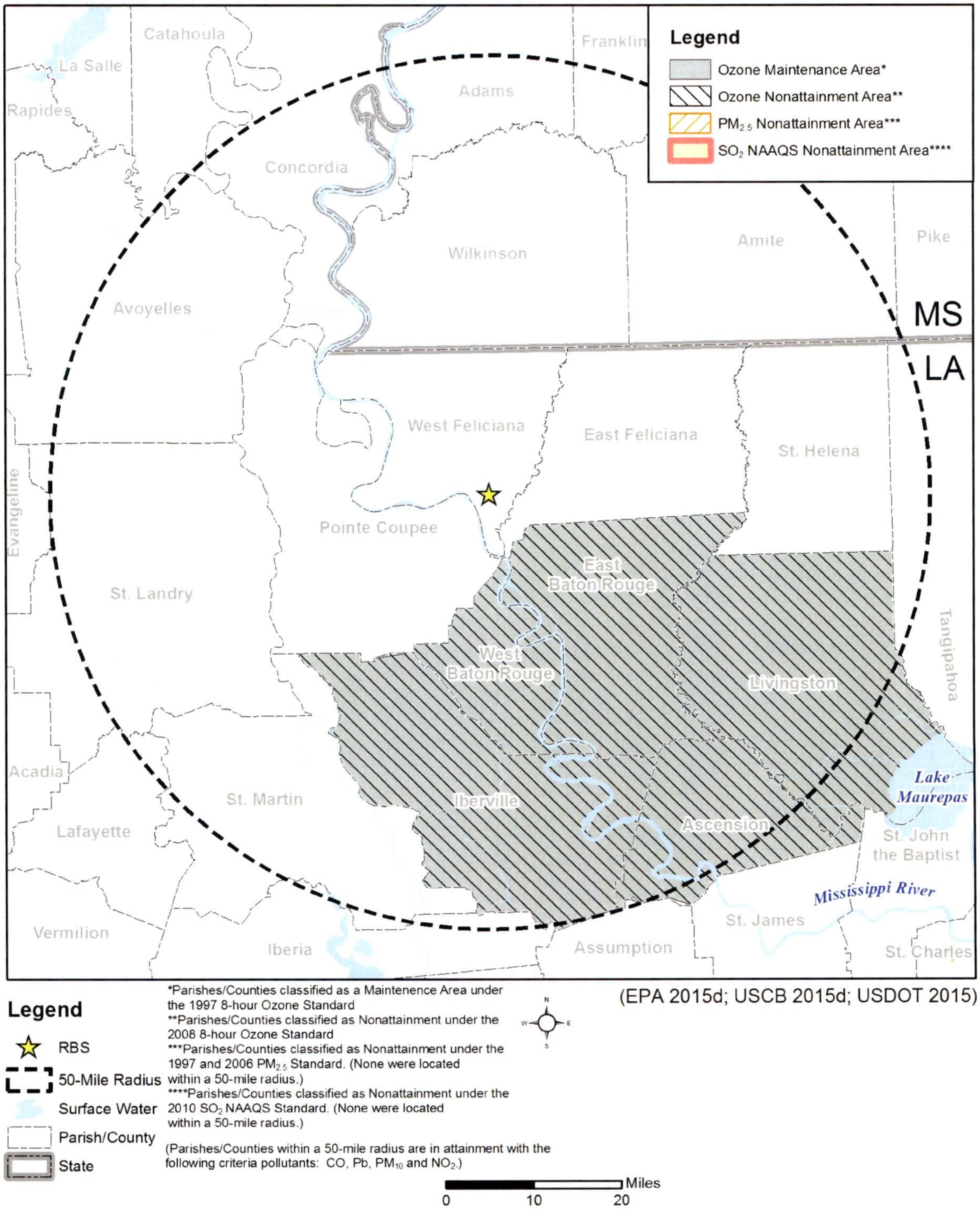
| Carbon Dioxide Equivalent ($CO_2e$) Emissions, Metric Tons[(a)] [(b)] | | | | | |
|---|---|---|---|---|---|
| **Emission Source** | **2011** | **2012** | **2013** | **2014** | **2015** |
| Combustion sources (Table 3.2-2) | 651 | 400 | 615 | 358 | 817 |
| Workforce commuting | 2,893 | 2,893 | 2,893 | 2,893 | 2,893 |
| Total | 3,544 | 3,293 | 3,508 | 3,251 | 3,710 |

(Entergy 2016h)

a. GHG calculated emissions from diesel and natural gas combustion sources are based on fuel usage for diesel combustion sources and MMBtu/hour rating/operational hours for natural gas combustion source shown in footnotes "a" and "b" in Table 3.2-3.

b. GHG calculated emissions from workforce commuting are based on the following:

- Statistical information from U.S. Census Bureau indicates that 10.5 percent of U.S. residents carpool to work (USCB 2015e). Number of RBS employees as of October 2016 was 680. Utilizing the 10.5 percent USCB carpool statistic, a value of 609 passenger vehicles per day was determined and utilized.
- EPA's Greenhouse Gas Equivalencies Calculator shows that the CO2e/vehicle/year was estimated to be 4.75 metric tons (EPA 2015c).
- Carbon dioxide has a global warming potential (100-year time horizon) of 1, based on Table A-1 to Subpart A of 40 CFR Part 98.
- 609 vehicles × 4.75 metric tons $CO_2e$/vehicle/year × 1 (global warming potential).




(EPA 2015d; USCB 2015d; USDOT 2015)

**Figure 3.2-1**
**Nonattainment and Maintenance Areas, 50-Mile Radius of RBS**

## 3.3 Noise

Two ambient sound-level surveys were conducted in support of licensing for RBS. The first survey was conducted June 15–16, 1972, prior to the construction of RBS. A follow-up survey was conducted January 9–10, 1980, during construction of RBS (but specifically during periods of the day when there was little construction activity occurring). There were a total of eight noise-sensitive receptors utilized for the surveys. Most of the differences in ambient sound levels between the two surveys appear to have resulted from seasonal variations; the ambient sound levels in June 1972 were heavily influenced by insect noise, which is not uncommon in the region during the summer months. (EOI 2008a, Section 2.5.5)

Subsequent to the completion of RBS, there have been no ambient sound-level surveys conducted in the vicinity specifically to establish the ambient sound-level conditions with RBS in operation. However, during the preparation of the RBS3 COL application, predictions of RBS noise emissions based on information provided in the RBS *Environmental Report—Operating License Stage* and the RBS FES were evaluated to establish representative ambient sound levels. The ranges of predicted ambient sound levels from RBS operations at the same receptors utilized in the RBS *Environmental Report—Operating License Stage* and the RBS FES are summarized in Table 3.3-1. (EOI 2008a, Section 2.5.5)

RBS is located in West Feliciana Parish, Louisiana, near the town of St. Francisville. There are no extant parish or state regulations regarding noise emissions (EOI 2008a, Section 5.8.1.1.1). Although RBS is not located within the town of St. Francisville, the town has established maximum permissible sound levels in the town's *Code of Ordinances*. The noise ordinance limits the sound levels based on the time of day and the zoning of the property from which the sound emanates. The ordinance does not prescribe a limit for noise emanating from industrial properties, but does prescribe a limit of 65 A-weighted decibels (dBA) during nighttime hours (i.e., 11 p.m. to 7 a.m.) from commercial properties. (EOI 2008a, Section 5.8.1.1.1; Municode 2015) The Department of Housing and Urban Development [24 CFR 51.101(a)(8)] uses day-night average sound levels of 55 dBA, recommended by the EPA as guidelines or goals for outdoors in residential areas (NRC 2013b, Section 3.3.3).

As shown in Table 3.3-1, RBS would be within the acceptable noise levels specified in St. Francisville's *Code of Ordinances*. Although there were four receptor locations that could range slightly above the Department of Housing and Urban Development sound level of 55 dBA recommended by the EPA, the EPA has no authority to regulate ambient noise levels.

The entire RBS site is zoned for industrial use (M2—General Industry District) by West Feliciana Parish, as discussed in Section 3.1.1. The loudest noise-generating source on the RBS site is the mechanical draft cooling towers. Periodic use of the gun range and GAI-Tronics® equipment is another onsite activity that creates occasional noise. As discussed in Section 3.0.3, the sensitive receptor closest to RBS is a residence located approximately 0.8 miles northwest and, as shown in Table 3.0-1, the parks nearest to RBS are approximately 3 miles north-northeast, west-northwest, and northwest.

Over a 5-year period (2011–2015), there have been no noise complaints related to actual plant operations. However, Entergy did previously receive a complaint during this 5-year period from a local resident regarding activities associated with the firing range. Specifically, the complaint was related to nighttime training at the firing range. Based on meetings conducted by local law enforcement and Entergy, it was determined that nighttime activities at the firing range were not occurring during the time period specified by the local resident. Therefore, Entergy concluded that the source of noise which produced the complaint was unrelated to nighttime firing range activities. To date, there have been no additional complaints from the local resident. (Entergy 2016i)

## Table 3.3-1
## RBS Predicted Noise Emissions

| Receptor | Approximate Distance from RBS (miles) | Ambient Sound Level (dBA)[a] |
|---|---|---|
| R1 | 0.85 | 47–57 |
| R2 | 0.89 | 47–57 |
| R3 | 1.09 | 46–52 |
| R4 | 0.93 | 48–54 |
| R5 | 0.89 | 49–54 |
| R6 | 0.90 | 50–56 |
| R7 | 0.84 | 50–56 |
| R8 | 1.19 | 43–53 |

(EOI 2008a, Table 2.5-56)

a. Ranges result from the following:
- Separate predictions performed by Gulf States Utilities and the NRC.
- Use of different initial conditions: summer 1972 and winter 1980.

## 3.4 Geologic Environment

### 3.4.1 Geology

#### 3.4.1.1 Regional Geology

The majority of the site (approximately two-thirds of the site) is located on upland areas east of the Mississippi River, where the maximum elevation is approximately 120 feet amsl. The upland areas of the site are heavily dissected by dry swales and intermittent streams. The remaining one-third of the site stretches approximately north to south across 3,000 to 4,000 feet of floodplains of the Mississippi River, where the elevation of land surface is approximately 30 to 40 feet amsl. Major drainage features include the Alligator Bayou to the west and Grants Bayou to the south and east of the site. The western boundary of the RBS site runs along the Mississippi River. (EOI 2008a, Section 2.3.1.2.1)

The Gulf Coastal Plain physiographic province has been dominated by marine and fluvial processes along the Gulf of Mexico continental margin for several hundred million years. Thick sedimentary sequences deposited by the Mississippi River within the Gulf Coastal Plain have played an important role in the geologic processes of the region since post-Miocene time. (EOI 2008b, Section 2.5.1.1)

##### 3.4.1.1.1 Physiography

The RBS site region lies entirely within the Gulf Coastal Plain physiographic province (Figure 3.4-1). This province extends 500 miles inland from the coast to include the Mississippi Embayment geologic province north of the RBS site as shown in Figure 3.4-2. The Gulf Coastal Plain physiographic province is divided into subprovinces that include the Southern Hills, the Mississippi Alluvial Valley, the Delta Plain, the Prairie Coastwise Terrace, the Loess Hills, the Eastern Hills, the Western Hills, and the Chenier Plain. (EOI 2008b, Section 2.5.1.1.1)

Southern Hills

The RBS site is situated 1.9 miles northeast of the east bank of the Mississippi River on the uplands of the western edge of the Southern Hills subprovince (Figure 3.4-1). The Southern Hills covers portions of southern Mississippi, southern Louisiana, and southeastern Texas. The topography is characterized by gently rolling hills and flat-topped ridges that range in elevation from 50 to 500 feet amsl and generally decreases toward the Gulf Coast. (EOI 2008b, Section 2.5.1.1.1.1)

Mississippi Alluvial Valley

The Mississippi Alluvial Valley subprovince lies to the north, south, and west of the RBS site (Figure 3.4-1). In terms of geomorphology, the southern boundary of the section is based on the southern extent of the Pleistocene valley walls (Prairie Coastwise Terraces) (Figure 3.4-1). The geologic boundary between the Mississippi Alluvial Valley and Delta Plain subprovinces is based on the northern extent of the Atchafalaya River, which is the first true distributary of the Mississippi River and is located approximately 40 miles north of the RBS site. This subprovince includes a number of inter-distributary lowlands, basins, and ridges. Elevations generally range from 50 to 250 feet amsl. Higher elevations occur in tributary valleys, with highs of 300 feet amsl in the Ouachita River Valley and 500 feet amsl in the upper Red River Valley near the Ouachita Mountains. The topographic highs along the Mississippi River are remnants of older alluvial deposits that were mostly eroded and removed from the valley. The valley topography is relatively flat with a gentle southward gradient and is characterized by fluvial geomorphic features typical of a braided stream and meandering river system (e.g., valley train, oxbow lakes, meander belts, and floodplains). Deposits in the Mississippi Alluvial Valley consist primarily of Pleistocene to Holocene sediments derived from the Mississippi River and its tributaries. (EOI 2008b, Section 2.5.1.1.1.2)

Delta Plain

The Delta Plain subprovince lies to the south of the RBS site (Figure 3.4-1). The topography of the Delta Plain is characterized by abandoned distributary channels, distributary levee ridges, and coalescing delta complexes near the mouth of the Mississippi River. The distributary levee ridges form the most prominent topographic features, but do not exceed elevation 10 feet amsl. Distributary channels radiate in a fan shape and form apices of delta complexes. The morphologic expression of the channel and distributary features become markedly less pronounced with increasing age, and eventually become buried as a result of coastal subsidence. (EOI 2008b, Section 2.5.1.1.1.3)

Prairie Coastwise Terrace

The Prairie Coastwise Terrace subprovince occupies the area south of the RBS site (Figure 3.4-1). The Prairie Coastwise Terrace extends across southern Mississippi, southern Louisiana, and southeastern Texas. The topography of this subprovince is characterized by gently rolling hills and remnants of dissected terrace surfaces that range in elevation from 25 to 150 feet amsl and gradually decrease in elevation coastward. The Prairie Coastwise Terrace is underlain by terrace deposits of the late Pleistocene Prairie Complex. (EOI 2008b, Section 2.5.1.1.1.4)

Loess Hills

The Loess Hills subprovince lies to the east of the Mississippi Alluvial Valley subprovince, both of which are located north of the RBS site (Figure 3.4-1). The Loess Hills extend along the eastern bank of the Mississippi River from Kentucky to southwestern Mississippi, and consist of an eastward thinning loess (silt) deposit that is 0 to 100 feet thick and extends 10 to 30 miles east of the Mississippi River. (EOI 2008b, Section 2.5.1.1.1.5)

The topography of the Loess Hills is characterized by flat-topped ridgelines and fluvial terraces separated by deeply incised dendritic drainage systems. In the RBS site region, the Loess Hills vary in elevation from 100 to 300 feet amsl. Erosion along the eastern edge of the Mississippi

River floodplain has formed a steep escarpment along the western edge of the Loess Hills. (EOI 2008b, Section 2.5.1.1.1.5)

The Loess Hills were formed through the deposition of successive sheets of silt during the late Quaternary. Up to five distinct periods of loess deposition are documented. Each of these deposits are separated by leached buried soils that represent significant periods of landscape stability. (EOI 2008b, Section 2.5.1.1.1.5)

Eastern Hills

The Eastern Hills subprovince lies northeast of the RBS site (Figure 3.4-1). The Eastern Hills cover the area from central Mississippi and central Alabama to western Tennessee and extend to the eastern margin of the Gulf Coastal Plain. The topography is characterized by gently rolling hills that range in elevation from 100 to 600 feet amsl, which gradually decrease in elevation southward. The Eastern Hills are underlain by Miocene to Paleocene sedimentary rocks and drained by tributaries of the Mississippi River. (EOI 2008b, Section 2.5.1.1.1.6)

Western Hills

The Western Hills subprovince lies northwest of the RBS site (Figure 3.4-1). The Western Hills cover the area from central Louisiana to central Arkansas, and extend westward into eastern Texas. The topography is characterized by gently rolling hills ranging in elevation from 200 to 700 feet amsl and a gradual decrease in elevation southward. The Western Hills are underlain by Miocene to Paleocene sedimentary rocks and drained by the Arkansas River and Red River, two major tributaries of the Mississippi River. (EOI 2008b, Section 2.5.1.1.1.7)

Chenier Plain

The Chenier Plain subprovince is located southwest of the RBS site and occupies the area between the Prairie Coastwise Terrace subprovince and the Gulf of Mexico (Figure 3.4-1). The Chenier Plain extends along the Louisiana and eastern Texas coastline. Cheniers are abandoned beaches of the Gulf of Mexico, with large expanses of Holocene marshes that developed on prograding mudflats. A typical Chenier ridge is less than 10 feet high, but may extend for miles or tens of miles. The topography of the Chenier Plain is characterized by low-lying coastal ridges and marshes. The most prominent features are abandoned beach ridges at elevations between sea level and 25 feet amsl. Subtle variations in elevations, on the order of inches, have a pronounced effect on vegetation and habitat in the Chenier Plain. The only preserved pre-Holocene features are remnants of the Prairie Coastwise Terrace and emergent landforms developed above salt dome piercement structures. (EOI 2008b, Section 2.5.1.1.1.8)

#### 3.4.1.1.2 Stratigraphy

Soil Units

The soil units in the region include Holocene-aged deposits consisting of sand, sandy silt, silt, clayey silt, silty clay, and clay deposited along the banks of the Mississippi River, and terrace deposits of the Upland Complex. Figure 3.4-3 shows the distribution of surface deposits surrounding the site.

The majority of the site is located in the soil units of the Upland Complex, designated as the Pliocene Citronelle Formation. The Citronelle Formation overlies the lower Prairie Allogroup. The upper Prairie Allogroup and undifferentiated Prairie Allogroup are not found on the RBS property, but they do outcrop to the north (undifferentiated) and to the east and south (upper) of the RBS property boundary (Figure 3.4-3).

The Citronelle Formation is divided into an upper and lower formation. This informal break in the formation follows the previous investigation's separation of the sands and clayey sands and the sands and gravelly sands. The upper Citronelle Formation consists mainly of fine to coarse sands with varying amounts of fines. In the developed portion of the site, this layer has been removed and replaced with fill. The upper Citronelle generally has a thickness ranging from 20 to 60 feet and is encountered above elevations -50 feet amsl. The general lack of gravel within the upper Citronelle serves as one of the major distinguishing characteristics between the lower and upper portions of the formation. (EOI 2008b, Section 2.5.1.2.3.1.1.2)

Pleistocene terrace deposits occur through the eastern half of the site area and are exposed extensively near the RBS plant (EOI 2008b, Section 2.5.1.2.3.1.2.1.1). These upland terrace deposits are overlain by a surficial layer of loess, which is usually 10 feet or less in thickness. The loess layer is present everywhere, except where it has been eroded in some stream channels. (RBS 2015, Section 2.4.13.1.2)

The Port Hickey Formation is part of the Prairie Allogroup (equivalent to the Lower Prairie Terrace) and was deposited during the Sangamon Interglacial Stage. At the RBS plant, the terrace is generally at an elevation between 100 and 130 feet amsl, with a gradient that gradually rises to the north. Where not disturbed by the construction of RBS, the Port Hickey Terrace surface is at an elevation of approximately 108.5 feet amsl and has the typical clayey terrace top stratum that is underlain, in part, by the Port Hickey Terrace sand substratum. Where the Port Hickey substratum is absent, the top stratum is underlain by the fine sands and clayey sands of the Citronelle Formation. (EOI 2008b, Section 2.5.1.2.3.1.2.1.1)

In the site area, Holocene deposits are exposed along the Mississippi River to the west of the site and its tributaries, including Alligator Bayou to the west and Grants Bayou to the south of RBS. Within the Holocene floodplain immediately adjacent to the Mississippi River, a natural levee borders the river and achieves an elevation of approximately 46 feet amsl. In the backswamp area, elevations as low as -31 feet amsl are found. The Holocene top stratum silts and clays extend to approximately -50 feet amsl in the site area. These silts and clays are underlain by deep deposits of alluvial sands extending below -117 feet amsl, the maximum penetration of RBS borings in this area. (EOI 2008b, Section 2.5.1.2.3.1.2.2)

Rock Units

The general geologic conditions of the upper 550 feet are depicted as geologic cross sections in Figure 3.4-4.

The Pascagoula Formation was the oldest formation encountered by the borings associated with the RBS 3 COL project. The deepest penetrations into the clay were to a depth of approximately 550 feet. Borings encountered the Pascagoula clay at depths of approximately 120 to 140 feet, resulting in penetrations of more than 400 feet into the formation. Previously, the deepest penetrations into the formation were less than 100 feet in the immediate area of RBS. (EOI 2008b, Section 2.5.1.2.3.1.1.1).

### 3.4.1.2 Site Geology

The Gulf Coastal Plain physiographic province comprises two geologic provinces: the Gulf Coast Basin and the Mississippi Embayment (Figure 3.4-2). Both the Gulf Coast Basin and the Mississippi Embayment have distinct geologic histories. (EOI 2008b, Section 2.5.1.1.2)

Most of the RBS site region is situated within the Gulf Coast Basin geologic province (Figure 3.4-2). The Gulf Coast Basin geologic province contains marine sediments deposited during episodic sea level transgressions and regressions, and terrestrial sediments deposited on river floodplains and deltas along the continental margin. The sediments are composed of sand, silt, gravel, clay, marl, limestone, salt, and chalk that range in age from Jurassic to Holocene and form a seaward-thickening wedge more than 50,000 feet thick near the present Gulf of Mexico coastline. Development of the thick sedimentary wedge resulted in depression of the crust within the Gulf Coast Basin to depths of up to 7 miles. (EOI 2008b, Section 2.5.1.1.2.1)

The RBS site is located in a relatively domeless area between the Interior Salt Basin and the Coastal Salt Basin (Figure 3.4-2). South of the RBS site, the sedimentary beds are interrupted by numerous east-west trending growth faults that become less steep with depth and become bedding-plane slips. These faults are activated by compaction and subsidence of the sediments and are not derived from basement tectonic structures. Some movement may be continuing on several of these growth faults. (EOI 2008b, Section 2.5.1.1.2.1)

The Gulf Coast Basin extends from the Gulf of Mexico to the buried Ouachita Orogenic belt (Figure 3.4-2). The basin formed during initial rifting of the Gulf of Mexico during the Triassic. As a result of continental rifting and formation of new oceanic crust, the properties of basement materials within the Gulf Coast Basin are transitional between continental and oceanic materials. In the northern part of the basin, the basement is defined as thick transitional crust reflecting continental affinity. In areas closer to the Gulf of Mexico oceanic plate, the crust is defined as thin transitional crust reflecting oceanic affinity. The basin has been affected by a long series of tectonic, volcanic, depositional, isostatic, and climatic processes. (EOI 2008b, Section 2.5.1.1.2.1)

The northern portion of the RBS site region is located within the Mississippi Embayment geologic province. The Mississippi Embayment syncline is the primary structural element that affected regional stratigraphic patterns in the Lower Mississippi Valley in pre-Quaternary times. The geological province extends from the buried Ouachita Orogenic belt to the northern margin of the Gulf Coastal Plain and lies between the Appalachian Mountains in west-central Alabama and the Ouachita Mountains in southern Arkansas (Figure 3.4-2). The Mississippi Embayment formed in response to crustal downwarping associated with the extension of the Reelfoot Rift within the North American craton during the Late Cretaceous. The Mississippi Embayment is underlain by Paleozoic strata and igneous and metamorphic basement rocks. The structure of the embayment is characterized by a south-southwest plunging syncline that continues southward across the Gulf Coast Basin (Figure 3.4-2). (EOI 2008b, Section 2.5.1.1.2.2)

### 3.4.2 Soils

#### 3.4.2.1 Onsite Soils and Geology

The site sits on the dissected uplands formed by the Pleistocene terrace deposits and the Citronelle Formation (Figure 3.4-3). The average elevation of the floodplain is approximately 38 feet amsl, and the average upland elevation is approximately 95 feet amsl (EOI 2008b, Section 2.5.1.2.1).

The Mississippi River floodplain extends into the site area on the southwest. At this point, the entire floodplain is 27 miles wide. Near the site, the Mississippi River meanders close to the northeastern margin of the floodplain at the base of the bluffs forming the eastern valley wall. The main uplands are formed by the Citronelle Formation of Late Pliocene to early Pleistocene, covered by a thin blanket of loess. The upland surfaces are generally of higher elevation and more sculptured than the younger terraces that overlap upland erosional slopes. Natural drainage is generally good with most surface water collecting in deep erosional gullies, which form the principal relief in the otherwise gently sloping surface. Localized swamp conditions exist in some depressed areas, although most runoff is collected in the various forks of Grants Bayou, a small perennial stream that flows through the area east and south of the site. Within the plant site, the uplands rise to an average of approximately 125 feet amsl. A maximum elevation of 147 feet amsl is present in isolated locations within the site area, particularly to the east. (EOI 2008b, Section 2.5.1.2.1) Figure 3.0-2 illustrates the topography of the RBS property.

Detailed soil units on and adjacent to the RBS site are shown in Figure 3.4-5 and described in Table 3.4-1.

During construction of RBS, the site was excavated to allow for the construction of RBS Unit 1 and RBS Unit 2. The site was excavated to elevation 20 feet amsl. After the excavation was completed, it was decided that RBS Unit 2 would not be built. The unused portion of the excavated site was partially backfilled to elevation 65 feet amsl. (EOI 2008b, Section 2.5.4.1.2) Two general types of fill were used (EOI 2008b, Section 2.5.4.2.2.1.1):

- General fill includes excavated Loess and Port Hickey Top Stratum soils that were used for site development. The general fill also includes fill known as Class III fill, which classifies as clayey sand with an angle of internal friction of 32 degrees. Soils encountered as fill include lean clays, poorly graded sands, and clayey sands, with natural moisture contents ranging from 7 to 37 percent.

- Engineered fill was used to backfill the majority of the RBS Unit 2 excavation from elevation 20 feet amsl to the current surface of elevation approximately 65 feet amsl. The engineered fill has a mean of 5 percent gravel and 5 percent of material passing the No. 200 sieve.

### 3.4.2.2 Erosion Potential

Because RBS has been operational since the mid-1980s, stabilization measures are already in place to prevent erosion and sedimentation impacts to the site and vicinity. Based on information from the U.S. Department of Agriculture (USDA), all soil units listed in Table 3.4-1 that are subject to erosion have a slight erosion potential with the exception of Feliciana and Natchez silt loams (8 to 60 percent slopes), which were rated moderate to severe for slope erodibility (USDA 2015d). The Feliciana and Natchez silt loams (8 to 60 percent slopes) are located in areas of steep to moderate slopes surrounding the plant industrial area, and do not extend beneath any plant structures.

RBS maintains and implements a stormwater pollution prevention plan (SWPPP) that identifies potential sources of pollution that would reasonably be expected to affect the quality of stormwater, such as erosion, and identifies best management practices (BMPs) that will be used to prevent or reduce the pollutants in stormwater discharges (RBS 2013a).

These practices, as they relate to erosion, include non-structural preventative measures and source controls, as well as structural controls to prevent erosion or treat stormwater containing pollutants caused by erosion. In addition, any ground disturbance of one or more acres requires a construction stormwater permit to be obtained from the LDEQ. The construction stormwater permit specifies BMPs to reduce erosion caused by stormwater runoff, thereby minimizing the risk of pollution from soil erosion and sediment, and potentially from other pollutants that the stormwater may contact. Although currently, no license-renewal-related construction activities are planned, these activities would continue to be managed in adherence to the RBS SWPPP.

### 3.4.2.3 Prime Farmland Soils

USDA Natural Resources Conservation Service maps show areas of prime farmland surrounding the developed portion of the RBS property outside the plant perimeter fence. All locations designated as prime farmlands are small, isolated patches with the largest area located west of the developed portion of RBS (Figure 3.4-5). These areas would most likely still be considered prime farmland even though it is part of the property owned by RBS; however, even if areas of the property are designated prime farmland, RBS would not be subject to the Farmland Protection Policy Act (FPPA), because the act does not include federal permitting or licensing for activities on private or non-federal lands (USDA 2015e). Soil units designated as prime farmland are included in Table 3.4-1.

### 3.4.3 Seismic History

Epicentral locations for all recorded earthquakes from 1842 to 2015 in the central Gulf Coastal Plain with a recorded magnitude of 3.0 or greater are plotted in Figure 3.4-6. Historic earthquake data for the areas between latitude 27.5° to 33.61° north and longitude 86° to 96° west were assembled. (ANSS 2016; Entergy 2016j, Figure 3.4-5; EOI 2008b, Table 2.5.2AA-201; USGS 2015b)

In addition to earthquakes within the site region, the New Madrid, Missouri, earthquake sequence of 1811–1812 was felt in the northern part of Louisiana with an intensity of V-VI Modified Mercalli (MM), and in the southern part of the state with an intensity of III-IV MM. Although not felt within the region, the March 27, 1964, earthquake in Prince William Sound, Alaska, reportedly caused water oscillations in the New Orleans area, with a peak-to-peak amplitude of approximately 6 feet with a period of approximately 5 seconds. (EOI 2008b, Section 2.5.1.1.5.5)

Within the state of Louisiana from 1842 to 2015, there have been 20 small earthquakes, as shown in Figure 3.4-7 and listed in Table 3.4-2. Within a 50-mile radius of the RBS site, there have been only six epicenters recorded in the last 173 years (Table 3.4-3). The maximum earthquake was the 1930 event in Donaldsonville, Louisiana, (approximately 55.9 miles south-southeast of the site) with an epicentral intensity of nearly VI MM (RBS 2015, Section 2.4.2.2). The maximum horizontal ground surface acceleration calculated for the Donaldsonville earthquake is 0.07g (RBS 2015, Section 2.4.2.2). The RBS plant has been designed for a maximum horizontal ground surface acceleration of 0.1g (RBS 2015, Table 1.3-6) for the safe shutdown earthquake.

The site lies within a region of infrequent and minor seismic activity, and there are no major seismic zones within the state of Louisiana. Based on NUREG-1407, seismic hazards at RBS are low (NRC 1991, Section 3.2.3). In addition, the U.S. Geological Survey's (USGS's) national seismic hazard map shows that RBS is in a region that has a 2 percent in 50 years (once in 2,500 years [EOI 2008a, page 9A-2]) probability of exceeding a peak ground acceleration between 0.08 and 0.12g (USGS 2015c, Figure 1).

**Table 3.4-1**
**Onsite Soil Unit Descriptions**

| Map Symbol (Figure 3.4-5) | Soil Unit Name | Description | Prime Farmland Designation |
|---|---|---|---|
| CN | Commerce soils, gently undulating, frequently flooded | The Commerce component makes up 90 percent of the map unit. Slopes are 0 to 3 percent. This component is on natural levees on Mississippi River delta plains. The parent material consists of silty alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is somewhat poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is very high. Shrink-swell potential is moderate. This soil is frequently flooded. It is not ponded. A seasonal zone of water saturation is at 33 inches during January, February, March, April, and December. Organic matter content in the surface horizon is about 2 percent. Non-irrigated land capability classification is 5w. This soil meets hydric criteria. | Not prime farmland |
| FA | Fausse soils, 0 to 1 percent slopes, frequently flooded | The Fausse, frequently flooded component makes up 75 percent of the map unit. Slopes are 0 to 1 percent. This component is on low, ponded backswamps on alluvial plains. The parent material consists of clayey alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is very poorly drained. Water movement in the most restrictive layer is moderately low. Available water to a depth of 60 inches (or restricted depth) is high. Shrink-swell potential is very high. This soil is frequently flooded. It is frequently ponded. A seasonal zone of water saturation is at 0 inches during January, February, March, April, November, and December. Organic matter content in the surface horizon is about 9 percent. Non-irrigated land capability classification is 7w. This soil meets hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 2 percent. | Not prime farmland |

**Table 3.4-1 (Continued)**
**Onsite Soil Unit Descriptions**

| Map Symbol (Figure 3.4-5) | Soil Unit Name | Description | Prime Farmland Designation |
|---|---|---|---|
| Fe | Feliciana silt loam, 1 to 3 percent slopes | The Feliciana component makes up 85 percent of the map unit. Slopes are 1 to 3 percent. This component is on terraces on uplands. The parent material consists of loess. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is very high. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 3 percent. Non-irrigated land capability classification is 2e. This soil does not meet hydric criteria. There are no saline horizons within 30 inches of the soil surface. | All areas are prime farmland |
| Fg | Feliciana silt loam, 3 to 8 percent slopes | The Feliciana component makes up 90 percent of the map unit. Slopes are 3 to 8 percent. This component is on terraces on uplands. The parent material consists of silty loess. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is very high. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 3 percent. Non-irrigated land capability classification is 3e. This soil does not meet hydric criteria. There are no saline horizons within 30 inches of the soil surface. | Not prime farmland |

**Table 3.4-1 (Continued)**
**Onsite Soil Unit Descriptions**

| Map Symbol (Figure 3.4-5) | Soil Unit Name | Description | Prime Farmland Designation |
|---|---|---|---|
| FH | Feliciana and Natchez silt loams, 8 to 60 percent slopes | The Feliciana component makes up 60 percent of the map unit. Slopes are 8 to 40 percent. This component is on terraces on uplands. The parent material consists of loess. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is very high. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 3 percent. Non-irrigated land capability classification is 6e. This soil does not meet hydric criteria. There are no saline horizons within 30 inches of the soil surface.<br>The Natchez component makes up 30 percent of the map unit. Slopes are 12 to 60 percent. This component is on loess bluffs on hills. The parent material consists of loess over calcareous loess. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is very high. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 2 percent. Non-irrigated land capability classification is 7e. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 1 percent. | Not prime farmland |
| Fr | Frost silt loam, ponded | The Frost component makes up 90 percent of the map unit. Slopes are 0 to 1 percent. This component is on depressions on loess uplands. The parent material consists of loess. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is moderately low. Available water to a depth of 60 inches is very high. Shrink-swell potential is moderate. This soil is frequently flooded. It is frequently ponded. A seasonal zone of water saturation is at 0 inches during January, February, March, April, May, June, July, August, September, October, November, and December. Organic matter content in the surface horizon is about 2 percent. Non-irrigated land capability classification is 7w. This soil meets hydric criteria. | Not prime farmland |

**Table 3.4-1 (Continued)**
**Onsite Soil Unit Descriptions**

| Map Symbol (Figure 3.4-5) | Soil Unit Name | Description | Prime Farmland Designation |
|---|---|---|---|
| MB | Morganfield and Bigbee soils, frequently flooded | The Morganfield component makes up 60 percent of the map unit. Slopes are 0 to 2 percent. This component is on floodplains on loess uplands. The parent material consists of thick silty alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is very high. Shrink-swell potential is low. This soil is frequently flooded. It is not ponded. A seasonal zone of water saturation is at 42 inches during January, February, March, and April. Organic matter content in the surface horizon is about 2 percent. Non-irrigated land capability classification is 4w. This soil does not meet hydric criteria.<br>The Bigbee component makes up 30 percent of the map unit. Slopes are 0 to 2 percent. This component is on second-level terraces on coastal plains. The parent material consists of sandy alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is excessively drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is low. Shrink-swell potential is low. This soil is frequently flooded. It is not ponded. A seasonal zone of water saturation is at 57 inches during January, February, and March. Organic matter content in the surface horizon is about 1 percent. Non-irrigated land capability classification is 5w. This soil does not meet hydric criteria. | Not prime farmland |

**Table 3.4-1 (Continued)**
**Onsite Soil Unit Descriptions**

| Map Symbol (Figure 3.4-5) | Soil Unit Name | Description | Prime Farmland Designation |
|---|---|---|---|
| RC | Robinsonville and Convent soils, occasionally flooded | The Robinsonville component makes up 60 percent of the map unit. Slopes are 1 to 5 percent. This component is on natural levees on Mississippi River delta plains. The parent material consists of loamy alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is high. Shrink-swell potential is low. This soil is occasionally flooded. It is not ponded. A seasonal zone of water saturation is at 60 inches during January, February, March, and April. Organic matter content in the surface horizon is about 1 percent. Non-irrigated land capability classification is 2w. This soil does not meet hydric criteria.<br>The Convent component makes up 30 percent of the map unit. Slopes are 0 to 3 percent. This component is on natural levees on Mississippi River delta plains. The parent material consists of silty alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is somewhat poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is very high. Shrink-swell potential is low. This soil is occasionally flooded. It is not ponded. A seasonal zone of water saturation is at 33 inches during January, February, March, April, and December. Organic matter content in the surface horizon is about 2 percent. Non-irrigated land capability classification is 3w. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 3 percent. | All areas are prime farmland |

**Table 3.4-1 (Continued)
Onsite Soil Unit Descriptions**

| Map Symbol (Figure 3.4-5) | Soil Unit Name | Description | Prime Farmland Designation |
|---|---|---|---|
| TU | Tunica and Sharkey soils, undulating, frequently flooded | The Tunica component makes up 60 percent of the map unit. Slopes are 1 to 3 percent. This component is on intermediate position on natural levees on Mississippi River delta plains. The parent material consists of clayey over loamy alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is very low. Available water to a depth of 60 inches is high. Shrink-swell potential is moderate. This soil is frequently flooded. It is not ponded. A seasonal zone of water saturation is at 27 inches during January, February, March, and April. Organic matter content in the surface horizon is about 2 percent. Non-irrigated land capability classification is 5w. This soil meets hydric criteria.<br>The Sharkey component makes up 30 percent of the map unit. Slopes are 0 to 1 percent. This component is on broad flats on lower natural levees on Mississippi River delta plains. The parent material consists of clayey alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is very low. Available water to a depth of 60 inches is moderate. Shrink-swell potential is very high. This soil is frequently flooded. It is not ponded. A seasonal zone of water saturation is at 12 inches during January, February, March, April, and December. Organic matter content in the surface horizon is about 2 percent. Non-irrigated land capability classification is 5w. This soil meets hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 3 percent. | Not prime farmland |

**Table 3.4-1 (Continued)**
**Onsite Soil Unit Descriptions**

| Map Symbol (Figure 3.4-5) | Soil Unit Name | Description | Prime Farmland Designation |
|---|---|---|---|
| UB | Urban land | This map unit consists of areas where more than 85 percent of the surface is covered by asphalt, concrete, buildings, or other impervious surfaces. Examples are business centers, parking lots, industrial sites, grain elevators, and nuclear power plants along the Mississippi River industrial corridor. The mapped areas range from 100 to 500 acres.<br>Included with this urban land in mapping are areas of lawns on miscellaneous, artificial fill. In some areas, several feet of this fill has been placed over the original soil surface. The included areas make up about 15 percent of the map unit. Examination and identification of soils or soil material in this map unit was impractical. Careful onsite investigation is needed to determine the potential and limitations for any proposed use. | Not prime farmland |
| We | Weyanoke silt, 1 to 3 percent slopes | The Weyanoke component makes up 85 percent of the map unit. Slopes are 1 to 3 percent. This component is on floodplains on uplands. The parent material consists of silty alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is high. Shrink-swell potential is low. This soil is rarely flooded. It is not ponded. A seasonal zone of water saturation is at 39 inches during January, February, March, and April. Organic matter content in the surface horizon is about 1 percent. Non-irrigated land capability classification is 2e. This soil does not meet hydric criteria. | All areas are prime farmland |

(USDA 2001; USDA 2015d)

**Table 3.4-2**
**Louisiana Historic Earthquakes ≥ 3.0 Mb, 1842–2015**

| Year | Month | Day | Latitude (N) | Longitude (W) | Intensity | Magnitude (Mb) | Distance to Site (miles) | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1842 | May | 7 | 30.7700 | -91.9200 | | 3.9 | 34.9 | North of Palmetto, Louisiana |
| 1868 | November | 28 | 31.3100 | -92.4600 | | 3.8 | 76.9 | Alexandria, Louisiana |
| 1870 | January | 9 | 31.1400 | -92.2900 | | 4.2 | 62.6 | Northwest of Echo, Louisiana |
| 1905 | February | 3 | 30.5000 | -91.1000 | | 3.7 | 22.5 | Merrydale, Louisiana (Baton Rouge) |
| 1927 | December | 15 | 28.9000 | -89.4000 | | 3.8 | 172.8 | South of Southwest Pass Entry, Louisiana |
| 1929 | July | 28 | 28.9000 | -89.4000 | | 3.8 | 172.8 | South of Southwest Pass Entry, Louisiana |
| 1930 | October | 19 | 30.0000 | -91.0000 | V-VI | | 55.9 | Donaldsonville, Louisiana |
| 1947 | September | 20 | 31.9000 | -92.6000 | | 3.3 | 108.8 | Southeast of Winnfield, Louisiana |
| 1952 | October | 17 | 30.1000 | -93.7000 | | 3.1 | 148.2 | East of Orange, Texas (Louisiana) |
| 1958 | November | 6 | 29.9000 | -90.1000 | | 3.1 | 94.4 | Marrero, Louisiana (New Orleans) |
| 1958 | November | 19 | 30.3000 | -91.1000 | V | | 34.5 | Baton Rouge, Louisiana |
| 1959 | October | 15 | 29.8000 | -93.1000 | | 3.7 | 124.5 | Creole, Louisiana |
| 1964 | April | 23 | 31.5000 | -93.8000 | V | 3.7 | 154.7 | Western Louisiana |
| 1964 | April | 24 | 31.6000 | -93.8000 | V | 3.7 | 157.1 | Western Louisiana |
| 1964 | April | 27 | 31.5000 | -93.8000 | V | 3.4 | 154.7 | Western Louisiana |
| 1964 | April | 28 | 31.7000 | -93.6000 | V | 4.4 | 149.0 | Western Louisiana |
| 1981 | February | 13 | 30.0000 | -91.8000 | | 3.1 | 59.3 | Southern Louisiana |

**Table 3.4-2 (Continued)**
**Louisiana Historic Earthquakes ≥ 3.0 Mb, 1842–2015**

| Year | Month | Day | Latitude (N) | Longitude (W) | Intensity | Magnitude (Mb) | Distance to Site (miles) | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1983 | October | 16 | 30.2430 | -93.3930 | | 3.8 | 127.7 | Louisiana-Texas |
| 2005 | December | 20 | 30.2580 | -90.7080 | | 3.0 | 50.7 | Louisiana |
| 2010 | August | 2 | 30.8150 | -90.8540 | | 3.0 | 28.6 | Louisiana |

(ANSS 2016; Entergy 2016j, Table 3.4-2; EOI 2008b, Table 2.5.2AA-201; USGS 2015b)

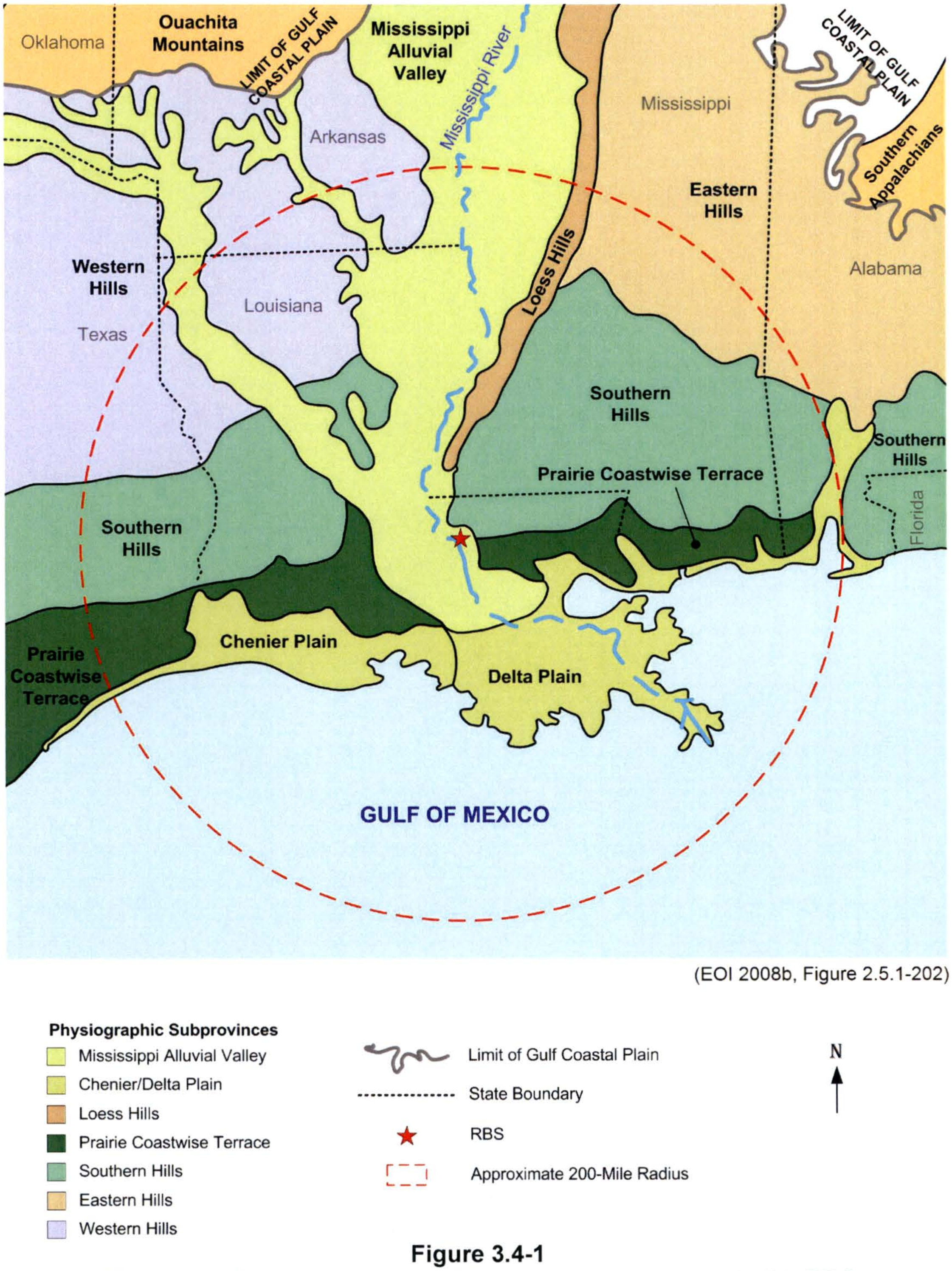
Mb: body-wave magnitude.

**Table 3.4-3**
**Historic Earthquakes ≥ 3.0 Mb, 50-Mile Radius, 1842–2015**

| Year | Month | Day | Latitude (N) | Longitude (W) | Intensity | Magnitude (Mb) | Distance to Site (miles) | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1842 | May | 7 | 30.7700 | -91.9200 | | 3.9 | 34.9 | North of Palmetto, Louisiana |
| 1898 | February | 13 | 31.4500 | -91.3000 | | 3.0 | 47.9 | South of Natchez, Mississippi |
| 1905 | February | 3 | 30.5000 | -91.1000 | | 3.7 | 22.5 | Merrydale, Louisiana (Baton Rouge) |
| 1958 | November | 19 | 30.3000 | -91.1000 | V | | 34.5 | Baton Rouge, Louisiana |
| 2005 | December | 20 | 30.2580 | -90.7080 | | 3.0 | 50.7 | Louisiana |
| 2010 | August | 2 | 30.8150 | -90.8540 | | 3.0 | 28.6 | Louisiana |

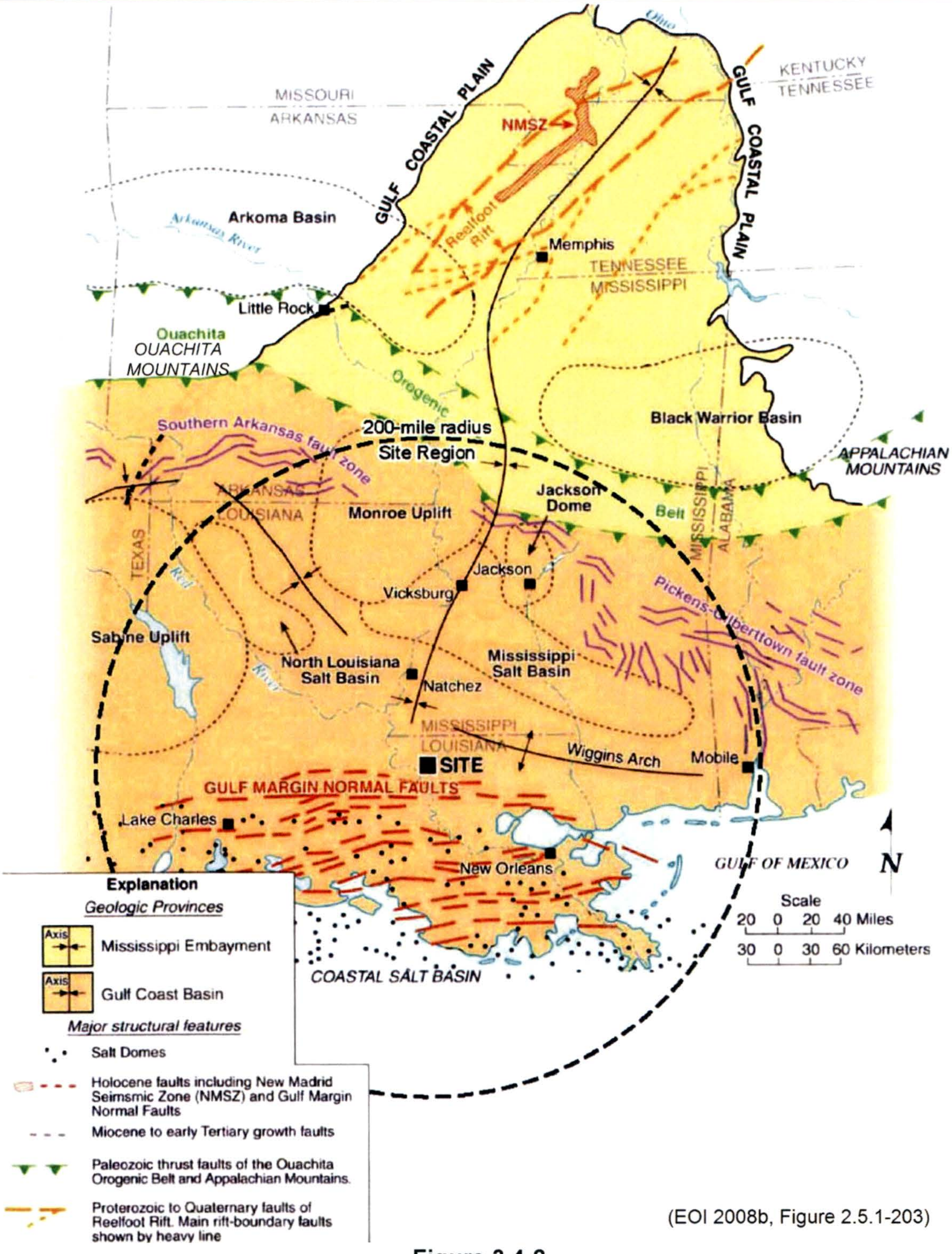
(ANSS 2016; Entergy 2016j, Table 3.4-2; EOI 2008b, Table 2.5.2AA-201; USGS 2015b)

Mb: body-wave magnitude.



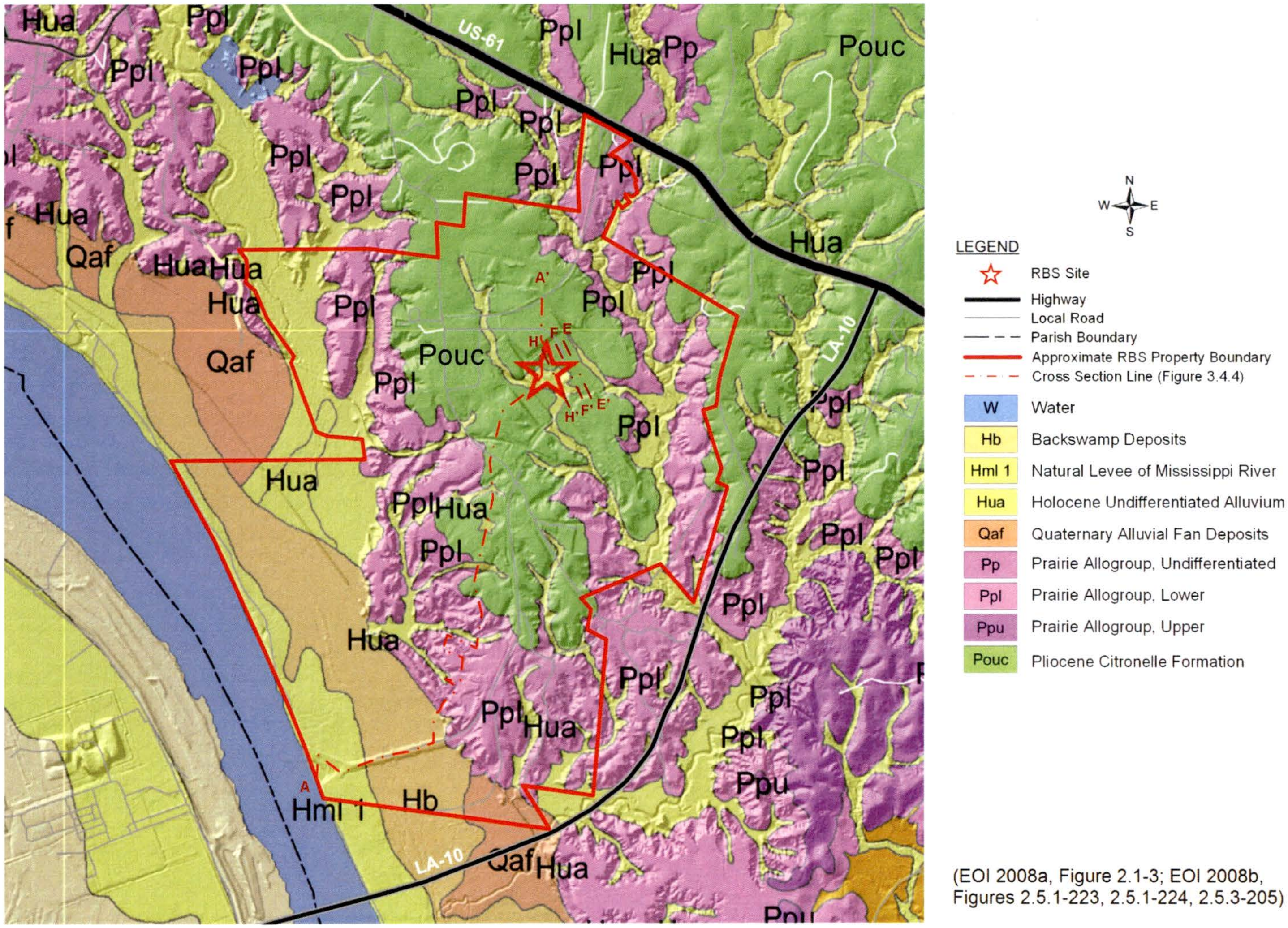

(EOI 2008b, Figure 2.5.1-202)

**Figure 3.4-1**
**Physiographic Provinces and Subprovinces Associated with RBS**



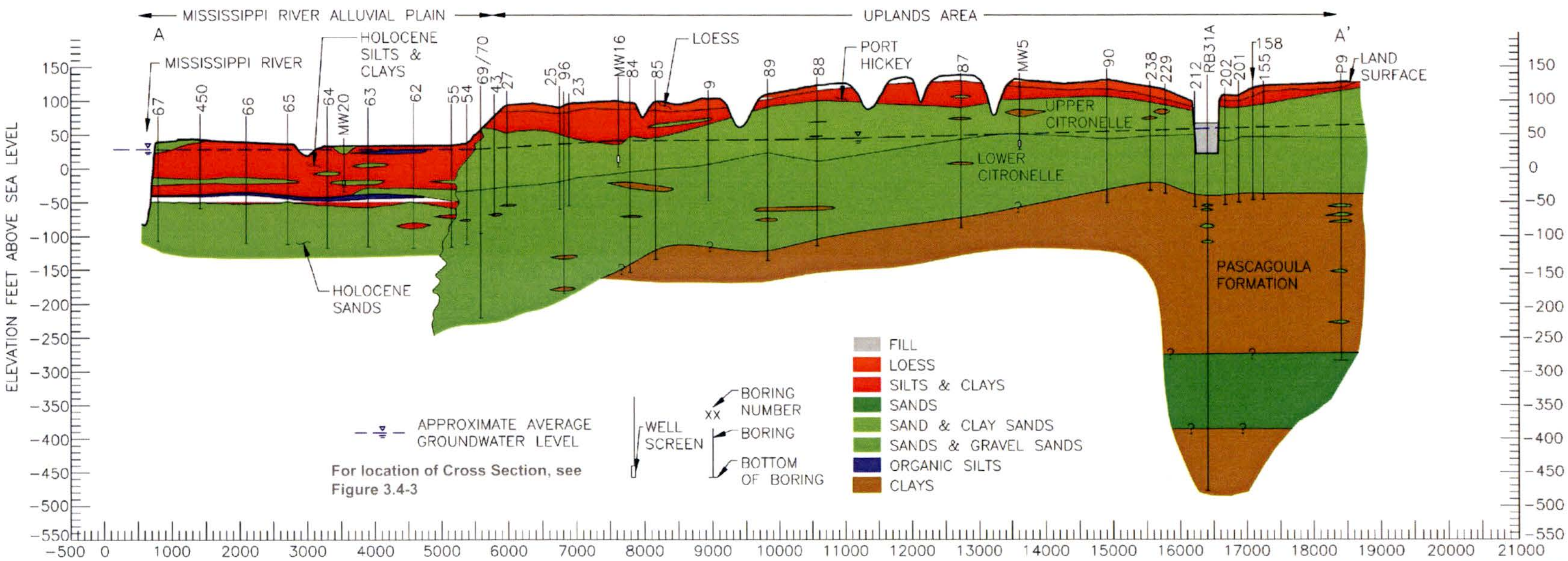

(EOI 2008b, Figure 2.5.1-203)

**Figure 3.4-2**
**Regional Geologic Provinces**




(EOI 2008a, Figure 2.1-3; EOI 2008b, Figures 2.5.1-223, 2.5.1-224, 2.5.3-205)

**Figure 3.4-3**
**Surficial Geology Map, RBS Property**



(EOI 2008b, Figure 2.5.1-231)

**Figure 3.4-4**
**RBS Geologic Cross Section (A-A')**
**(Sheet 1 of 2)**

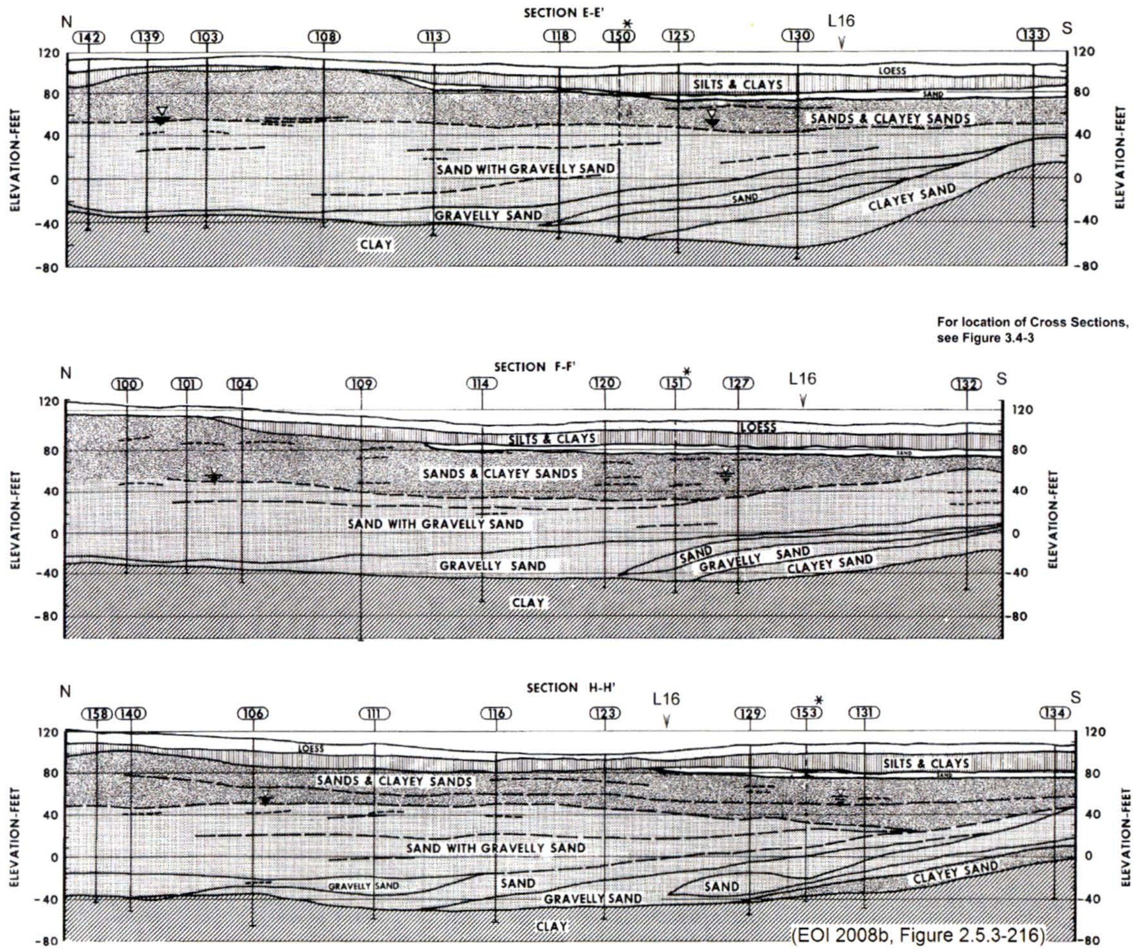
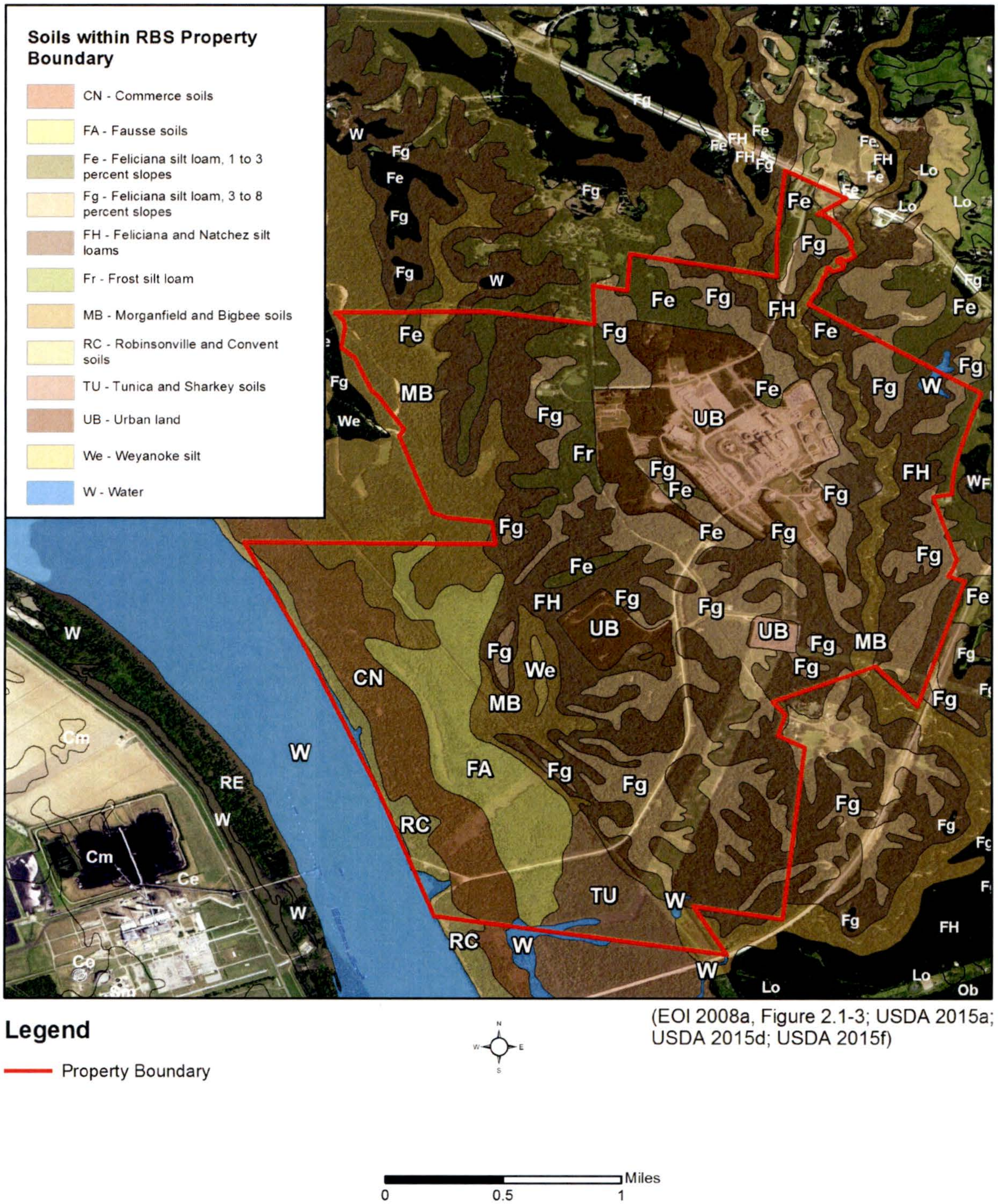
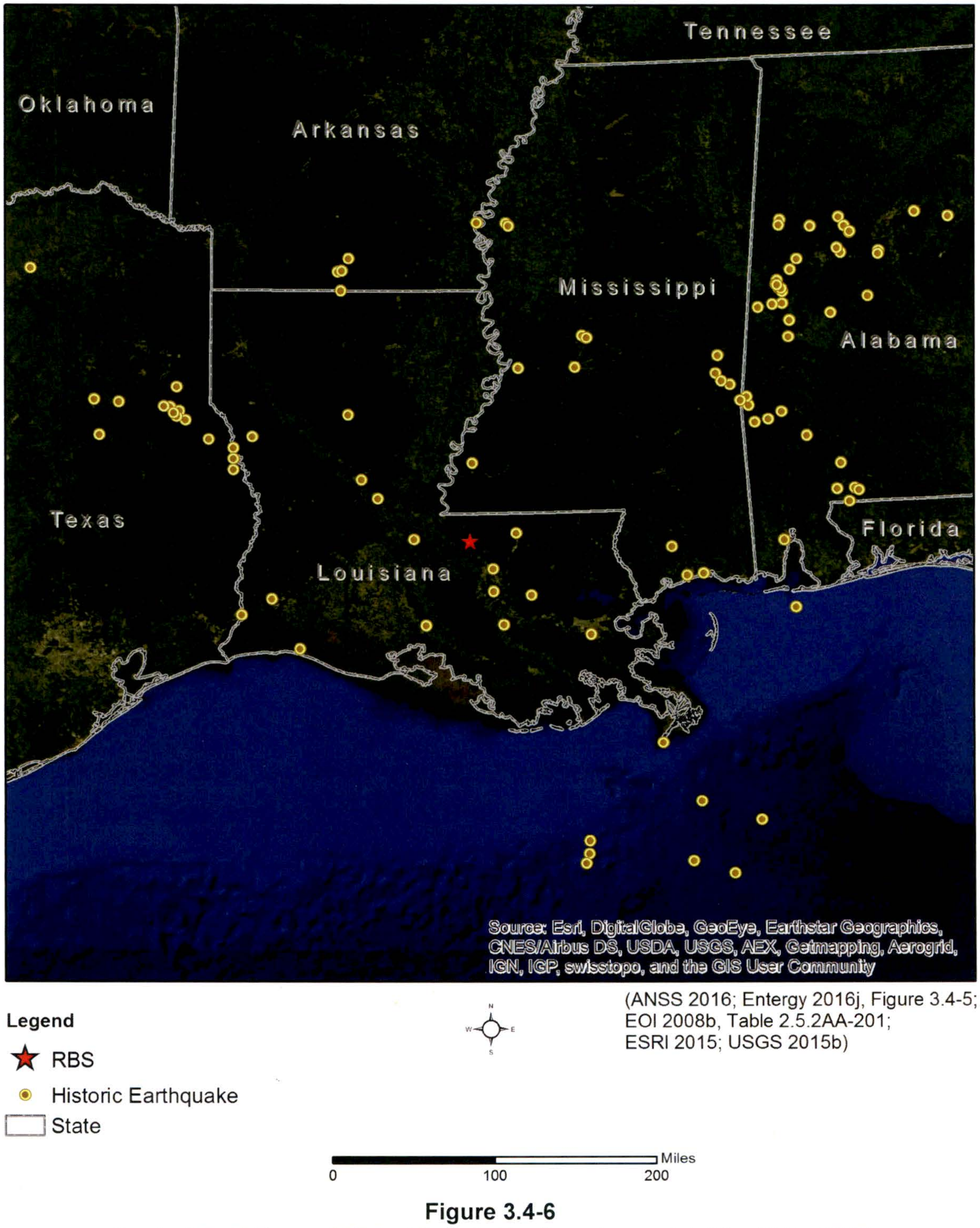



**Figure 3.4-4**
**RBS Geologic Cross Sections (E-E', F-F', H-H')**
**(Sheet 2 of 2)**



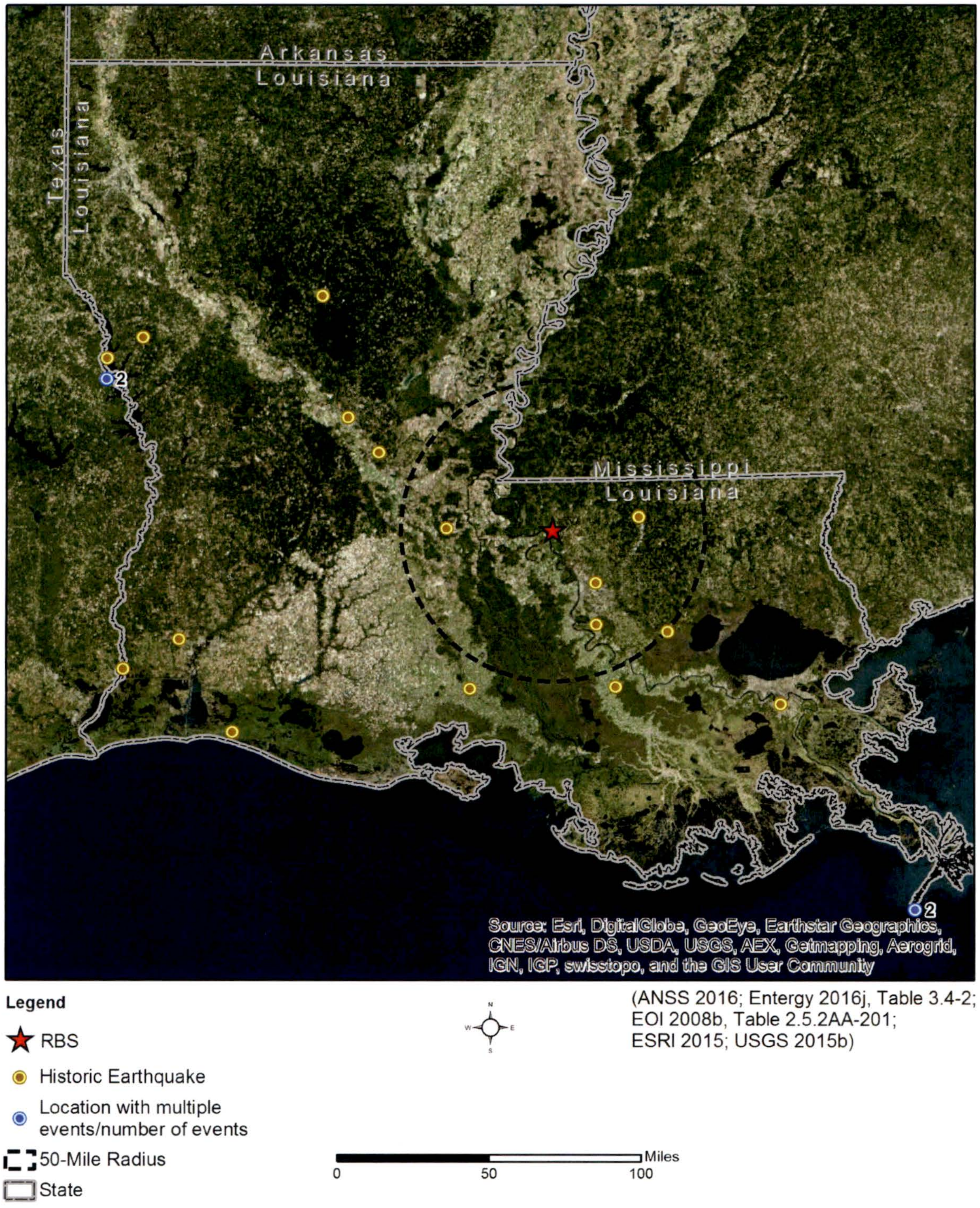

(EOI 2008a, Figure 2.1-3; USDA 2015a; USDA 2015d; USDA 2015f)

**Figure 3.4-5**
**Distribution of Soil Units, RBS Property**




(ANSS 2016; Entergy 2016j, Figure 3.4-5; EOI 2008b, Table 2.5.2AA-201; ESRI 2015; USGS 2015b)

**Figure 3.4-6**
**Central Gulf Coastal Plain Historic Earthquakes ≥ 3.0 Mb, 1842–2015**




(ANSS 2016; Entergy 2016j, Table 3.4-2; EOI 2008b, Table 2.5.2AA-201; ESRI 2015; USGS 2015b)

**Figure 3.4-7**
**Louisiana Historic Earthquakes ≥ 3.0 Mb, 1842–2015**

## 3.5 Water Resources

### 3.5.1 Surface Water Resources

RBS is located above the Mississippi River floodplain on elevated, gently sloping terrain at approximately RM 262 (Figure 3.5-1). The plant is separated from the river by a natural levee formed above the riverbank and by the lower floodplain area, which is crossed by Alligator Bayou and its tributaries (Figure 3.0-2).

The Mississippi River and its tributaries drain a total of 1,245,000 square miles, which is 41 percent of the 48 contiguous states of the United States. (USACE 2015). With its headwaters in Minnesota, the Mississippi flows southward for approximately 2,300 miles into the Gulf of Mexico (USGS 1998). Because the river is so vast, management agencies have divided it into three segments which contain a variety of habitat conditions and fisheries. The upper 512 miles from Lake Itasca to St. Anthony Falls in Minnesota is considered the headwaters reach of the Mississippi River. This portion of the Mississippi flows alternately through forests and wetlands. Dams have been built to form 11 small reservoirs, modify the elevation, and discharge several natural river lakes. These dams variously function for flood control, electricity generation, water supply, or recreation. (Schramm 2004, page 303)

The Upper Mississippi River reach stretches 668 miles from St. Anthony Falls, Minnesota, to Alton, Illinois, a few miles above the confluence with the Missouri River. The Upper Mississippi River is impounded by 28 locks and dams built for commercial navigation and one dam (at Keokuk, Iowa) built for commercial navigation and hydropower generation. These dams are operated to maintain minimum navigation channel depth (9 feet); thus, the dams have little effect on the river stage and discharge during spring floods. (Schramm 2004, page 303)

Downstream from the confluence of the Missouri River near West Alton, Missouri, north of St. Louis, the Mississippi flows undammed to Head of Passes in Louisiana, where it branches into several distributaries that carry water to the Gulf of Mexico. The 195-mile reach from the mouth of the Missouri River to the mouth of the Ohio River is referred to as the Middle Mississippi River by management agencies. At the Missouri River confluence, water volumes in the Mississippi River almost double. The 976-mile reach from the Ohio River to Head of Passes is referred to as the LMR. Water from the Ohio River increases Mississippi River discharge 150 percent. Although discharge and channel size differ between the two reaches, they share similar hydrologic conditions, methods and levels of channelization, and loss of connectivity with the historic floodplain. (Schramm 2004, page 304)

With an average discharge of 593,000 cubic feet per second (cfs), the Mississippi River is the largest river in the United States (NRC 2006, Section 2.6.1.1). Based on 2004 U.S. Army Corps of Engineers (USACE) bathymetric information for the Mississippi River at the RBS intake location (RM 262), the width of the Mississippi River is approximately 1,700 feet with an average maximum depth of approximately 70 feet (EOI 2008a, Figure 2.3-19). The occurrence of low flow in the LMR is determined by flows of the major tributaries in the drainage basin. (RBS 2015, Section 2.4.11.1) During the period 1965–2015, the minimum and maximum flows recorded near the RBS site were 111,000 cfs and 1,619,000 cfs, respectively. The mean flow rate during this same period was 514, 080 cfs. (USACE 2016) The probable minimum flow rate of the Mississippi River at RBS during the operating life of the station is not anticipated to be less than 100,000 cfs (RBS 2015, Section 2.4.11.1). Based on the RBS LPDES permit fact sheet, the 7-day, 10-year low flow is 141,955 cfs (Attachment A).

The existing comprehensive flood control and navigation plan for the Mississippi River consists of a levee system along the main stem of the river and its tributaries in the alluvial plain; reservoirs on the tributary streams; floodways to receive excess flow from the river; and channel improvements such as revetment, dikes, and dredging to increase channel capacity. Below Baton Rouge, Louisiana, 92 miles of operative revetment works are in place and a low-water navigation channel 9 feet deep and 300 feet wide between Cairo, Illinois, and Baton Rouge, Louisiana, is maintained by dredging and dikes. Other flood control programs consist of control structures, cutoffs, pumping plants, floodwalls, and floodgates. The channel cutoff program inaugurated in the 1930s consisted of 16 cutoffs which, along with two major chutes, have reduced the river distance between Memphis, Tennessee, and Baton Rouge, Louisiana, by 170 miles. This program has lowered river stages by 10 feet at Vicksburg, Mississippi, at project design flood stages. Besides the flood control features, the plan provides for construction and maintenance of a navigable channel from Baton Rouge, Louisiana, to Cairo, Illinois. (Entergy 2016j, Section 3.5.1)

The major flood control levee systems, floodways, and control structures near RBS are described below.

<u>Levees</u>

The alluvial valley of the Mississippi River extends from Cape Girardeau, Missouri, approximately 50 miles upstream of Cairo, Illinois (RM 956) to the Gulf of Mexico. It varies in width from 20 to 80 miles, with an average width of 45 miles. During a flood, the river goes out of its banks in some areas and deposits sediment, forming banks generally 10 to 15 feet above the floodplain. This building of natural levees occurred, for the most part, before the present levee system was constructed. The river has almost uninterrupted manmade levees on the west bank from Cape Girardeau to the Gulf. On the east side of the river, levees alternate with high bluffs from Cairo to Baton Rouge (RM 230); from Baton Rouge to the Gulf, there are continuous levees. (Entergy 2016j, Section 2.4.1.2.1)

<u>Floodway and Diversion Structures</u>

When all the control structures in the Mississippi River Basin are considered, the floodway system and associated structures in the river delta have the most direct bearing on river flood stage at the RBS site. The system consists of three major floodways, which are the West Atchafalaya Floodway, the Morganza Floodway, and the Bonnet Carre Spillway, plus the Atchafalaya River proper. (EOI 2008b, Section 2.4.1.2.1) This system is shown in Figure 3.5-1.

Four primary flood control structures operated by the USACE are located in the lower alluvial valley of the Mississippi River (Figure 3.5-1): the Bonnet Carre Spillway, the Old River Control Structure, the Morganza Floodway, and the Atchafalaya Basin Floodway (Entergy 2016j, Section 3.5.1).

a. Bonnet Carre Spillway

   The Bonnet Carre Spillway is located on the east bank of the Mississippi River approximately 25 miles above New Orleans, Louisiana. The Bonnet Carre Spillway and structure can divert approximately 250,000 cfs of floodwaters from the Mississippi River to Lake Pontchartrain. (Entergy 2016j, Section 3.5.1)

b. Old River Control Structure

   The Old River Control Structure is located on the west bank of the Mississippi River at approximately RM 314.5 above Head of Passes. The structure, which is designed to carry about 620,000 cfs of floodwaters, prevents the Atchafalaya River from capturing Mississippi River flow and controls the flow into the Atchafalaya River and basin. (Entergy 2016j, Section 3.5.1)

c. Morganza and West Atchafalaya Floodways

   The flow diverted from the main channel near Old River is carried by the Atchafalaya River through the Morganza Floodway and the West Atchafalaya Floodway. These two floodways follow down to the end of the levee system along the Atchafalaya River and merge into a single broad floodway that passes the flow to the Gulf of Mexico through two outlets: Wax Lake and the Lower Atchafalaya River. (Entergy 2016j, Section 3.5.1)

   The Morganza Floodway structure, located just above the town of Morganza, Louisiana, and between the Mississippi River and the Atchafalaya Basin Floodway, is designed to convey approximately 600,000 cfs of Mississippi River floodwaters to the Gulf of Mexico via the Atchafalaya Basin Floodway, thence through the lower Atchafalaya River and Wax Lake outlet. (Entergy 2016j, Section 3.5.1)

   The Atchafalaya River starts from the confluence of the Red and Old rivers. The Atchafalaya Basin Floodway extends from the confluence to the Gulf of Mexico. The floodway is designed to carry half of the projected flood (1,515,000 cfs) to the Gulf of Mexico. These floodwaters enter the floodway through the Red and Old rivers and the Morganza Floodway. (Entergy 2016j, Section 3.5.1)

The chronological sequences of floodway operation during a severe flood would be as follows:

1. As the river discharge approaches 1,250,000 cfs, the Bonnet Carre Spillway is opened. The spillway is operated to prevent the Carrolton (New Orleans) Stage from exceeding 20 feet. As the flow increases, the Old River Control Structure

would be operated to allow water from the Mississippi River to flow into the Atchafalaya River. The Morganza Floodway is the next flood relief structure that would be operated. (EOI 2008b, Section 2.4.1.2.1)

2. The West Atchafalaya Floodway is protected at its upper end by a fuse-plug, making the West Atchafalaya Floodway operational. The remaining flood flow is discharged by the Mississippi River and the Bonnet Carre Spillway. (EOI 2008b, Section 2.4.1.2.1)

Local Streams

RBS is located on high ground approximately 2 miles east of the Mississippi River. Surface drainage of the property is maintained by Alligator Bayou and its tributary, Grants Bayou. Flow from Alligator Bayou enters Thompson Creek and then passes to the Mississippi River. (EOI 2008a, Section 2.3.1.1.2)

The flow of streams in the site area consists primarily of surface runoff during periods of precipitation and the days immediately following. Plant area runoff flows to West Creek, which drains about 1 square mile before joining the main stem of Grants Bayou. West Creek flows intermittently. During construction of RBS, a 110-foot wide (50-foot base width) Fabriform® ditch was constructed in the plant area to contain West Creek flow and to minimize the potential for plant flooding during extreme rainfall events. (EOI 2008a, Section 2.3.1.1.2)

Potential for Flooding

The combined discharge of the three parallel floodways is approximately one-half of the USACE project design flood at the latitude of Red River Landing. The maximum postulated flood flow that has been calculated by the USACE is officially defined as the LMR project design flood. (EOI 2008b, Section 2.4.1.2.1)

Flow of the LMR in the site area is affected by diversions into the Atchafalaya River through the Old River diversion channel near Coochie, Louisiana, about 53 river miles upstream of the site. Records collected by the USACE from Red River Landing, Louisiana, about 12 river miles below the diversion, and Tarbert Landing, Mississippi, about 6 river miles below the diversion, indicate that the minimum daily discharge is 75,000 cfs, which occurred on November 4, 1939. On that day, the flow into the Old River diversion was 13,400 cfs. (EOI 2008a, Section 2.3.1.1.1)

A control structure on the diversion canal was completed in 1963, and minimum flows are now somewhat controlled. Based on these flow controls and recorded flow data, it is doubtful that the daily flow in the river downstream of the Old River diversion would ever be lower than 100,000 cfs. Since 1963, the lowest recorded flow at Tarbert Landing is 111,000 cfs, which occurred in 1988. (EOI 2008a, Section 2.3.1.1.1)

Major floods on the LMR (below the confluence with the Ohio River at RM 954) generally coincide with floods of the major tributaries. A substantial contribution from the Ohio River is required to produce a major flood. The flood season extends from mid-January to July. The flood of record occurred during the spring of 1927 and had an estimated confined discharge of 2,345,000 cfs at the latitude of Red River Landing. The estimated historic water level at the site for this flood is 55.5 feet amsl. The USACE determined a project design flood discharge at the latitude of Red River Landing of 3,030,000 cfs. A portion of this flow would be diverted upstream of the site into the Atchafalaya Floodway (Old River Control Structure, approximately RM 314.5) and the Morganza Floodway (RM 285). The project design flood passing the site would be approximately 1,500,000 cfs. The water level at the site for this flood is estimated by the USACE to be 54.5 feet amsl, about 40 feet below plant grade. (EOI 2008a, Section 2.3.1.1.1)

Based on Federal Emergency Management Agency (FEMA) flood map data for West Feliciana Parish (effective February 1979), areas within the 100-year floodplain are located within narrow bands in the drainage ways of the local streams within the RBS property, and along the low-lying areas of the Mississippi River, as shown in Figure 3.5-2. The remainder of the property, including the RBS plant site, is located in areas of designated minimal flooding. (FEMA 2015)

Safety-related equipment at RBS is located in buildings protected from flood water entry or situated at a minimum elevation of 98 feet amsl. Finish grade at the edge of plant buildings is about 95 feet amsl. (RBS 2015, Section 2.4.2.3.1)

### 3.5.1.1 Surface Water Discharges

#### 3.5.1.1.1 LPDES-Permitted Outfalls

Chemical additives approved by the LDEQ are used to control the pH, scale, and corrosion in the CWS, and to control biofouling of plant equipment. Discharges containing water treatment additives at or below LDEQ-approved concentrations are monitored and discharged to the Mississippi River in accordance with the site's LPDES Permit No. LA0042731 (Attachment A). The current LPDES permit authorizes discharges from 14 outfalls (6 external and 8 internal). The outfalls (Figure 3.5-3) and their associated effluent limits are shown in Table 3.5-1.

LPDES Outfall 301 (mobile metal cleaning wastewaters), which is permitted to receive metal cleaning wastewaters, is a mobile outfall to allow wastewater treatment skids to be installed prior to discharging to the Mississippi River via LPDES Outfall 001 (cooling tower blowdown). There have been no discharges from this outfall since the permit was re-issued in 1999 (Attachment A).

#### 3.5.1.1.2 Stormwater Runoff

Stormwater discharges associated with industrial activities at RBS are regulated and controlled through LPDES Permit No. LA0042731 (Attachment A) issued by the LDEQ. RBS samples stormwater runoff at LPDES Outfalls 002, 003, 004, and 005 on a quarterly basis. RBS also maintains and implements a SWPPP that identifies potential sources of pollution, such as erosion, that would reasonably be expected to affect the quality of stormwater, and identifies BMPs that will be used to prevent or reduce the pollutants in stormwater discharges (RBS 2013a).

3.5.1.1.3 Sanitary Wastewaters

Sanitary wastewater is transferred to the onsite wastewater treatment plant where it is managed appropriately. The wastewater treatment plant is a sanitary treatment facility that is composed of high-density polyethylene-lined aerated lagoons, sedimentation ponds, and rock filter basins; a gravity sand filter; and an ultraviolet disinfection unit (RBS 2015, Section 9.2.4.2)

The wastewater treatment plant has a capacity to accommodate 20 years of sludge accumulation at a time in two separate sedimentation ponds. The design of the wastewater treatment plant employs two parallel treatment systems, with one side of the system dedicated to the portion of the plant inside the Protected Area. Sludge from this system may need to be dried, compressed, and stored as low-level dry active waste. The other (larger) side of the system serves the bulk of sewage media from outlying site area support structures. Sludge from this system can be disposed of in an offsite permitted landfill. (RBS 2015, Section 9.2.4.2)

Discharges of sanitary wastewaters (Outfall 201) are regulated by RBS's LPDES Permit No. LA0042731 (Attachment A), prior to discharging either to the Mississippi River via LPDES Outfall 001 (cooling tower blowdown), or Grant's Bayou via Outfall 002 (stormwater runoff) when discharging a mixture of sanitary and maintenance wastewaters.

RBS also utilizes a MO-DAD sanitary wastewater treatment system at the small structure located at the unmanned checkpoint facility leading to the plant and the auxiliary control room located in the Unit 2 excavation area. These leach-field systems generate no surface wastewater discharges and are regulated under the Louisiana Department of Health and Hospitals (LDHH) Permit No. 1030185 and Permit No. 1089509, as discussed in Section 9.5.1.4.

3.5.1.1.4 Dredging

RBS performs annual maintenance dredging for the removal of no greater than 125,000 cubic yards of silt accumulation around the intake screens in the Mississippi River in accordance with a USACE NOD-23 general permit. The dredging material is deposited back into deeper portions of the Mississippi River in accordance with the permit. (USACE 2012)

3.5.1.1.5 Compliance History

Although there have been noncompliance incidents associated with RBS wastewater discharges to receiving surface waters over the previous 5 years (2012–2016) as shown in Table 9.5-1, these incidents were promptly corrected, and none resulted in a notice of violation.

### 3.5.2 Groundwater Resources

3.5.2.1 <u>Groundwater Aquifers</u>

The RBS site is underlain by approximately 5,000 feet of unconsolidated deposits consisting of a complex sequence of silt, sand, and clay layers. The results of subsurface explorations presented in the RBS *Updated Safety Analysis Report* (USAR) indicate that the shallow soils at the site consist of an approximately 10-foot-thick layer of loess overlying sand and clay layers of the Citronelle formation. (GZA 2007, Section 4.1.2)

The loess, a silty clay, generally follows the contours of the site, except where it has been eroded away in erosion gullies associated with Grants Bayou. In areas along the Mississippi River, the Port Hickey Terrace formation, consisting of a 10-foot-thick layer of silts and clays, immediately underlies the loess layer. (GZA 2007, Section 4.1.2)

The lower terrace alluvial deposits of the Mississippi floodplain and Port Hickey Terrace together form the Mississippi River Alluvial Aquifer (MRAA). This aquifer is an unconfined flow system which may be locally semi-confined where fine-grained materials overlie coarse-grained materials. The MRAA is in direct hydraulic connection with the Mississippi River as well as underlying deposits, such as the tertiary aquifer. (GZA 2007, Section 4.1.2)

The Port Hickey and Citronelle Formation deposits together form the Upland Terrace Aquifer (UTA). This aquifer is an unconfined flow system which may be locally semi-confined where fine-grained materials overlie coarse-grained materials. A network of piezometers and observation wells installed within an 8,000-foot radius of the plant area, as reported in the RBS USAR, have shown the western part of the UTA responds to changes in the Mississippi River stage, indicating that a hydraulic connection exists between these deposits and the river. Effects of the river on the UTA dissipate with distance and appear to have no significant effect in water level fluctuations on the eastern part of the site or at the plant area. (GZA 2007, Section 4.2.1)

In the upper terrace regions of the site, the UTA overlies the sand and clay sediments of the Fleming Grand Gulf Formation, also known as the tertiary aquifers. It has been shown that the UTA and the tertiary aquifers are hydraulically separated by several hundred feet of clay (i.e., the Pascagoula clay). (GZA 2007, Section 4.2.1)

The Tertiary aquifers have been divided into three separate zones. Generally, each of these zones represents a confined flow system composed of multiple sand units. However, in many areas, the confining clay layers may contain silt and sand, and may be leaky, thin, or absent. The sand units of the Tertiary aquifers may be unconfined in the outcrop areas or in areas where they are overlain by sands of the UTA. (EOI 2008b, Section 2.4.12.1.2.3) Correlations of the three zones with laterally equivalent aquifers in the Baton Rouge area are presented in Tables 3.5-2 and 3.5-3.

Depths of the Tertiary aquifers are summarized in Table 3.5-4. Zone 1 includes four sand units that extend from 380 to 870 feet below ground surface (bgs). The total thickness of the Zone 1 sands is 270 feet. The uppermost Zone 1 sand extends from 380 to 500 feet bgs and consists of fine sand with occasional lenses of silty clay and clayey silt. A 300-foot-thick confining layer separates Zones 1 and 2. Zone 2 extends from 1,170 to 1,290 feet bgs and includes two sand units with a total thickness of 90 feet. A 270-foot-thick confining layer separates Zones 2 and 3. The Zone 3 sands extend from 1,560 to 1,880 feet bgs and include two sand units with a total thickness of 210 feet. (EOI 2008b, Section 2.4.12.1.3.1)

### 3.5.2.2 Hydraulic Properties

The results of onsite pumping tests to assess the hydraulic properties of the MRAA, UTA, and tertiary aquifers are presented in the RBS USAR, and are summarized below (GZA 2007, Section 4.2.2).

Hydraulic properties of the MRAA were determined through pump testing in September of 1977 using a 190-foot-deep test well. The average coefficient of transmissivity was determined to be 139,000 gallons per day per foot (gpd/ft). The mean effective storage coefficient was determined as 0.001. (GZA 2007, Section 4.2.2)

Hydraulic properties of the UTA were determined through pump testing in the late fall and early winter of 1974. Based on this test, which utilized 13 observation wells and one 150-foot pumping well, the average coefficient of transmissivity was determined to be 184,400 gpd/ft. The mean effective storage coefficient was determined as 0.08. The effective porosity of the UTA ranged between 0.24 and 0.32. (GZA 2007, Section 4.2.2)

Hydraulic properties of the tertiary Zone 3 aquifer were determined through pump tests using a 1,890-foot test well. The average coefficient of transmissivity was determined to be 35,000 gpd/ft. The mean effective storage coefficient was determined as 0.0001. The effective porosity of the tertiary Zone 3 aquifer was calculated as 0.12. (GZA 2007, Section 4.2.2)

No hydraulic properties were found for the tertiary Zone 2 aquifer, most likely due to no use in the RBS and surrounding areas. Similarly, no hydraulic properties were published for the Pascagoula clay confining layer; however, it has been lithologically described as an approximately 200-foot-thick hard clay at the RBS site (Figure 3.4-4) with isolated and discontinuous sand lenses.

### 3.5.2.3 Potentiometric Surfaces

In general, RBS site topography consists of two terraces: an upper terrace at approximately 100 feet amsl, on which the RBS station is constructed, and a lower alluvial floodplain at approximately 38 feet amsl, generally consisting of swamps and bayous associated with the Mississippi River floodplain (GZA 2007, Section 4.0). The topography surrounding the plant, as well as the original topography of the site area, is gently sloping land with elevations across the upper terrace generally ranging between 105 and 110 feet amsl. North of the plant area, the topography increases to approximately 130 feet amsl at the North Access Road. The western edge of the upper terrace is approximately 1.4 miles from the plant area, where it meets the floodplain or lower terrace region of the site, which runs generally parallel to the Mississippi River. (GZA 2007, Section 4.1.2)

Historically, shallow groundwater flow in the UTA in the vicinity of RBS can be expected to be in a southwesterly direction towards the Mississippi River. The groundwater table elevation at the plant is reported to be approximately 57 feet amsl (40 feet bgs), based on the information presented in the RBS USAR. Assuming the hydraulic gradient for groundwater in the UTA is approximately 0.003 feet/feet, an effective groundwater flow velocity of 0.30 feet/day was calculated for flow through the unconfined UTA. (GZA 2007, Section 4.2.3)

Groundwater potentiometric surface maps for the first quarter of 2015 and 2016 in the UTA are included as Figures 3.5-4 and 3.5-5. Both figures show the groundwater flow direction from the RBS site to the Mississippi River, consistent with the historic groundwater flow direction described above.

### 3.5.2.4 Groundwater Protection Program

In May 2006, the Nuclear Energy Institute (NEI) approved the Groundwater Protection Initiative (GPI), an industry-wide voluntary effort to enhance nuclear power plant operators' management of their groundwater protection program. 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 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*. (NEI 2007) The goal of the GPI is to identify leaks of licensed material as soon as possible.

In conjunction with the GPI, RBS's groundwater monitoring program includes 98 monitoring wells, inclusive of the two radiological environmental monitoring program (REMP) locations. Figure 3.5-6 shows locations of these groundwater monitoring wells; monitoring well construction details are presented in Table 3.5-5. Results associated with RBS groundwater monitoring are discussed in Section 4.5.2.4.

### 3.5.2.5 Sole Source Aquifers

A sole source aquifer, as defined by the EPA, is an aquifer that supplies at least 50 percent of the drinking water for its service area, and for which there are no reasonably available alternative drinking water sources should the aquifer become contaminated. The sole source aquifer program was created by the U.S. Congress as part of the Safe Drinking Water Act, which allows for the protection of these resources. (EPA 2016a)

The RBS site is in EPA Region 6, which has oversight responsibilities for public water supplies in Arkansas, Louisiana, New Mexico, Oklahoma, Texas, and 66 federally recognized tribal nations within these five states (EPA 2016b). The EPA has designated six aquifers in Region 6 as SSAs. Two of these SSAs (Chicot Aquifer and Southern Hills Regional Aquifer System) are located in the state of Louisiana. (EPA 2015e) The Southern Hills Regional Aquifer System is the primary source of public and domestic water in the northern 10 parishes of southeastern Louisiana and western Mississippi (USGS 1983). The Southern Hills Regional Aquifer System is jointly managed with EPA Region 4 (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee) (EPA 2015f).

The Southern Hills Regional Aquifer System is a gulfward dipping and thickening, complexly interbedded aquifer system extending from the northern limit of its recharge area near Vicksburg, Mississippi, to as far south as the Baton Rouge area in southeastern Louisiana. As many as 13 interdependent aquifer units compose the system in the southern part of the area and are known to coalesce or pinch out northward (updip) into fewer units. (USGS 1983) The aquifers in southeast Louisiana that compose the Southern Hills Regional Aquifer System include the MRAA, the UTA, and the Tertiary aquifers (Zones 1, 2, and 3 sands) (EOI 2008b, Section 2.4.12.2.1)

The RBS site is located within the areal extent of the Southern Hills Regional Aquifer System (Figure 3.5-7). At the RBS site, the UTA is not in direct contact with the Tertiary aquifers and is separated from the tertiary sands by 200 feet of the Pascagoula clay (Figure 3.4-4) (EOI 2008b, Section 2.4.12.2.1).

Separation of the UTA and tertiary sands by the Pascagoula clay confining layer can be seen with observations of the normal groundwater elevations within the individual aquifers. As discussed in Section 3.5.2.1, the UTA is in contact with the MRAA near the Mississippi River. The MRAA also appears to be in contact with the Zone 1 tertiary sands based on observed groundwater elevation fluctuations in correlation with the stage of the Mississippi River (EOI 2008b, Section 2.4.12.3.1.3).

The top of the Pascagoula Formation has been measured at approximately -30 feet amsl at the RBS location (EOI 2008b, Figure 2.4.12-230). The water levels measured in the tertiary aquifer Zone 1 wells are approximately 28 feet amsl, whereas the water level in Zone 3 wells are approximately -5 feet amsl (EOI 2008b, Section 2.4.12.3.1.3), showing an upward hydraulic gradient from the tertiary aquifers to the UTA across the Pascagoula clay.

### 3.5.3 Water Use

#### 3.5.3.1 Surface Water Use

Surface water use in parishes located within a 6-mile radius of RBS (West Feliciana, East Feliciana, Pointe Coupee, and East Baton Rouge) is presented in Table 3.5-6. Total surface water withdrawals in 2013 for these parishes were reported as 377.05 MGD. The largest use of surface water was associated with power generation at 339.78 MGD followed by industrial companies at 34.68 MGD. No surface water withdrawals for public supply or rural domestic purposes were reported for any of the four parishes.

Table 3.5-6 also presents surface water withdrawals by basin. Of the 377.05 MGD of surface water withdrawals for the four parishes listed above, greater than 99 percent (374.6 MGD) was associated with the Mississippi River Basin. In West Feliciana Parish, where RBS is located, the Mississippi River is by far the dominant surface water supply. Surface water withdrawals in 2013 were reported as 32.35 MGD, of which 17.36 MGD were used for power generation. With the exception of power generation, industrial companies (14.35 MGD) were the next largest users of surface water in West Feliciana Parish. In neighboring Pointe Coupee Parish, which is by far the largest user of the Mississippi River Basin, surface water withdrawals were reported as 324.09 MGD (approximately 86 percent), of which 322.42 MGD were used for power generation.

As discussed in Section 2.2.2, RBS withdraws cooling water from the Mississippi River through two intake screens at a design flow rate of 16,000 gpm (23.0 MGD). The probable minimum flow rate of the Mississippi River at RBS during the operating life of the station is not anticipated to be less than 100,000 cfs, as discussed in Section 3.5.1. Although the lowest flow recorded over the previous 50 years (1965–2015) was 111,000 cfs as discussed in Section 3.5.1, when assuming a flow of 100,000 cfs, RBS would withdraw only approximately 0.04 percent of the flow in the Mississippi River.

As shown in Figure 2.2-1, the drift/evaporation rate from the CWS and SWCS cooling towers is 17.7 MGD (27.4 cfs) and 0.38 MGD (0.6 cfs), respectively, based on design maximum. Therefore, of the volume of water withdrawn (23.0 MGD), 4.9 MGD (7.6 cfs) would be returned to the Mississippi River, and 18.1 MGD (28.0 cfs) would be lost to the atmosphere from drift and evaporation. Conservatively using the lowest anticipated flow of 100,000 cfs during the operating life of the station, the 28.0 cfs would represent only approximately 0.03 percent of the Mississippi River flow at the RBS intake structure.

In Louisiana, there is no general permitting system for surface water withdrawals from the Mississippi River.

3.5.3.2 Groundwater Use

Groundwater use in parishes located within a 6-mile radius of RBS (West Feliciana, East Feliciana, Pointe Coupee, and East Baton Rouge) is presented in Table 3.5-7. Total groundwater water withdrawals in 2013 for these parishes were reported as 201.72 MGD. The largest use of groundwater was associated with public water supplies at 81.42 MGD followed by industrial companies at 80.21 MGD. The largest user of groundwater occurs in East Baton Rouge Parish at 151.87 MGD.

Groundwater usage in West Feliciana and Pointe Coupee parishes is substantially less than surface water usage. In 2013, groundwater withdrawals in West Feliciana Parish were reported as 9.64 MGD. Power generation and public suppliers were the largest users of groundwater, accounting for approximately 85 percent (8.23 MGD) of the parish groundwater withdrawals in 2013. The remaining water use was for industrial and rural domestic purposes. For Pointe Coupee Parish, groundwater withdrawals in 2013 were reported as 36.85 MGD. Irrigation was the largest user accounting for approximately 50 percent (18.30 MGD) of the parish groundwater withdrawals in 2013.

Detailed information on the registered groundwater wells within a 2-mile band around the RBS property boundary (Figure 3.5-8) is presented in Table 3.5-8. These wells withdraw from the 800-, 1,000-, 1,200-, 1,500-, 2,400-, and 2,800-foot sands of the Baton Rouge area, the MRAA, and the UTA, and are used for both domestic and non-domestic purposes. (LDNR 2015)

Four water supply wells at the existing RBS facility are listed as industrial use. Two of the wells (wells P-1A and P-1B) are 390 feet apart and are screened within the tertiary Zone 3 aquifer (2,800-foot sand) at a total depth of approximately 1,800 feet bgs. These two wells are used to supply water for general site purposes, including plant makeup water. A third well (Well BP-1) is screened in the tertiary Zone 1 aquifer (1,200-foot sand) and is 500 feet deep. Groundwater from this well is used for various maintenance and construction activities (where potable water is unavailable) and dust suppression. The fourth well (Well P-05) is screened within the UTA at depths of 84 to 124 feet bgs. This well is capable of pumping 800 gpm to two 300,000-gallon water storage tanks. Water from this well is used for normal fire protection (EOI 2008b, Section 2.4.12.2.4); however, it is also used in the monitoring well program to measure groundwater levels to develop potentiometric maps. There is also a monitoring well (MW-125) screened within the UTA that is periodically utilized to remediate tritium-contaminated water. Based on the previous 5 years (2011–2015), annual average water withdrawals from the five wells listed above have ranged from 7 to 42 gpm in the tertiary Zone 3 aquifer (2,800-foot sand), 0.3 to 2 gpm in the tertiary Zone 1 aquifer (1,200-foot sand), and 1 to 4 gpm in the UTA as shown in Table 3.5-9.

### 3.5.4 Water Quality

#### 3.5.4.1 Surface Water Quality

The Mississippi River is extensively used for water supply (e.g., power generation and industrial), navigation, and commercial fishing. There are no public advisories concerning recreational contact or fish consumption for Louisiana's part of the Mississippi River (LMRCC 2014, Section 3.6.3). Current water quality concerns involve excessive amounts of nitrogen and phosphorus (nutrients) that have resulted in the growth of large amounts of algae that decay and consume oxygen, thereby causing a zone of low dissolved oxygen or "hypoxic zone" in the Northern Gulf of Mexico. Agricultural sources contribute more than 70 percent of the nitrogen and phosphorus delivered to the Gulf, compared to only 9 to 12 percent from urban sources. (EPA 2016c)

RBS is located on segment 070201 of the Mississippi River that stretches from the Old River Control Structure to Monte Sano Bayou. This segment of the river is classified as suitable for primary contact recreation, secondary contact recreation, fish and wildlife propagation, and drinking water supply. As such, the river is suitable for the propagation of fish, aquatic life and wildlife; for fishing and fish consumption; for drinking water; and for primary and secondary contact recreation. Primary contact recreation is defined as direct contact with the water as a result of swimming, bathing, surfing, or similar water contact activities. Secondary contact recreation is defined as incidental contact with the water during activities such as wading, fishing, and boating that are not likely to result in full body immersion. Based on the LDEQ's *2014 Louisiana Water Quality Inventory: Integrated Report Fulfilling Requirements of the Federal Clean Water Act, Sections 305(b) and 303(d)*, which was finalized in 2015, the Mississippi River segment on which RBS is located is not impaired (LDEQ 2015, Appendix A, page 66).

### 3.5.4.2 Groundwater Quality

The quality of groundwater in West Feliciana Parish generally varies with distance down-dip from the recharge area. Water in the recharge areas of the UTA and the tertiary aquifers normally is a sodium-bicarbonate type and occasionally a calcium-bicarbonate type. (RBS 1984, Section 2.3.3.2) Water from the UTA system generally is soft and low in dissolved solids. Locally, iron or saltwater may be present. Water from the tertiary aquifers at the 800-foot, 1,000-foot, 1,200-foot, 1,500-foot, and 1,700-foot sands is soft and generally does not exceed the EPA's Secondary Maximum Contaminant Levels (SMCLs) for pH and concentrations of chloride, iron, and dissolved solids. Water from the tertiary aquifers at the 2,000-foot, 2,400-foot, and 2,800-foot sands generally is soft and generally does not exceed SMCLs for drinking water for color, pH, and concentrations of iron, manganese, and dissolved solids. (USGS 2016)

The MRAA generally contains a calcium-bicarbonate type water, which tends to be slightly acidic in recharge areas. Groundwater in this aquifer usually contains objectionable concentrations of iron and usually is very hard. (RBS 1984, Section 2.3.3.2) Generally, water from the MRAA exceeds the SMCLs for drinking water for iron and manganese (USGS 2016).

As part of the RBS radiological groundwater monitoring program, groundwater samples are collected from selected monitoring wells on site and analyzed for radionuclides to detect potential impacts to groundwater from inadvertent leaks or spills. Samples are collected quarterly, or more frequently if deemed necessary, by chemistry site personnel. (Entergy 2014b) Results associated with RBS groundwater monitoring are discussed in Section 4.5.2.4.

#### 3.5.4.2.1 History of Radioactive Releases

Following is a summary of historic radioactive releases that have occurred at RBS since 2008. As discussed in Section 4.5.2.4.3, the only historic release where tritium is currently being detected in groundwater is associated with the December 2011 event involving the detection of tritium (48,245 picoCuries per liter [pCi/l]) in the PZ-01 groundwater monitoring well near the field administration building.

Temporary Blowdown Pipe

In January 2008 (RBS 2008), a temporary aboveground cooling tower blowdown pipe break resulted in the release of radioactively contaminated water to the ground and nearby stormwater drainage system. The radioactively contaminated water reached the Mississippi River via Outfall 003 and Grants Bayou. Tritium was the only radionuclide detected at a concentration of 28,043 pCi/l in Outfall 003. (Entergy 2009) No activity was detected in Grant's Bayou (RBS 2008). Groundwater sampling was performed, and additional wells were used to assist in characterizing any potential groundwater flow from this event. All results for gamma and H-3 were less than minimum detectable activity. (Entergy 2009)

PZ-01 Monitoring Well

In December 2011, a positive groundwater sample was confirmed in monitoring well PZ-01, located near the field administration building. Only tritium was identified in the sample at a concentration of 48,245 pCi/l. (Entergy 2012c) As a result of the positive detection in PZ-01, 30 additional monitoring wells were installed in 2012, 7 additional monitoring wells were installed in 2013, 1 additional monitoring well was installed in 2014, 9 additional monitoring wells were installed in 2015, and 6 additional monitoring wells were installed in 2016 to define the plume and attempt to determine the source. In addition, a hydrogeological investigation at PZ-01 was conducted in 2012. Based on current data, the plume is well defined. (Entergy 2014c; FTN 2016a; FTN 2016b) The source contributing to the contamination is currently believed to be coming from tritium-contaminated water from equipment leaks and previous spills seeping through degraded turbine building and heater bay floor joints, which were re-sealed in 2016.

RBS is currently monitoring the tritium plume and remediating the contaminated groundwater to lower tritium levels in the groundwater. In addition to monitored natural attenuation, tritium-contaminated groundwater is periodically pumped from an existing onsite monitoring well (MW-125) into temporary storage tanks. The water is then circulated in the tanks to obtain a representative sample and examined for radioactivity in accordance with RBS's *Offsite Dose Calculation Manual* (ODCM) (RBS 2013b). Once the water in the tanks has been found to be within acceptable LDEQ and NRC regulatory limits, the contents are discharged to the Mississippi River via Outfall 101 (low-volume waste treatment system).

The current understanding of the groundwater hydrology is that this activity will flow via the UTA to the MRAA and into the Mississippi River, and will not affect any offsite wells in the vicinity of RBS (Entergy 2012c). Geological estimates concluded that due to decay, dilution, and dispersion, the activity present is not likely to be detected in the Mississippi River if it were to infiltrate to the UTA and migrate off site (Entergy 2016g).

Wastewater Treatment Plant Greywater Line

In October 2012, diluted radioactive water containing tritium (4,260 pCi/l) and small traces of Cobalt-60 (0.00082 pCi/l) leaked onto the ground near the wastewater treatment plant due to equipment failure. Liquid radwaste discharges flow into the CWS blowdown line which connects upstream of the wastewater treatment plant tie-in. Therefore, during periods of liquid radwaste discharges, some of the diluted radioactive water would have been able to leak onto the ground. (Entergy 2013c)

RBS has groundwater monitoring wells downgradient of the greywater piping leak location. The site conceptual hydrology model indicates a downgradient flow generally to the southwest from the greywater piping leak to the Mississippi River. Although no water was available to perform an analysis because the source was not identified until the flow had already stopped (Entergy 2013c), RBS did perform a dose calculation based on the average tritium and Cobalt-60 concentrations in liquid radwaste discharges during the time period involved and concentrations being discharged to the Mississippi River. Even with extremely conservative assumptions, the maximum calculated dose to the public was a small percentage of the 10 CFR Part 50 liquid effluent dose objectives (Entergy 2013c).

Due to the significant dilution volume of the Mississippi River, it is highly unlikely that any radioactivity that may enter the groundwater from the greywater piping leak would have any meaningful impact off site. In addition, because the groundwater flow at the site is generally to the southwest, no offsite wells would be affected by this event. (Entergy 2013c)

Condensate Storage Tank

In February 2013, the condensate storage tank sump overflowed into the berm area, which had been excavated to support inspections of buried piping, thereby soaking into the backfill in the excavation area. Estimated volume of the overflow was 380 gallons. Tritium concentrations in the overflow water were 1,135,000 pCi/l with a total gamma activity of 1,145 pCi/l. RBS has groundwater monitoring wells downgradient of the condensate storage tank. The site conceptual hydrology model indicates a downgradient flow generally to the southwest from the condensate storage tank to the Mississippi River. (RBS 2013c) Geologists determined that the tritium associated with this release would not be detected past the site boundary due to dilution, dispersion, and decay (Entergy 2014a).

Blowdown Line

In January 2014, the bonnet on a temporary blowdown line gate valve cracked due to sub-freezing temperatures, resulting in the release of a circulating water/liquid radwaste discharge water mixture onto the ground. This water mixture contained no gamma activity, with a maximum tritium value of 4,580 pCi/l. (Entergy 2015m) RBS has groundwater monitoring wells downgradient of the leak area. The site conceptual hydrology model indicates a downgradient flow generally to the southwest to the Mississippi River (Entergy 2015m). Geological estimates concluded that the activity is not likely to be detected if it were to infiltrate to the UTA and migrate to the Mississippi River due to decay, dilution, and dispersion. Due to the significant dilution volume of the Mississippi River, there would not be any meaningful dose impact off site. Potential annual dose to a member of the public was estimated to be less than 10 CFR Part 50 Appendix I dose limits. (Entergy 2015m)

C-Tunnel

In May 2014, a small amount of groundwater containing tritium (28,270 pCi/l) was leaking into the C-Tunnel through a service water primary piping penetration. Follow-up sampling and leak rate determinations indicated the tritium activity and leak rates varied and seemed to be affected by rainfall. Based on investigations, it was determined that the most likely source of tritium was two abandoned liquid radwaste discharge lines located above the leaking penetration that still contained liquid (Entergy 2015m). Plans are to abandon in place and fill these two lines with a cementitious mixture in 2017. The site conceptual hydrology model indicates a downgradient flow generally to the southwest to the Mississippi River (Entergy 2015m). Geological estimates concluded that the activity is not likely to be detected if it were to infiltrate to the UTA and migrate to the Mississippi River due to decay, dilution, and dispersion. Due to the significant dilution volume of the Mississippi River, there would not be any meaningful dose impact off site. Potential annual dose to a member of the public was estimated to be less than the 10 CFR Part 50 Appendix I dose limits. (Entergy 2015m)

Turbine Building

In August 2015, a valving error caused an estimated spill of 60,000 gallons from the condensate demineralizer system inside the turbine building on the 67-foot elevation. As previously discussed above, some floor joints in the turbine building may have been degraded, which could allow some of the liquid spill to seep through to the soil and subsequently to the groundwater. If any water seeped through these joints, it is estimated that due to decay, dilution, and dispersion, the activity present is not likely to be detected in the Mississippi River if it were to infiltrate to the UTA and migrate off site. The site conceptual hydrology model indicates a downgradient flow generally to the southwest to the Mississippi River. Geological estimates concluded that the activity is not likely to be detected if it were to infiltrate to the UTA and migrate to the Mississippi River due to decay, dilution, and dispersion. Due to the significant dilution volume of the Mississippi River, there would not be any meaningful dose impact off site. (Entergy 2016g) As previously discussed, the turbine building floor joints were re-sealed in 2016.

3.5.4.2.2 History of Nonradioactive Releases

Industrial practices at RBS that involve the use of chemicals are those activities typically associated with painting, cleaning parts/equipment, refueling onsite vehicles/generators, fuel oil and gasoline storage, and the storage and use of water-treatment additives. The use and storage of chemicals at RBS are controlled in accordance with Entergy's fleet chemical control procedure and site-specific spill prevention plans (Entergy 2015f; RBS 2013a; RBS 2013d). In addition, as discussed in Section 2.2.4, nonradioactive wastes are managed in accordance with Entergy's waste management procedure which contains preparedness and prevention control measures (Entergy 2015d).

Based on the review of site condition reporting records documenting spill events over the previous 10 years (2007–2016), there has been only one nonradioactive spill that triggered a notification event to the LDEQ. In October 2016, an estimated 60 gallons of hydraulic fluid from a service truck's hydraulic oil reservoir leaked onto the ground. Sorbents were used to absorb visible puddles, and the area was cleaned up and the fluid placed in drums for disposal. No oil entered any waterway. (Entergy 2016k)

Historically, nonradioactive spills that have occurred at RBS have been minor in nature and immediately remediated, and no spill events at the RBS site have required a regulatory agency overseeing the incident or resulted in a notice of violation.

**Table 3.5-1**
**LPDES-Permitted Outfalls**

| Outfall[a] | Description | Parameter[b] | Permit Requirement |
|---|---|---|---|
| 001 | Cooling tower blowdown[c] | Flow | Report monthly average and daily maximum in MGD |
| | | Temperature | 105°F monthly average<br>110°F daily maximum |
| | | Free available chlorine | 0.2 mg/l monthly average<br>0.2 mg/l daily maximum<br>0.63 lbs/day<br>1.64 lbs/day |
| | | Total zinc | 1.0 mg/l monthly average<br>1.0 mg/l daily maximum |
| | | pH | (6.0–9.0 SU) |
| 002 | Stormwater runoff | Flow | Report daily maximum in MGD |
| | | Total organic carbon | 50 mg/l daily maximum |
| | | Oil and grease | 15 mg/l daily maximum |
| | | pH | (6.0–9.0 SU) |
| 003 | Stormwater runoff | Flow | Report daily maximum in MGD |
| | | Total organic carbon | 50 mg/l daily maximum |
| | | Oil and grease | 15 mg/l daily maximum |
| | | Total suspended solids[d] | 100 mg/l daily maximum |
| | | pH | (6.0–9.0 SU) |

**Table 3.5-1 (Continued)**
**LPDES-Permitted Outfalls**

| Outfall[a] | Description | Parameter[b] | Permit Requirement |
|---|---|---|---|
| 004 | Stormwater runoff | Flow | Report daily maximum in MGD |
| | | Total organic carbon | 50 mg/l daily maximum |
| | | Oil and grease | 15 mg/l daily maximum |
| | | pH | (6.0–9.0 SU) |
| 005 | Stormwater runoff | Flow | Report daily maximum in MGD |
| | | Total organic carbon | 50 mg/l daily maximum |
| | | Oil and grease | 15 mg/l daily maximum |
| | | pH | (6.0–9.0 SU) |
| 006 | Clarifier underflow | Flow | Report daily maximum in MGD |
| | | Clarifying agents | Record types and quantities used |
| 007 | Hydrostatic test wastewater | Flow | Report monthly average and daily maximum in MGD |
| | | Total suspended solids | 90 mg/l daily maximum |
| | | Oil and grease | 15 mg/l daily maximum |
| | | Total organic carbon | 50 mg/l daily maximum |
| | | Benzene | 50 μg/l daily maximum |
| | | Total BTEX | 250 μg/l daily maximum |
| | | Total lead | 50 μg/l daily maximum |

**Table 3.5-1 (Continued)**
**LPDES-Permitted Outfalls**

| Outfall[a] | Description | Parameter[b] | Permit Requirement |
|---|---|---|---|
| 101 | Low-volume waste treatment system | Flow | Report monthly average and daily maximum in MGD |
| | | Total suspended solids | 30 mg/l monthly average<br>100 mg/l daily maximum |
| | | Oil and grease | 15 mg/l monthly average<br>20 mg/l daily maximum |
| 104 | Vehicle wash wastewater | Flow | Report monthly average and daily maximum in MGD |
| | | Chemical oxygen demand | 300 mg/l daily maximum |
| | | Total suspended solids | 45 mg/l daily maximum |
| | | Oil and grease | 15 mg/l daily maximum |
| | | pH | (6.0–9.0 SU) |
| 201 | Treated sanitary wastewater | Flow | Report monthly average and daily maximum in MGD |
| | | Biological oxygen demand | 30 mg/l monthly average<br>45 mg/l daily maximum |
| | | Total suspended solids | 30 mg/l monthly average<br>45 mg/l daily maximum |
| | | Oil and grease[e] | 15 mg/l monthly average<br>20 mg/l daily maximum |
| | | Fecal coliform | 200 colonies/100 ml monthly average<br>400 colonies/100 ml daily maximum |
| | | pH | (6.0–9.0 SU) |

**Table 3.5-1 (Continued)**
**LPDES-Permitted Outfalls**

| Outfall[a] | Description | Parameter[b] | Permit Requirement |
|---|---|---|---|
| 301 | Mobile metal-cleaning wastewaters | Flow | Report monthly average and daily maximum in MGD |
| | | Total suspended solids | 30 mg/l monthly average<br>100 mg/l daily maximum |
| | | Oil and grease | 15 mg/l monthly<br>20 mg/l daily maximum |
| | | Total copper | 1.0 mg/l monthly average<br>1.0 mg/l daily maximum |
| | | Total iron | 1.0 mg/l monthly average<br>1.0 mg/l daily maximum |
| 401 | Low-volume wastewater | Flow | Report monthly average and daily maximum in MGD |
| | | Total suspended solids | 30 mg/l monthly average<br>100 mg/l daily maximum |
| | | Oil and grease | 15 mg/l monthly<br>20 mg/l daily maximum |
| 501 | Low-volume wastewater | Flow | Report monthly average and daily maximum in MGD |
| | | Total suspended solids | 30 mg/l monthly average<br>100 mg/l daily maximum |
| | | Oil and grease | 15 mg/l monthly<br>20 mg/l daily maximum |

**Table 3.5-1 (Continued)**
**LPDES-Permitted Outfalls**

| Outfall[a] | Description | Parameter[b] | Permit Requirement |
|---|---|---|---|
| 601 | Low-volume wastewater | Flow | Report monthly average and daily maximum in MGD |
| | | Total suspended solids | 30 mg/l monthly average<br>100 mg/l daily maximum |
| | | Oil and grease | 15 mg/l monthly<br>20 mg/l daily maximum |

a. Table based on information from RBS LPDES Permit No. LA0042731 (Attachment A).
b. Monitoring frequencies are specified in Part I of RBS LPDES Permit LA0042731 (Attachment A).
c. Whole effluent toxicity testing is also a permit condition associated with Outfall 001.
d. Required only when discharging low-volume wastewaters.
e. Required only when discharging maintenance wastewaters.

**Table 3.5-2**
**Correlation of Quaternary and Tertiary Deposits in the RBS Site Area to Other Areas**

<table>
<tr><th colspan="2"></th><th colspan="3">Other Areas</th><th>Local Area</th><th>RBS Area</th></tr>
<tr><th>System</th><th>Series</th><th colspan="2">CampVanDorn, Mississippi (Brown & Guyton 1943)</th><th>Baton Rouge Area (Morgan 1961)</th><th>East and West Feliciana Parishes (Morgan 1963)</th><th>2006 and 2007 Investigation Data</th></tr>
<tr><td rowspan="2">Quaternary</td><td rowspan="2">Holocene and Pleistocene</td><td rowspan="2">Citronelle Formation</td><td rowspan="2"></td><td>Alluvial Deposits</td><td>Undifferentiated Quaternary Alluvium</td><td>Mississippi River Alluvial Aquifer</td></tr>
<tr><td>Shallow Pleistocene 400-foot sand<br>600-foot sand</td><td>Undifferentiated Quaternary Upland Deposits</td><td>Upland Terrace Aquifer</td></tr>
<tr><td rowspan="4">Tertiary</td><td>Pliocene</td><td rowspan="3">Pascagoula Formation</td><td rowspan="3">Fort Adams Member Homochitto Member</td><td>800-foot sand</td><td></td><td></td></tr>
<tr><td rowspan="3">Miocene</td><td>1,000-foot sand<br>1,200-foot sand</td><td>Zone 1</td><td>Zone 1</td></tr>
<tr><td>1,700-foot sand<br>2,000-foot sand</td><td>Zone 2</td><td>Zone 2</td></tr>
<tr><td colspan="2">Hattiesburg Formation Catahoula Sandstone</td><td>2,400-foot sand<br>2,800-foot sand</td><td>Zone 3</td><td>Zone 3</td></tr>
</table>

(EOI 2008b, Table 2.4.12-201)

## Table 3.5-3
## Correlation of Hydrogeologic Units in Southeastern Louisiana

| System | Series | Stratigraphic Unit | Hydrogeologic Units: Aquifer System or Confining Unit | Aquifer or Confining Unit: Baton Rouge Area, North | Baton Rouge Area, South | East Florida Parishes, North | East Florida Parishes, South | New Orleans Area |
|---|---|---|---|---|---|---|---|---|
| Quaternary | Holocene | Mississippi River and other alluvial deposits | Near-surface aquifers or confining unit | Mississippi River Alluvial Aquifer | | No regionally extensive hydrogeologic units | | New Orleans Aquifer System: Shallow Aquifers |
| | | | | | | | | Mississippi River Alluvial Aquifer |
| | Pleistocene | Unnamed Pleistocene Deposits | Southern Hills Regional Aquifer System: Chicot equivalent aquifer system or surficial confining unit | No regionally extensive hydrogeologic units | | | | Gramercy Aquifer |
| | | | | | | | | Norco Aquifer |
| | | | | Shallow sands | | | | Gonzales-New Orleans Aquifer |
| | | | | Upland Terrace Aquifer | 400-foot sand | Upland Terrace Aquifer | Upper Ponchatoula Aquifer | 1,200-foot sand |
| | | | | | 600-foot sand | | | |
| Tertiary | Pliocene | Fleming Formation: Blounts Creek Member | Evangeline equivalent aquifer system or surficial confining unit | 800-foot sand | | Lower Ponchatoula Aquifer | | Generally, no fresh groundwater occurs in deeper units |
| | | | | 1,000-foot sand | | | | |
| | | | | 1,200-foot sand | | Big Branch Aquifer | | |
| | Miocene | | | 1,500-foot sand | | Kentwood Aquifer | Abita Aquifer | |
| | | | | 1,700-foot sand | | | Covington Aquifer | |
| | | | | | | Slidell Aquifer | | |
| | | Castor Creek Member | Unnamed confining unit | | | | | |
| | | Williamson Creek Member<br>Dough Hills Member<br>Carnahan Bayou Member | Jasper equivalent aquifer system | 2,000-foot sand | | Tchefuncte Aquifer | | |
| | | | | 2,400-foot sand | | Hammond Aquifer | | |
| | | | | 2,800-foot sand | | Amite Aquifer | | |
| | | | | | | Ramsay Aquifer | | |
| | | Lena Member | Unnamed confining unit | | | | | |
| | Oligocene | Catahoula Formation | Catahoula equivalent aquifer system | Catahoula Aquifer | | Franklinton Aquifer | | |

(EOI 2008b, Table 2.4.12-202)

**Table 3.5-4**
**Correlation and Depths of Freshwater-Bearing Tertiary Sands at the RBS Site**

| Zone (Morgan 1963) | Baton Rouge Area (Morgan 1961) | Top of Sand (depth below ground surface of 110 feet amsl at RBS site) | Bottom of Sand (depth below ground surface of 110 feet amsl at RBS site) | Thickness (feet) |
|---|---|---|---|---|
| 1 | 1,000-foot sand & 1,200-foot sand | 380 | 500 | 120 |
| 1 | 1,500-foot sand | 560 | 600 | 40 |
| 1 | 1,500-foot sand | 680 | 700 | 20 |
| 1 | 1,500-foot sand | 780 | 870 | 90 |
| 2 | 2,000-foot sand | 1,170 | 1,240 | 70 |
| 2 | 2,000-foot sand | 1,270 | 1,290 | 20 |
| 3 | 2,400-foot sand | 1,560 | 1,620 | 60 |
| 3 | 2,800-foot sand | 1,730 | 1,880 | 150 |

(EOI 2008b, Table 2.4.12-203)

Note: Data developed from Borehole P-1B at the RBS site.

**Table 3.5-5**
**Onsite Well Construction Details**

| Well | Well Diameter (inches) | Elevations (feet NAVD 1988) | | | | | | Well Construction Material |
|---|---|---|---|---|---|---|---|---|
| | | Water Level Reference | Ground | Top of Filter (approx.)[(a)] | Top of Screen (approx.)[(a)] | Bottom of Screen (approx.)[(a)] | Bottom of Filter (approx.)[(a)] | |
| WD | 6.00 | (b) | (b) | (b) | (b) | (b) | (b) | (b) |
| WU | 6.00 | (b) | (b) | (b) | (b) | (b) | (b) | (b) |
| MW-01 | 2.00 | 128. 9 | 126.4 | (b) | 28.0 | 18.0 | (b) | Schedule 40 PVC |
| MW-02 | 2.00 | 99.2 | 96.2 | (b) | 22.0 | 12.0 | (b) | Schedule 40 PVC |
| MW-03 | 2.00 | 138.6 | 135.9 | (b) | 31.0 | 21.0 | (b) | Schedule 40 PVC |
| MW-04 | 2.00 | 96.5 | 93.6 | (b) | 16.0 | 6.0 | (b) | Schedule 40 PVC |
| MW-05 | 2.00 | 133.4 | 130.7 | (b) | 43.0 | 33.0 | (b) | Schedule 40 PVC |
| MW-06 | 2.00 | 95.9 | 93.0 | (b) | 16.0 | 6.0 | (b) | Schedule 40 PVC |
| MW-07 | 2.00 | 91. 6 | 88.8 | (b) | 3.0 | -7.0 | (b) | Schedule 40 PVC |
| MW-08 | 2.00 | 142.0 | 138.8 | (b) | 30.0 | 20.0 | (b) | Schedule 40 PVC |
| MW-09 | 2.00 | 104. 7 | 102.4 | (b) | 52.0 | 42.0 | (b) | Schedule 40 PVC |
| MW-10 | 2.00 | 110. 3 | 107.4 | (b) | 6.0 | -5.0 | (b) | Schedule 40 PVC |
| MW-11 | 2.00 | 138.9 | 135.7 | (b) | 31.0 | 21.0 | (b) | Schedule 40 PVC |
| MW-12 | 2.00 | 128.0 | 124.9 | (b) | 29.0 | 19.0 | (b) | Schedule 40 PVC |
| MW-13 | 2.00 | 105. 9 | 103.0 | (b) | -2.0 | -12.0 | (b) | Schedule 40 PVC |
| MW-14 | 2.00 | 138.7 | 134.7 | (b) | 35.0 | 25.0 | (b) | Schedule 40 PVC |
| MW-15 | 2.00 | 137. 6 | 134.7 | (b) | 36.0 | 26.0 | (b) | Schedule 40 PVC |

**Table 3.5-5 (Continued)**
**Onsite Well Construction Details**

| Well | Well Diameter (inches) | Elevations (feet NAVD 1988) | | | | | | Well Construction Material |
|---|---|---|---|---|---|---|---|---|
| | | Water Level Reference | Ground | Top of Filter (approx.)[a] | Top of Screen (approx.)[a] | Bottom of Screen (approx.)[a] | Bottom of Filter (approx.)[a] | |
| MW-16 | 2.00 | 102.6 | 99.4 | [b] | 19.0 | 9.0 | [b] | Schedule 40 PVC |
| MW-17 | 2.00 | 127.0 | 124.0 | [b] | 29.0 | 19.0 | [b] | Schedule 40 PVC |
| MW-18 | 2.00 | 116.0 | 113.2 | [b] | 26.0 | 16.0 | [b] | Schedule 40 PVC |
| MW-19 | 2.00 | 114.9 | 112.2 | [b] | 32.0 | 22.0 | [b] | Schedule 40 PVC |
| MW-20 | 2.00 | 49.1 | 46.5 | [b] | -14.0 | -24.0 | [b] | Schedule 40 PVC |
| MW-21 | 2.00 | 107.6 | 104.9 | [b] | 25.0 | 15.0 | [b] | Schedule 40 PVC |
| MW-100 | 2.00 | 70.3 | 67.6 | 59.6 | 58.0 | 48.0 | 55.6 | Schedule 40 PVC |
| MW-102 | 2.00 | 110.0 | 106.5 | 1.5 | -4.0 | -14.0 | -13.5 | Schedule 40 PVC |
| MW-103 | 2.00 | 97.0 | 94.0 | 18.5 | 15.0 | 5.0 | 4.0 | Schedule 40 PVC |
| MW-104 | 2.00 | 96.1 | 93.2 | 50.2 | 41.0 | 31.0 | 31.0 | Schedule 40 PVC |
| MW-106 | 2.00 | 96.2 | 93.2 | 46.2 | 44.9 | 34.9 | 32.2 | Schedule 40 PVC |
| MW-107 | 2.00 | 96.2 | 93.1 | 15.1 | 12.4 | 2.4 | 2.4 | Schedule 40 PVC |
| MW-108 | 2.00 | 96.5 | 93.6 | 47.6 | 43.6 | 33.6 | 31.6 | Schedule 40 PVC |
| MW-110 | 2.00 | 96.7 | 93.6 | 45.6 | 44.2 | 34.6 | 31.6 | Schedule 40 PVC |
| MW-111 | 2.00 | 96.7 | 93.7 | 16.3 | 14.3 | 4.3 | 3.7 | Schedule 40 PVC |
| MW-112 | 2.00 | 96.2 | 93.4 | 46.4 | 43.4 | 33.4 | 33.4 | Schedule 40 PVC |
| MW-114 | 2.00 | 97.5 | 94.5 | 46.5 | 44.5 | 34.5 | 34.5 | Schedule 40 PVC |

**Table 3.5-5 (Continued)**
**Onsite Well Construction Details**

| Well | Well Diameter (inches) | Elevations (feet NAVD 1988) | | | | | | Well Construction Material |
|---|---|---|---|---|---|---|---|---|
| | | Water Level Reference | Ground | Top of Filter (approx.)[(a)] | Top of Screen (approx.)[(a)] | Bottom of Screen (approx.)[(a)] | Bottom of Filter (approx.)[(a)] | |
| MW-116 | 2.00 | 96.3 | 93.3 | 45.8 | 43.3 | 33.3 | 33.3 | Schedule 40 PVC |
| MW-118 | 2.00 | 95.8 | 92.8 | 45.3 | 42.8 | 32.8 | 32.8 | Schedule 40 PVC |
| MW-120 | 2.00 | 96.6 | 93.6 | 46.0 | 43.6 | 33.6 | 33.6 | Schedule 40 PVC |
| MW-122R | 2.00 | 95.1 | 92.0 | 45.0 | 42.0 | 32.0 | 32.0 | Schedule 80 PVC |
| MW-124 | 2.00 | 68.9 | 65.2 | 46.0 | 43.2 | 33.2 | 33.2 | Schedule 40 PVC |
| MW-125 | 2.00 | 69.5 | 65.2 | 33.0 | 30.2 | 20.2 | 17.2 | Schedule 80 PVC |
| MW-126 | 2.00 | 66.5 | 63.4 | 45.8 | 43.4 | 33.4 | 33.4 | Schedule 40 PVC |
| MW-128 | 2.00 | 69.7 | 67.1 | 45.7 | 43.1 | 33.1 | 33.1 | Schedule 80 PVC |
| MW-130 | 2.00 | 66.2 | 63.4 | 47.0 | 44.4 | 34.4 | 34.4 | Schedule 40 PVC |
| MW-131 | 2.00 | 66.4 | 63.5 | 31.5 | 29.5 | 19.5 | 19.5 | Schedule 80 PVC |
| MW-132 | 2.00 | 67.2 | 64.3 | 46.5 | 44.3 | 34.3 | 34.3 | Schedule 80 PVC |
| MW-134 | 2.00 | 68.7 | 65.8 | 47.6 | 44.8 | 34.8 | 34.8 | Schedule 80 PVC |
| MW-137 | 2.00 | 97.6 | 94.5 | 32.5 | 29.5 | 19.5 | 19.5 | Schedule 80 PVC |
| MW-139 | 2.00 | 95.9 | 92.7 | 30.7 | 27.7 | 17.7 | 17.7 | Schedule 80 PVC |
| MW-141 | 2.00 | 97.8 | 94.8 | 40.8 | 38.3 | 28.3 | 19.8 | Schedule 80 PVC |
| MW-142 | 2.00 | 69.4 | 66.2 | 48.8 | 46.2 | 36.2 | 36.2 | Schedule 80 PVC |
| MW-144 | 2.00 | 69.5 | 66.3 | 58.9 | 56.3 | 46.3 | 46.3 | Schedule 80 PVC |
| MW-146 | 2.00 | 69.6 | 66.0 | 48.5 | 46.0 | 36.0 | 36.0 | Schedule 80 PVC |

**Table 3.5-5 (Continued)**
**Onsite Well Construction Details**

| Well | Well Diameter (inches) | Elevations (feet NAVD 1988) | | | | | | Well Construction Material |
|---|---|---|---|---|---|---|---|---|
| | | Water Level Reference | Ground | Top of Filter (approx.)[a] | Top of Screen (approx.)[a] | Bottom of Screen (approx.)[a] | Bottom of Filter (approx.)[a] | |
| MW-147 | 2.00 | 69.8 | 66.7 | 36.2 | 32.0 | 22.0 | 21.7 | Schedule 80 PVC |
| MW-148 | 2.00 | 69.6 | 66.3 | 58.6 | 56.3 | 46.3 | 44.8 | Schedule 80 PVC |
| MW-151 | 2.00 | 97.1 | 94.0 | 40.0 | 37.0 | 27.0 | 27.0 | Schedule 80 PVC |
| MW-153 | 2.00 | 109.0 | 105.4 | 22.4 | 20.4 | 10.4 | 10.4 | Schedule 80 PVC |
| MW-155 | 2.00 | 68.1 | 64.9 | 19.9 | 16.8 | 6.8 | 6.6 | Schedule 80 PVC |
| MW-156[c] | 2.00 | 66.9 | 64.8 | 36.8 | 42.4 | 35.3 | 22.8 | Schedule 80 PVC |
| MW-157[d] | 2.00 | 67.3 | 64.6 | 22.6 | 28.3 | 20.0 | 10.6 | Schedule 80 PVC |
| MW-158[c] | 2.00 | 68.8 | 66.6 | 36.6 | 44.0 | 36.9 | 24.6 | Schedule 80 PVC |
| MW-159[d] | 2.00 | 69.5 | 66.6 | 25.1 | 30.7 | 22.5 | 13.1 | Schedule 80 PVC |
| MW-161 | 2.00 | 95.4 | 92.0 | 37.0 | 33.8 | 23.8 | 23.6 | Schedule 80 PVC |
| MW-162 | 4.00 | 70.0 | 67.0 | 64.0 | 57.5 | 52.5 | 52.5 | Schedule 40 PVC |
| MW-164 | 4.00 | 97.5 | 95.2 | 47.2 | 45.0 | 35.0 | 35.2 | Schedule 40 PVC |
| MW-165 | 4.00 | 97.5 | 95.1 | 34.1 | 31.0 | 21.0 | 15.1 | Schedule 40 PVC |
| MW-167 | 4.00 | 66.8 | 63.8 | 17.3 | 15.0 | 5.0 | 4.5 | Schedule 40 PVC |
| MW-169 | 4.00 | 68.1 | 65.0 | 17.0 | 14.0 | 4.0 | 4.0 | Schedule 40 PVC |
| MW-170 | 2.00 | 95.4 | 92.2 | 59.3 | 52.0 | 42.0 | 41.2 | Schedule 80 PVC |
| MW-172 | 2.00 | 97.8 | 94.7 | 53.7 | 47.0 | 37.0 | 36.9 | Schedule 80 PVC |
| MW-174 | 2.00 | 94.7 | 91.8 | 53.2 | 51.0 | 41.0 | 41.1 | Schedule 80 PVC |

**Table 3.5-5 (Continued)**
**Onsite Well Construction Details**

| Well | Well Diameter (inches) | Elevations (feet NAVD 1988) | | | | | | Well Construction Material |
|---|---|---|---|---|---|---|---|---|
| | | Water Level Reference | Ground | Top of Filter (approx.)[a] | Top of Screen (approx.)[a] | Bottom of Screen (approx.)[a] | Bottom of Filter (approx.)[a] | |
| MW-178 | 4.00 | 97.8 | 95.1 | 47.1 | 45.0 | 35.0 | 35.0 | Schedule 40 PVC |
| MW-179 | 4.00 | 97.8 | 95.2 | 35.2 | 30.0 | 20.0 | 19.2 | Schedule 40 PVC |
| MW-180 | 2.00 | 112.2 | 109.0 | 63.0 | 49.0 | 39.0 | 36.0 | Schedule 80 PVC |
| MW-182 | 2.00 | 93.2 | 90.3 | 50.3 | 42.0 | 32.0 | 32.3 | Schedule 80 PVC |
| MW-185 | 2.00 | 68.3 | 65.2 | 4.8 | 1.0 | -9.0 | -9.4 | Schedule 80 PVC |
| MW-186 | 4.00 | 97.8 | 95.1 | 49.1 | 47.0 | 37.0 | 36.5 | Schedule 40 PVC |
| MW-187 | 4.00 | 97.6 | 95.0 | 30.0 | 32.0 | 22.0 | 21.7 | Schedule 40 PVC |
| MW-188 | 4.00 | 95.9 | 92.7 | 56.7 | 54.0 | 44.0 | 43.4 | Schedule 40 PVC |
| BP-1 | (b) | (b) | (b) | (b) | (b) | (b) | (b) | (b) |
| P-01 | 2.00 | 122.7 | 119.8 | (b) | (b) | (b) | (b) | Schedule 40 PVC |
| P-02 | 1.50 | 145.5 | 119.6 | (b) | (b) | (b) | (b) | Galvanized pipe |
| P-05 | 14.00 | 95.5 | 92.2 | (b) | 4.0 | -32.0 | (b) | (b) |
| P-07 | 1.25 | 123.6 | 122.9 | (b) | (b) | (b) | (b) | Schedule 40 PVC |
| P-08 | 1.25 | 123.8 | 123.2 | (b) | (b) | (b) | (b) | Schedule 40 PVC |
| P-09 | 1.25 | 129.1 | 126.8 | (b) | (b) | (b) | (b) | Schedule 40 PVC |
| P-10 | 1.25 | 128.6 | 126.9 | (b) | (b) | (b) | (b) | Schedule 40 PVC |
| P-1A | 10.00 | 97.8 | 94.0 | (b) | -1,680.0 | -1,721.0 | (b) | (b) |
| P-1B | 10.00 | 97.8 | 94.0 | (b) | -1,686.0 | -1,727.0 | (b) | (b) |

**Table 3.5-5 (Continued)
Onsite Well Construction Details**

| Well | Well Diameter (inches) | Elevations (feet NAVD 1988) | | | | | | Well Construction Material |
|---|---|---|---|---|---|---|---|---|
| | | Water Level Reference | Ground | Top of Filter (approx.)[a] | Top of Screen (approx.)[a] | Bottom of Screen (approx.)[a] | Bottom of Filter (approx.)[a] | |
| P-1D | 2.00 | 52.0 | 50.0 | (b) | (b) | (b) | (b) | Schedule 40 PVC |
| P-1S | 2.00 | 52.1 | 50.0 | (b) | (b) | (b) | (b) | Schedule 40 PVC |
| P-72 | 1.25 | 146.4 | 144.0 | (b) | (b) | (b) | (b) | Schedule 40 PVC |
| T-14 | 1.25 | 114.6 | 113.2 | (b) | (b) | (b) | (b) | Galvanized pipe |
| PZ-01 | 2.00 | 96.7 | 94.4 | 46.4 | 44.0 | 34.0 | 29.4 | Schedule 40 PVC |
| PZ-02 | 1.25 | 96.7 | 94.7 | 29.7 | 27.0 | 17.0 | 16.7 | Schedule 40 PVC |
| PZ-03 | 2.00 | 67.0 | 64.0 | 8.0 | 6.0 | -4.0 | -5.0 | Schedule 40 PVC |
| SW-101[e] | 4.00 | 102.0 | 99.0 | 94.0 | 92.0 | 87.0 | 87.0 | Schedule 40 PVC |
| SW-102[e] | 4.00 | 123.0 | 120.0 | 116.0 | 115.0 | 110.0 | 110.0 | Schedule 40 PVC |
| SW-103[e] | 4.00 | 142.0 | 139.0 | 135.0 | 134.0 | 129.0 | 128.0 | Schedule 40 PVC |
| SW-104[e] | 4.00 | 153.0 | 150.0 | 146.0 | 145.0 | 140.0 | 140.0 | Schedule 40 PVC |
| (FTN 2012, Table 2.1; FTN 2013, Appendix D; FTN 2014a, Table 2; FTN 2014b, Table 2; FTN 2014c, Table 1; FTN 2016a, Table 2; FTN 2016b, Table 2; LDNR 2015) | | | | | | | | |

a. For angled monitoring wells (MW-156 through MW-159), details are based on boring length, not vertical depth below ground surface.

b. Not specified.

c. Well angled at 45 degrees from horizontal to the south.

d. Well angled at 56 degrees from horizontal to the south.

e. Sentinel wells (SW-101 through SW-104) are installed next to air relief valves along the discharge pipeline for leak detection purposes. The wells were installed above the water table with sumps designed to capture water leaking from the air relief valves or discharge piping before it enters groundwater. (FTN 2012, Section 2.1)

**Table 3.5-6**
**Surface Water Usage Summary, 2013**
**(West Feliciana, East Feliciana, Pointe Coupee, and East Baton Rouge Parishes)**

| Category | West Feliciana Parish (MGD) | East Feliciana Parish (MGD) | Pointe Coupee Parish (MGD) | East Baton Rouge Parish (MGD) | Total (MGD) |
|---|---|---|---|---|---|
| Public supply | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Industrial | 14.35 | 0.00 | 0.00 | 20.33 | 34.68 |
| Aquaculture | 0.00 | 0.00 | 1.59 | 0.00 | 1.59 |
| Domestic, rural | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Irrigation[a] | 0.56 | 0.09 | 0.00 | 0.00 | 0.65 |
| Livestock | 0.08 | 0.18 | 0.08 | 0.01 | 0.35 |
| Power generation | 17.36 | 0.00 | 322.42 | 0.00 | 339.78 |
| Total | 32.35 | 0.27 | 324.09 | 20.34 | 377.05 |
| **Basin Water Usage** | | | | | |
| Mississippi River Basin | 31.85 | 0.00 | 322.42 | 20.33 | 374.60 |
| Lake Pontchartrain-Maurepas | 0.50 | 0.27 | 0.00 | 0.01 | 0.78 |
| Atchafalaya-Teche-Vermilion River Basin | 0.00 | 0.00 | 1.67 | 0.00 | 1.67 |
| **Total** | **32.35** | **0.27** | **324.09** | **20.34** | **377.05** |

(USGS 2015d; USGS 2015e; USGS 2015f; USGS 2015g; USGS 2015h)

a. Includes general irrigation and rice irrigation.

**Table 3.5-7**
**Groundwater Usage Summary, 2013**
**(West Feliciana, East Feliciana, Pointe Coupee, and East Baton Rouge Parishes)**

| Category | West Feliciana Parish (MGD) | East Feliciana Parish (MGD) | Pointe Coupee Parish (MGD) | East Baton Rouge Parish (MGD) | Total (MGD) |
|---|---|---|---|---|---|
| Public supply | 3.85 | 2.77 | 3.64 | 71.16 | 81.42 |
| Industrial | 1.37 | 0.03 | 6.21 | 72.60 | 80.21 |
| Aquaculture | 0.00 | 0.00 | 6.35 | 0.22 | 6.57 |
| Domestic, rural | 0.04 | 0.27 | 0.23 | 0.24 | 0.78 |
| Irrigation[a] | 0.00 | 0.27 | 18.30 | 0.34 | 18.91 |
| Livestock | 0.00 | 0.02 | 0.12 | 0.11 | 0.25 |
| Power generation | 4.38 | 0.00 | 2.00 | 7.20 | 13.58 |
| Total | 9.64 | 3.36 | 36.85 | 151.87 | 201.72 |
| (USGS 2015d; USGS 2015e; USGS 2015f; USGS 2015g) | | | | | |

a. Includes general irrigation and rice irrigation.

**Table 3.5-8**
**Registered Groundwater Wells, 2-Mile Band around RBS Property Boundary**

| Water Well Number | Distance[a] (miles) | Well Depth (feet) | Use Description | Aquifer Name |
|---|---|---|---|---|
| 125-246[b] | 0.17 | 1,821 | Power generation (RBS P-1B) | 2,800-foot sand |
| 125-256[c] | 0.17 | 124 | Fire protection (RBS P-05) | UTA |
| 125-257[d] | 0.21 | 1,815 | Power generation (RBS P-1A) | 2,800-foot sand |
| 125-266[e] | 0.37 | 500 | Industrial (RBS BP-1) | 1,200-foot sand |
| 125-5205Z | 0.28 | 123 | Not specified (RBS) | UTA |
| 125-5204Z | 0.30 | 130 | Not specified (RBS) | UTA |
| 125-82 | 0.92 | 510 | Domestic | 1,200-foot sand |
| 125-5212Z[f] | 0.94 | 188 | Industrial (RBS) | 800-foot sand |
| 125-87 | 1.01 | 497 | Industrial | 1,200-foot sand |
| 125-68 | 1.04 | 483 | Domestic | 1,200-foot sand |
| 125-5053Z | 1.10 | 410 | Domestic | 1,200-foot sand |
| 125-241 | 1.11 | 161 | Domestic | UTA |
| 125-65 | 1.12 | 169 | Domestic | UTA |
| 125-91 | 1.12 | 485 | Domestic | 1,200-foot sand |
| 125-94 | 1.12 | 525 | Domestic | 1,200-foot sand |
| 125-64 | 1.13 | 1,647 | Domestic | 2,400-foot sand |
| 125-83 | 1.17 | 115 | Domestic | UTA |
| 125-84 | 1.17 | 180 | Domestic | UTA |
| 125-5276Z | 1.19 | 115 | Irrigation | UTA |
| 125-88 | 1.25 | 520 | Livestock | 1,200-foot sand |
| 125-86 | 1.27 | 480 | Domestic | 1,200-foot sand |
| 125-17 | 1.30 | 502 | Domestic | 1,200-foot sand |
| 125-72 | 1.32 | 114 | Domestic | UTA |
| 125-5292Z | 1.32 | 120 | Domestic | UTA |
| 125-5284Z | 1.35 | 120 | Domestic | UTA |
| 125-92 | 1.52 | 520 | Domestic | 1,200-foot sand |
| 125-56 | 1.64 | 1,486 | Domestic | 2,400-foot sand |
| 125-5337Z | 1.70 | 126 | Domestic | UTA |

**Table 3.5-8 (Continued)
Registered Groundwater Wells, 2-Mile Band around RBS Property Boundary**

| Water Well Number | Distance[a] (miles) | Well Depth (feet) | Use Description | Aquifer Name |
|---|---|---|---|---|
| 125-5340Z | 1.76 | 135 | Irrigation | UTA |
| 125-5289Z | 1.95 | 150 | Domestic | UTA |
| 125-5335Z | 1.96 | 140 | Irrigation | UTA |
| 125-5338Z | 1.96 | 130 | Domestic | UTA |
| 125-73 | 1.98 | 180 | Domestic | UTA |
| 125-245 | 2.04 | 120 | Commercial public supply | UTA |
| 125-244 | 2.06 | 120 | Commercial public supply | UTA |
| 125-294 | 2.08 | 285 | Inactive public supply | 1,000-foot sand |
| 125-283 | 2.10 | 280 | Rural public supply | 1.000-foot sand |
| 125-251 | 2.18 | 138 | Domestic | UTA |
| 125-5386Z | 2.24 | 175 | Domestic | Not specified |
| 125-250 | 2.35 | 110 | Domestic | UTA |
| 125-5283Z | 2.52 | 230 | Domestic | 1,200-foot sand |
| 077-314 | 2.57 | 163 | Industrial | MRAA |
| 077-315 | 2.57 | 163 | Industrial | MRAA |
| 077-43 | 2.60 | 1,610 | Domestic | 2800-foot sand |
| 125-5403Z | 2.63 | 140 | Not specified | UTA |
| 077-5484Z | 2.64 | 100 | Irrigation | MRAA |
| 125-290 | 2.67 | 1,752 | Rural public supply | 2,800-foot sand |
| 125-240 | 2.87 | 636 | Livestock | 1,500-foot sand |
| 125-60 | 2.88 | 176 | Livestock | UTA |
| 077-173 | 2.91 | 172 | Power generation | MRAA |
| 077-175 | 3.09 | 470 | Institution public supply | 1,200-foot sand |
| 077-295 | 3.10 | 1,575 | Institution public supply | 2,800-foot sand |
| 125-222 | 3.28 | 1,526 | Municipal public supply | 2,400-foot sand |
| 125-270 | 3.35 | 1,750 | Municipal public supply | 2,800-foot sand |
| 077-180 | 3.37 | 544 | Power generation | 1,200-foot sand |
| 077-245 | 3.39 | 556 | Power generation | 1,500-foot sand |
| 125-50 | 3.40 | 1,569 | Industrial paper/pulp processing | 2,400-foot sand |

### Table 3.5-8 (Continued)
### Registered Groundwater Wells, 2-Mile Band around RBS Property Boundary

| Water Well Number | Distance[a] (miles) | Well Depth (feet) | Use Description | Aquifer Name |
|---|---|---|---|---|
| 125-63 | 3.40 | 1,372 | Industrial paper/pulp processing | 2,400-foot sand |
| 125-215 | 3.41 | 2,068 | Industrial paper/pulp processing | 2,800-foot sand |
| 125-48 | 3.42 | 2,083 | Industrial paper/pulp processing | 2,800-foot sand |
| 125-285 | 3.46 | 170 | Not specified | UTA |
| 125-221 | 3.51 | 145 | Industrial | MRAA |

(LDNR 2015)

Note: This table does not include wells specified as piezometers or monitoring wells.

a. Distance in miles from center point of the RBS reactor. Wells listed are limited to those wells within a 2-mile band around the property boundary.
b. Water supply well P-1B.
c. Fire protection well P-05.
d. Water supply well P-1A.
e. Water supply well BP-1.
f. Fancy Point Switchyard restroom supply well; not utilized by RBS.

**Table 3.5-9**
**RBS Groundwater Well Withdrawals**

| Well ID | Aquifer | Total Gallons (2011) | Total Gallons (2012) | Total Gallons (2013) | Total Gallons (2014) | Total Gallons (2015) |
|---|---|---|---|---|---|---|
| P-1A | Tertiary (Zone 3) | 2,202,000 | 12,000 | 1,321,000 | 2,493,000 | 2,100,000 |
| P-1B | Tertiary (Zone 3) | 19,661,000 | 3,663,000 | 2,675,000 | 2,808,000 | 4,089,000 |
| Total Gallons | | 21,863,000 | 3,675,000 | 3,996,000 | 5,301,000 | 6,189,000 |
| Annual Average GPM | | 42 | 7 | 8 | 10 | 12 |
| BP-1 | Tertiary (Zone 1) | 165,000 | 419,000 | 188,000 | 275,000 | 849,000 |
| Total Gallons | | 165,000 | 419,000 | 188,000 | 275,000 | 849,000 |
| Annual Average GPM | | 0.3 | 0.8 | 0.4 | 0.5 | 1.6 |
| P-05[a] | Upland Terrace | 1,008,000 | 479,000 | 1,125,000 | 1,525,000 | 1,871,000 |
| MW-125 | Upland Terrace | [b] | [c] | 38,950 | 115,800 | 412,800 |
| Total Gallons | | 1,008,000 | 479,000 | 1,163,950 | 1,640,800 | 2,283,800 |
| Annual Average GPM | | 2 | 1 | 2 | 3 | 4 |

(Entergy 2016l)

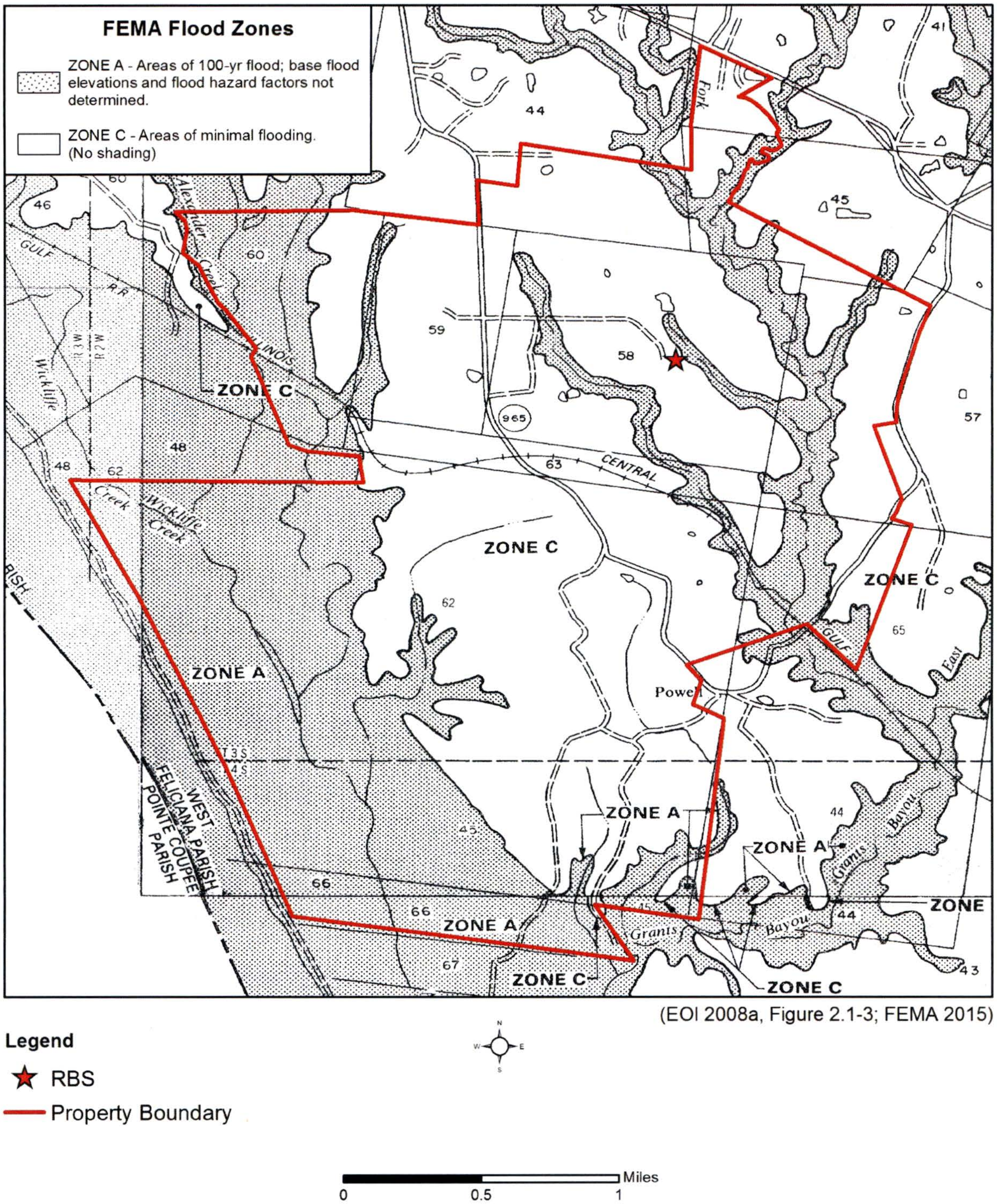
a. P-05 is a water supply well (fire protection); however, it is also used in the monitoring well program to measure groundwater levels to develop potentiometric maps.

b. Not installed until August 2012.

c. Not utilized as a remediation well until 2013.

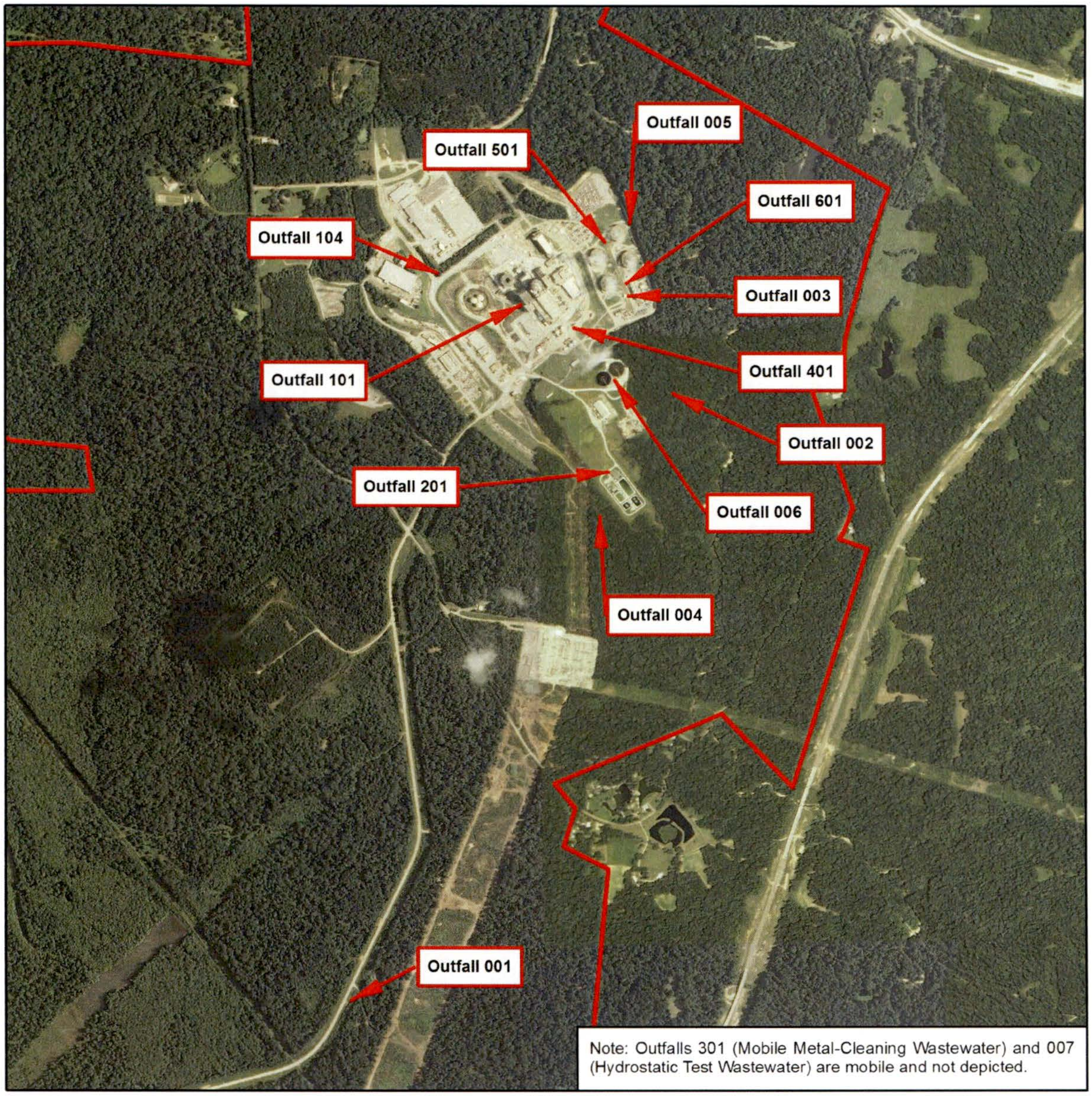

(Entergy 2016j, Figure 3.5-1; LOSCO 2014; USCB 2015d; USDOT 2015; USGS 2015a)

**Figure 3.5-1**
**Regional Hydrologic Features**




(EOI 2008a, Figure 2.1-3; FEMA 2015)

**Figure 3.5-2**
**FEMA Flood Zones, RBS Property**



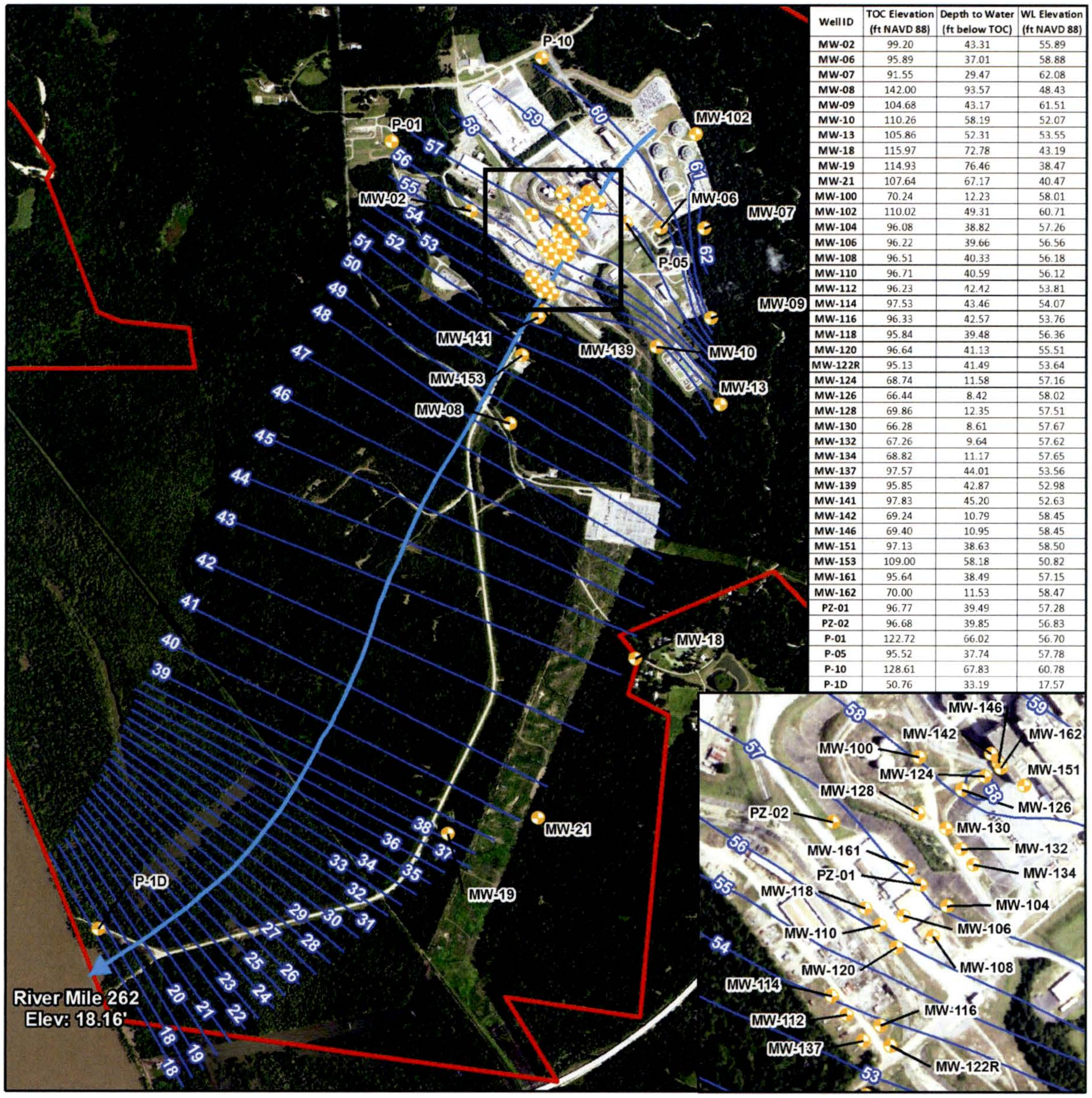

(EOI 2008a, Figure 2.1-3; Attachment A, LPDES Permit No. LA0042731; USDA 2015a)

**Legend**

Property Boundary

Miles
0 0.5 1

**Figure 3.5-3**
**LPDES-Permitted Outfalls**




| Well ID | TOC Elevation (ft NAVD 88) | Depth to Water (ft below TOC) | WL Elevation (ft NAVD 88) |
|---|---|---|---|
| MW-02 | 99.20 | 43.31 | 55.89 |
| MW-06 | 95.89 | 37.01 | 58.88 |
| MW-07 | 91.55 | 29.47 | 62.08 |
| MW-08 | 142.00 | 93.57 | 48.43 |
| MW-09 | 104.68 | 43.17 | 61.51 |
| MW-10 | 110.26 | 58.19 | 52.07 |
| MW-13 | 105.86 | 52.31 | 53.55 |
| MW-18 | 115.97 | 72.78 | 43.19 |
| MW-19 | 114.93 | 76.46 | 38.47 |
| MW-21 | 107.64 | 67.17 | 40.47 |
| MW-100 | 70.24 | 12.23 | 58.01 |
| MW-102 | 110.02 | 49.31 | 60.71 |
| MW-104 | 96.08 | 38.82 | 57.26 |
| MW-106 | 96.22 | 39.66 | 56.56 |
| MW-108 | 96.51 | 40.33 | 56.18 |
| MW-110 | 96.71 | 40.59 | 56.12 |
| MW-112 | 96.23 | 42.42 | 53.81 |
| MW-114 | 97.53 | 43.46 | 54.07 |
| MW-116 | 96.33 | 42.57 | 53.76 |
| MW-118 | 95.84 | 39.48 | 56.36 |
| MW-120 | 96.64 | 41.13 | 55.51 |
| MW-122R | 95.13 | 41.49 | 53.64 |
| MW-124 | 68.74 | 11.58 | 57.16 |
| MW-126 | 66.44 | 8.42 | 58.02 |
| MW-128 | 69.86 | 12.35 | 57.51 |
| MW-130 | 66.28 | 8.61 | 57.67 |
| MW-132 | 67.26 | 9.64 | 57.62 |
| MW-134 | 68.82 | 11.17 | 57.65 |
| MW-137 | 97.57 | 44.01 | 53.56 |
| MW-139 | 95.85 | 42.87 | 52.98 |
| MW-141 | 97.83 | 45.20 | 52.63 |
| MW-142 | 69.24 | 10.79 | 58.45 |
| MW-146 | 69.40 | 10.95 | 58.45 |
| MW-151 | 97.13 | 38.63 | 58.50 |
| MW-153 | 109.00 | 58.18 | 50.82 |
| MW-161 | 95.64 | 38.49 | 57.15 |
| MW-162 | 70.00 | 11.53 | 58.47 |
| PZ-01 | 96.77 | 39.49 | 57.28 |
| PZ-02 | 96.68 | 39.85 | 56.83 |
| P-01 | 122.72 | 66.02 | 56.70 |
| P-05 | 95.52 | 37.74 | 57.78 |
| P-10 | 128.61 | 67.83 | 60.78 |
| P-1D | 50.76 | 33.19 | 17.57 |

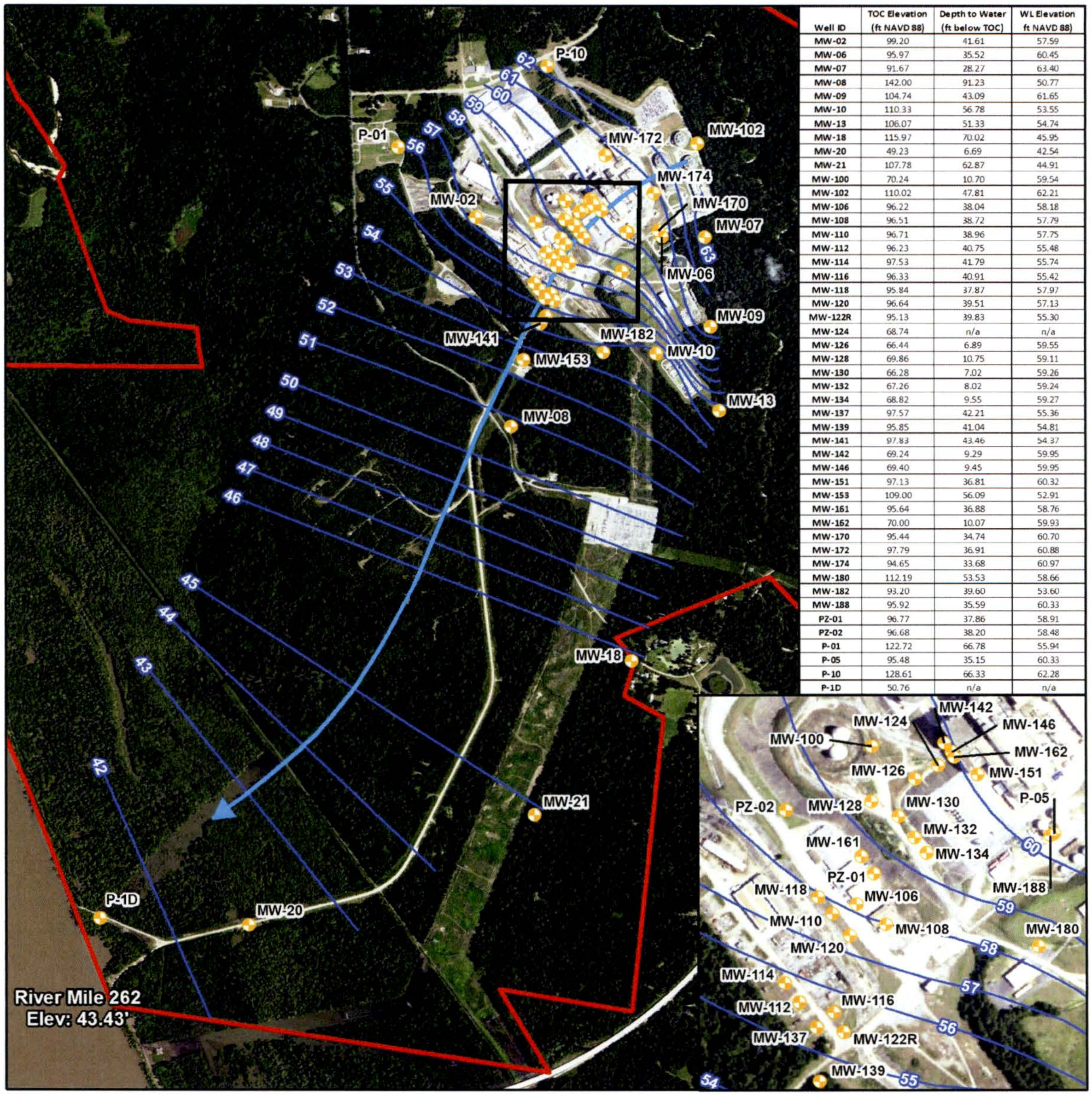
**Legend**

- Monitoring Well
- Flow Direction
- Potentiometric Surface February 2, 2015
- Property Boundary

(Entergy 2016m; EOI 2008a, Figure 2.1-3; USDA 2015a)

0 0.5 1 Miles

**Figure 3.5-4**
**RBS Potentiometric Surface Map, February 2, 2015**



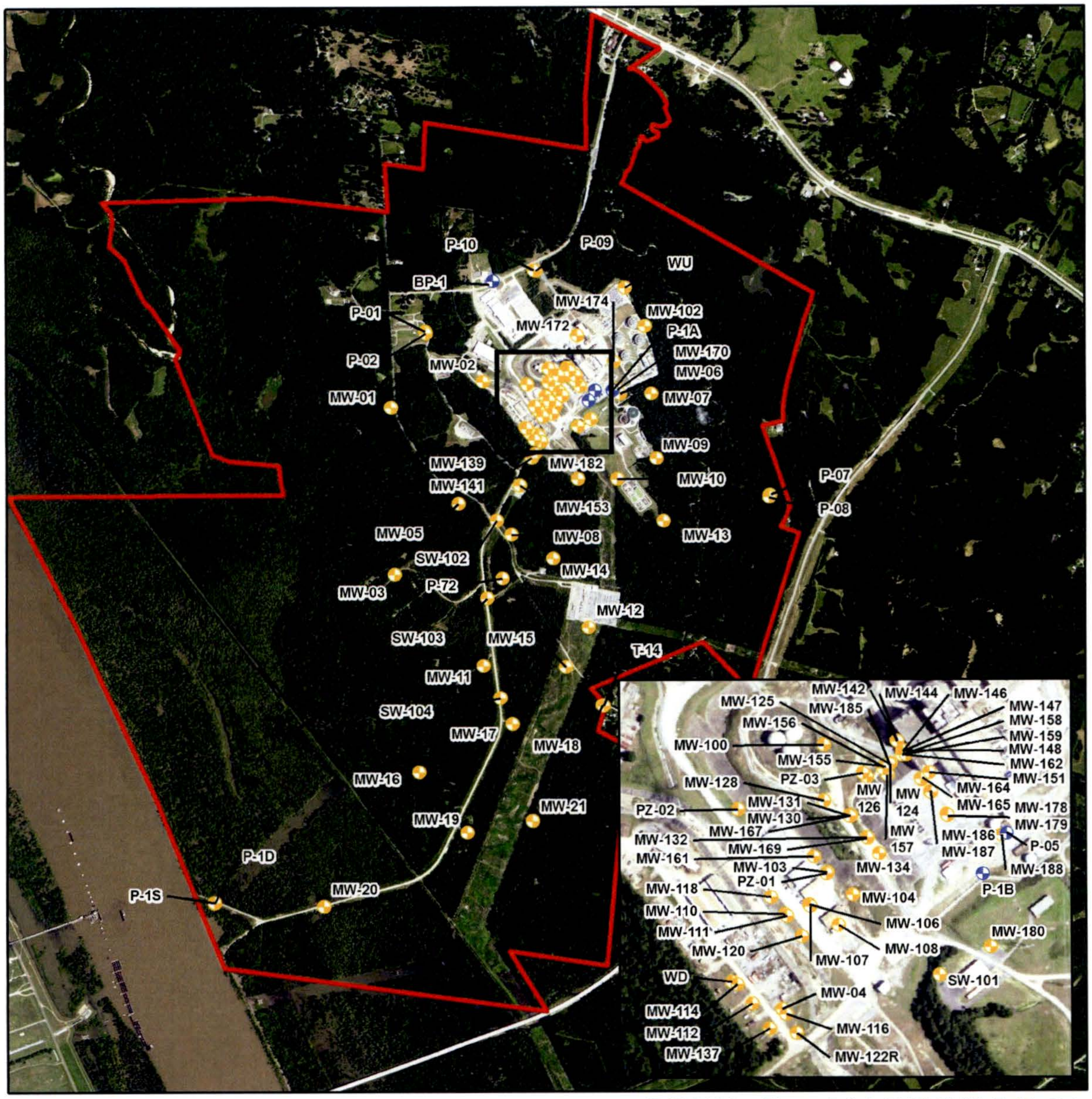

| Well ID | TOC Elevation (ft NAVD 88) | Depth to Water (ft below TOC) | WL Elevation ft NAVD 88) |
|---|---|---|---|
| MW-02 | 99.20 | 41.61 | 57.59 |
| MW-06 | 95.97 | 35.52 | 60.45 |
| MW-07 | 91.67 | 28.27 | 63.40 |
| MW-08 | 142.00 | 91.23 | 50.77 |
| MW-09 | 104.74 | 43.09 | 61.65 |
| MW-10 | 110.33 | 56.78 | 53.55 |
| MW-13 | 106.07 | 51.33 | 54.74 |
| MW-18 | 115.97 | 70.02 | 45.95 |
| MW-20 | 49.23 | 6.69 | 42.54 |
| MW-21 | 107.78 | 62.87 | 44.91 |
| MW-100 | 70.24 | 10.70 | 59.54 |
| MW-102 | 110.02 | 47.81 | 62.21 |
| MW-106 | 96.22 | 38.04 | 58.18 |
| MW-108 | 96.51 | 38.72 | 57.79 |
| MW-110 | 96.71 | 38.96 | 57.75 |
| MW-112 | 96.23 | 40.75 | 55.48 |
| MW-114 | 97.53 | 41.79 | 55.74 |
| MW-116 | 96.33 | 40.91 | 55.42 |
| MW-118 | 95.84 | 37.87 | 57.97 |
| MW-120 | 96.64 | 39.51 | 57.13 |
| MW-122R | 95.13 | 39.83 | 55.30 |
| MW-124 | 68.74 | n/a | n/a |
| MW-126 | 66.44 | 6.89 | 59.55 |
| MW-128 | 69.86 | 10.75 | 59.11 |
| MW-130 | 66.28 | 7.02 | 59.26 |
| MW-132 | 67.26 | 8.02 | 59.24 |
| MW-134 | 68.82 | 9.55 | 59.27 |
| MW-137 | 97.57 | 42.21 | 55.36 |
| MW-139 | 95.85 | 41.04 | 54.81 |
| MW-141 | 97.83 | 43.46 | 54.37 |
| MW-142 | 69.24 | 9.29 | 59.95 |
| MW-146 | 69.40 | 9.45 | 59.95 |
| MW-151 | 97.13 | 36.81 | 60.32 |
| MW-153 | 109.00 | 56.09 | 52.91 |
| MW-161 | 95.64 | 36.88 | 58.76 |
| MW-162 | 70.00 | 10.07 | 59.93 |
| MW-170 | 95.44 | 34.74 | 60.70 |
| MW-172 | 97.79 | 36.91 | 60.88 |
| MW-174 | 94.65 | 33.68 | 60.97 |
| MW-180 | 112.19 | 53.53 | 58.66 |
| MW-182 | 93.20 | 39.60 | 53.60 |
| MW-188 | 95.92 | 35.59 | 60.33 |
| PZ-01 | 96.77 | 37.86 | 58.91 |
| PZ-02 | 96.68 | 38.20 | 58.48 |
| P-01 | 122.72 | 66.78 | 55.94 |
| P-05 | 95.48 | 35.15 | 60.33 |
| P-10 | 128.61 | 66.33 | 62.28 |
| P-1D | 50.76 | n/a | n/a |

(Entergy 2016m; EOI 2008a, Figure 2.1-3; USDA 2015a)

**Legend**

- Monitoring Well
- Flow Direction
- Potentiometric Surface February 2, 2016
- Property Boundary

**Figure 3.5-5**
**RBS Potentiometric Surface Map, February 2, 2016**




**Legend**

Monitoring Well

Water Supply Well

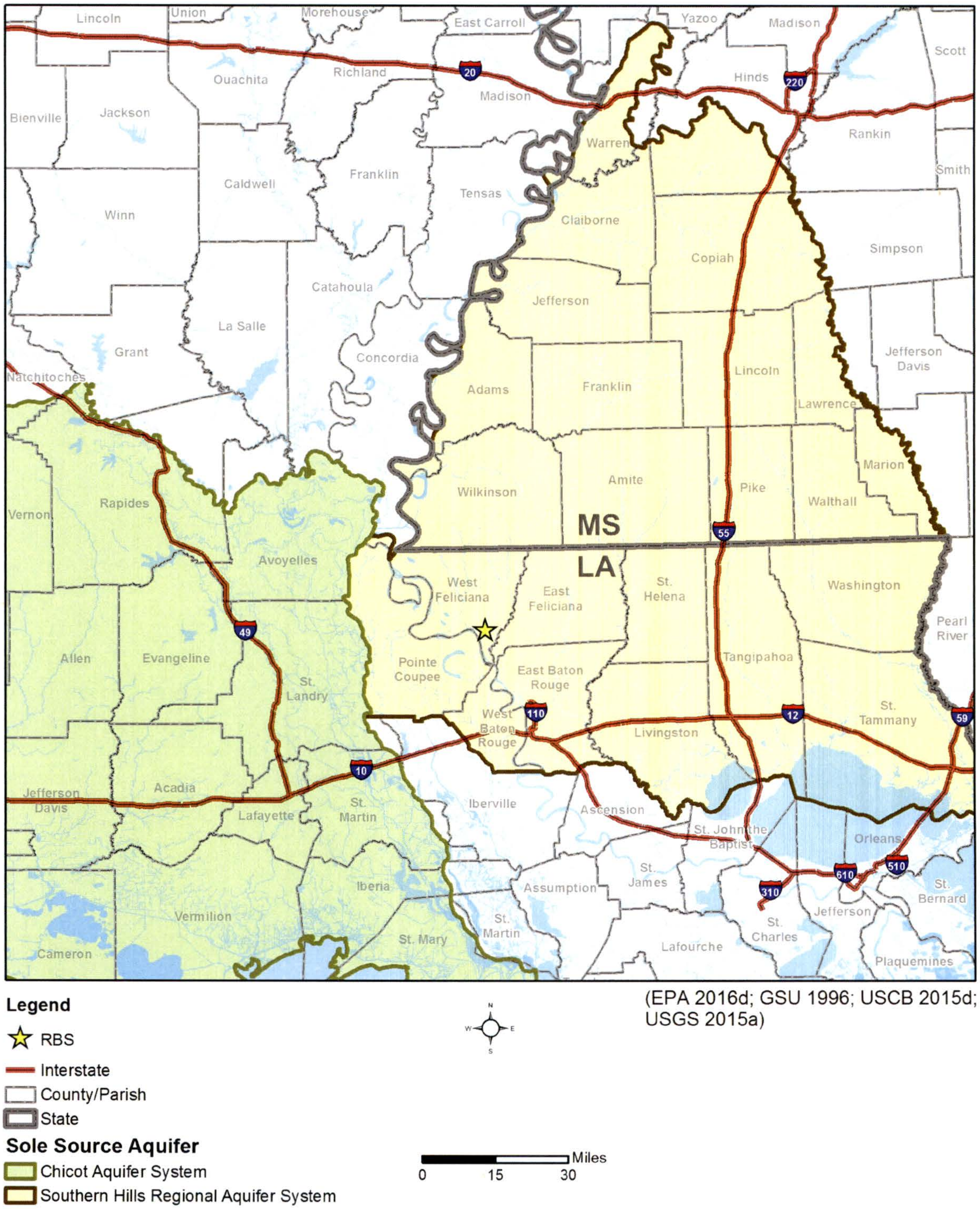
Property Boundary

N W E S

(EOI 2008a, Figure 2.1-3; FTN 2012, Table 2.1; FTN 2014a, Table 2; FTN 2014b, Table 2; FTN 2014c, Table 1; FTN 2016a, Table 2; FTN 2016b, Table 2; LDNR 2015; USDA 2015a)

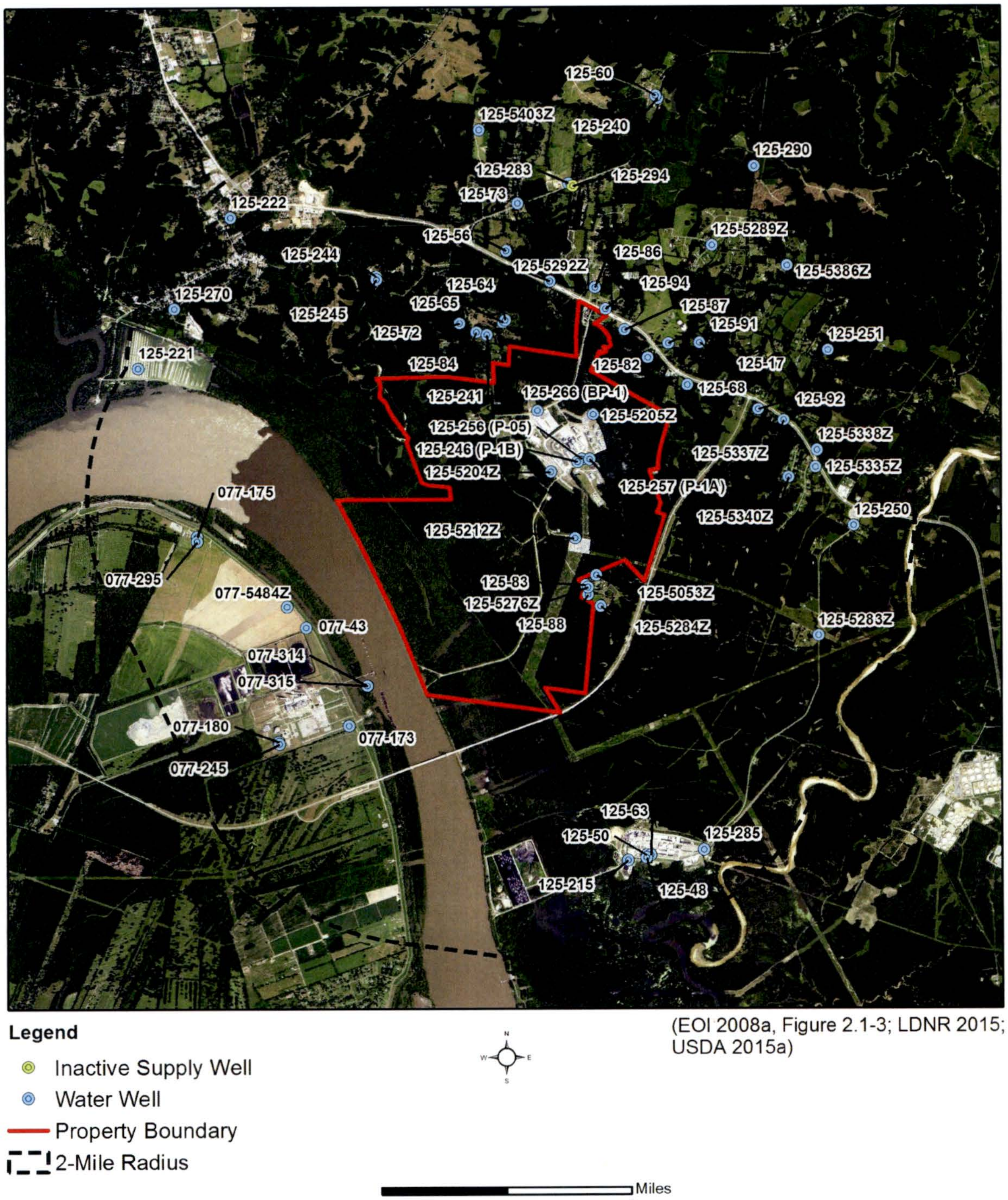
0 0.5 1 Miles

**Figure 3.5-6**
**Onsite Groundwater Monitoring Wells**




(EPA 2016d; GSU 1996; USCB 2015d; USGS 2015a)

**Figure 3.5-7**
**Southern Hills Regional Aquifer System**




(EOI 2008a, Figure 2.1-3; LDNR 2015; USDA 2015a)

**Figure 3.5-8**
**Registered Water Wells, 2-Mile Band around RBS Property Boundary**

## 3.6 Ecological Resources

Regional ecology is greatly influenced by the geomorphic and physiographic characteristics of the region. Soils determine the basic fertility of the region which, in turn, determines the types of plants that may grow. The plants that are present greatly influence the types and number of animals that reside in the region. Soil types also greatly influence the basic fertility of aquatic ecosystems and the species present. Climatological factors, such as temperature and precipitation, further refine the plants and animals that may live in a locale. West Feliciana Parish, where RBS is located, is in the LMR valley, and the site is adjacent to the Mississippi River (Figure 3.0-3). The regional ecology is described below.

### 3.6.1 Region

#### 3.6.1.1 Geomorphology

The Mississippi River has dominated the development of geologic and physiographic features in the region since the beginning of Neogene period. The region is underlain by a complex layering of sand, silt, and clay from former Mississippi River delta lobes, levee, and overbank flood deposits. Typically, deltaic sediments vary from a few feet to more than 700 feet along the course of the Mississippi River. (Entergy 2016j, Section 3.6.1.1) The various geologic and physiographic provinces in the region are discussed in Section 3.4.

#### 3.6.1.2 Soils

As discussed in Section 3.4.1.1.2, the soil units in the region include Holocene-aged deposits consisting of sand, sandy silt, silt, clayey silt, silty clay, and clay deposited along the banks of the Mississippi River, and terrace deposits of the Upland Complex. Figure 3.4-3 shows the distribution of surface deposits surrounding the site.

The majority of the site is located in the soil units of the Upland Complex, designated as the Pliocene Citronelle Formation. The Citronelle Formation overlies the lower Prairie Allogroup. The upper Prairie Allogroup and undifferentiated Prairie Allogroup are not found on the RBS property, but they do outcrop to the north (undifferentiated) and to the east and south (upper) of the RBS property boundary (Figure 3.4-3). Onsite soils are discussed more extensively in Section 3.4.2.

#### 3.6.1.3 Climate

As discussed in Section 3.2, the general climate can be described as humid subtropical with summers dominated by the Bermuda High, a semi-permanent anticyclone that is an extension of the Azores High-Pressure System. The Bermuda High can remain intact into the spring and fall and occasionally even into the winter season. The prevailing southeasterly winds combined with an abundant moisture supply from the warm waters of the Gulf of Mexico provide mild and rather humid weather throughout most of the year. The Bermuda High historically can lead to very light winds or even calm weather conditions, thus creating air stagnation problems in the region at times during summer and early fall. Air from higher latitudes in the north-central United States occasionally brings drier and cooler conditions to the area, but mainly for only brief periods of time during the winter months.

As discussed in Section 3.2.2.2, based on 30 years of data from Ryan Airport near Baton Rouge, the normal daily mean temperature is 68.5°F, with the highest daily mean monthly temperatures occurring during the summer months (June, July, and August). The normal daily minimum and maximum temperatures at Baton Rouge during the summer months average 72.8°F and 91.9°F, respectively. The mean number of days with a maximum temperature of 90°F or greater is 85.

As discussed in Section 3.2.2.3, based on the period 1981–2010, the normal annual precipitation for Ryan Airport is 60.6 inches. Snowfall is very infrequent across central and southern Louisiana. Normal annual snowfall values at Baton Rouge are 0.2 inches. Thunderstorms are a common occurrence at the RBS and the surrounding region throughout the year. The highest seasonal rate of occurrence for thunderstorms is in the summertime (June to August), when about 53 percent of all thunderstorm days occur.

RBS is located approximately 75 miles from the nearest point on the Gulf Coast. However, the potential still exists for strong winds associated with hurricanes and tropical storms to make it as far inland as RBS. The intensity and forward speed of hurricanes largely determines how far inland hurricane speeds are realized. Climate is discussed in greater detail in Section 3.2.

#### 3.6.1.4 Regional Water Systems

As discussed in Section 3.5, the Mississippi River is the primary hydrologic feature with which the plant interacts. The Mississippi River and its tributaries drain a total of 1,245,000 square miles, which is 41 percent of the 48 contiguous states of the United States. With its headwaters in Minnesota, the Mississippi flows southward for approximately 2,300 miles into the Gulf of Mexico. Downstream from the confluence of the Missouri River near West Alton, Missouri, north of St. Louis, the Mississippi flows un-dammed to Head of Passes in Louisiana, where it branches into several distributaries that carry water to the Gulf of Mexico.

There are many miles of frontage on the Mississippi River, which makes the river important for commercial navigation and recreation. In addition, the cooling water source for RBS plant operations is the Mississippi River. Surface waters in the vicinity of RBS are discussed in greater detail in Section 3.5.1.

#### 3.6.1.5 Regional Ecosystems

The area surrounding the RBS site overlaps the Mississippi Alluvial Plain and the Mississippi Valley Loess ecoregions. The floodplain of the Mississippi River consists of cypress-tupelo swamps and freshwater wetlands on the backside of a natural levee. In front of the levee is the river and an ever-changing mosaic of forested areas, wetlands, and erosion/deposition areas at the river's edge. (Daigle et al. 2006) A brief description of the regional ecosystems, including state-listed natural communities, is provided below.

#### 3.6.1.5.1 Cypress-Tupelo Swamp

Cypress-tupelo swamp is a forested, alluvial swamp that grows on intermittently exposed soils, most commonly along rivers and streams but also occurring in backswamp depressions and swales. Soils are inundated or saturated by surface water or groundwater on a nearly permanent basis throughout the growing season, except during periods of extreme drought. Cypress-tupelo swamps generally occur on mucks and clays, and also silts and sands with underlying clay layers (Alfisols, Entisols, Histosols, and Inceptisols). (LDWF 2015b)

This natural community exhibits relatively low floristic diversity, and associated species may vary widely from site to site. Undergrowth is often sparse because of low light intensity and long hydroperiod. Establishment of young trees can only occur during periods of exceptionally long drought, because neither bald cypress (*Taxodium distichum*) nor tupelo gum (*Nyssa aquatica*) seeds germinate underwater, nor can young seedlings of these trees survive long submergence. These swamps tend to be even-aged stands because the environmental conditions favorable for germination and establishment of saplings occur very infrequently. Also, bald cypress is an intolerant tree species requiring high light conditions for establishment and successful growth. Cypress-tupelo swamps provide important ecosystem functions, including maintenance of water quality, productive habitat for a variety of fish and wildlife species, and regulation of flooding and stream recharge. (LDWF 2015b)

Pre-settlement cypress-tupelo swamp may have covered approximately 2.5 million acres (Keim et al. 2006). Sizeable areas of cypress-tupelo swamp still remain, even though the historic extent is considerably reduced. Statewide estimates of swamp loss range from 25 to 50 percent of the original pre-settlement acreage, and old-growth examples are very rare. Threats to cypress-tupelo swamp are agricultural, industrial, and residential development; saltwater intrusion and subsidence; hydrological alterations (to include adjacent areas); construction of roads, pipelines, or utilities; logging on permanently flooded sites where natural or artificial regeneration is not feasible; soil damage from timber harvesting or industrial activities; contamination by chemicals (herbicides, fertilizers); and invasive exotic species. Cypress-tupelo swamps may be found throughout Louisiana in all river basins. (LDWF 2015b)

#### 3.6.1.5.2 Batture

Batture develops on the slope between the natural levee crest and major streams/rivers, and is a pioneer community which is first to appear on newly formed sand bars and river margins. These areas receive sands and silts with each flood. The soils are semi-permanently inundated or saturated, and inundation or saturation by surface water or groundwater occurs periodically, primarily during spring and summer months. As river sediments build up, a rapid succession of plant species progresses from willow (*Salix* spp.) and cottonwood into bottomland forest types, including the hackberry-American elm-green ash or sycamore-sweetgum-American elm variations. The successional sequence is a function of river meander movement rates and point bar formation. Rivers with swift meander movements over unconsolidated sands produce tapered slopes on point bars which are first colonized by the batture community. (LDWF 2015c)

Threats to batture include operation of drainage or diversion systems; hydrological alterations; construction of roads, pipelines, or utilities; invasive exotic species; and industrial activities and discharge. Batture occurs primarily along the Mississippi River, but also along the Atchafalaya, Red, and perhaps other river basins such as Pontchartrain, Barataria, Terrebonne, Vermilion-Teche, and Ouachita. (LDWF 2015c)

#### 3.6.1.5.3 Bottomland Hardwood Forest

Bottomland hardwood forest is forested, alluvial wetlands occupying broad floodplain areas flanking large river systems. It is maintained by a natural hydrologic regime of alternating wet and dry periods that follow seasonal flooding events. This natural community provides important ecosystem functions, including maintenance of water quality, productive habitat for a variety of fish and wildlife species, regulation of flooding, and stream recharge. Its soils are alluvial deposits, heavy clays to silty clays, high in organic matter and nutrients. The dominant forest species in this natural community can be aggregated into specific associations based on environmental factors such as physiography, topography, hydric (wet) soils, and hydrologic regimes. Vegetation associations are typically mixtures of broadleaf deciduous, needleleaf deciduous, and evergreen trees and shrubs. Plant community associates are overcup oak-water hickory bottomland forest; hackberry-American elm-green ash bottomland forest; and sweetgum-water oak bottomland forest. Bottomland hardwood forest loss is estimated to be 50 to 75 percent of the original pre-settlement acreage. Old-growth examples are very rare. (LDWF 2015d)

Clearing for agricultural production was the primary factor leading to fragmentation and decline. Other threats to bottomland hardwood forest include hydrological alterations; construction of roads, pipelines, or utilities; and invasive exotic species. Although predominant in the Mississippi River Alluvial Plain, bottomland hardwood forest is found throughout Louisiana in all river basins. This natural community is also important in the East Gulf Coastal Plain in association with major rivers. (LDWF 2015d)

#### 3.6.1.5.4 Small Stream Forest

Small stream forests are narrow wetland forests occurring along small rivers and large creeks which are seasonally flooded for brief periods. The percentage of sand, silt, calcareous clay, acidic clay, and organic material in the soil is highly variable (depending on local geology) and has a significant effect on plant species composition; soils are typically classified as silt-loams. Small stream forests are quite similar in species composition to hardwood slope forests in some locales. Critical ecosystem functions of this natural community include the filtering of surface and subsurface flows, improving water quality, and storing sediment and nutrients. (LDWF 2015e)

Threats to small stream forests include habitat conversion; gravel mining; invasive exotic species; construction of roads, pipelines, or utilities; and use of off-road vehicles. Small stream forests are found in the upper and lower West Gulf Coastal Plains in west, central, and northwest Louisiana. This natural community is also known from the Florida parishes in the East Gulf Coastal Plain and upper East Gulf Coastal Plain. This natural community occurs in the Pearl, Pontchartrain, Mississippi, Vermilion-Teche, Mermentau, Calcasieu, Sabine, Red, and Ouachita river basins. (LDWF 2015e)

3.6.1.5.5 Overcup Oak-Water Hickory Forest

Overcup oak-water hickory forest occurs in low-lying poorly drained flats, sloughs in the lowest backwater basins, and on low ridges with clay soils that are subject to inundation. Semi-permanently inundated or saturated soils for a major portion of the growing season are generally present. Such conditions typically occur during the spring and summer months, with a frequency ranging from 51 to 100 years per 100 years. (LDWF 2015f, page 23)

Overcup oak (*Quercus lyrata*) and water hickory (*Carya aquatic*) are co-dominants of this floodplain forest. Associate species include green ash (*Fraxinus pennsylvanica*), hackberry (*Celtis laevigata*), swamp dogwood (*Cornus foemina var. foemina*), swamp privet (*Forestiera acuminata*), planertree (*Planera aquatica*), buttonbush (*Cephalanthus occidentalis*), and vines. This community type has a long successional stage. (LDWF 2015f, page 23)

Typical threats to overcup oak-water hickory forest include urban expansion, residential and commercial development, land disturbance operations, introduction of exotic species, and many other human and some natural disturbance factors (LDWF 2015f, page 2).

3.6.1.5.6 Sweetgum-Water Oak Forest

Sweetgum-water oak forest dominants are sweetgum (*Liquidambar styraciflua*) and water oak (*Quercus nigra*). Major associates are hackberry, green ash, American elm (*Ulmus americana*), and Nuttall oak (*Quercus nuttallii*). This natural community occurs in alluvial floodplains, extensively in the Mississippi alluvial valley on well-drained, first bottom ridges. Associated species are red maple (*Acer rubrum*), red mulberry (*Morus rubra*), greenbrier (*Smilax* spp.), dwarf palmetto (*Sabal minor*), deciduous holly (*Ilex decidua*), green hawthorn (*Crataegus viridis*), peppervine (*Ampelopsis arborea*), trumpet-creeper (*Campsis radicans*), and poison ivy (*Toxicodendron radicans*). (LDWF 2015f, page 24)

Soils in this natural community are seasonally saturated or inundated for 1 to 2 months during growing season. Such conditions typically occur with a frequency ranging from 51 to 100 years per 100 years. (LDWF 2015f, page 24)

Typical threats to sweetgum-water oak forest include urban expansion, residential and commercial development, land disturbance operations, introduction of exotic species, and many other human and some natural disturbance factors (LDWF 2015f, page 2).

3.6.1.5.7 Spruce Pine-Hardwood Flatwood

Spruce pine-hardwood flatwood is indigenous to the western Florida parishes of southeast Louisiana. The wetland variant occupies poorly drained flats, depressional areas, and small drainages (sometimes called "slashes") that lie in a mosaic with higher, non-wetland areas which support a mesic variant. Both variants are distinguished by the prevalence of spruce pine (*Pinus glabra*) over loblolly pine (*Pinus taeda*), although loblolly is usually present at some level. Hardwoods usually dominate the forest, but spruce pine can dominate areas within the stand. (LDWF 2015g)

Soils in this natural community are hydric, acidic silt loams including the Encrow, Gilbert, and Springfield series. In addition, the soils are significantly higher in nutrient levels than those historically supporting the longleaf pine (*Pinus palustris*) communities occupying similar hydrologic settings immediately to the east. (LDWF 2015g)

Pre-settlement acreage is estimated at 50,000 to 100,000 acres with only 10 percent currently remaining. Threats to this natural community include residential or commercial development; construction of roads, pipelines, or utilities; conversion to slash or loblolly pine plantations; hydrological alterations (to include adjacent areas); and invasive exotic species. Spruce pine-hardwood flatwood occurs in a very narrow range in Louisiana in Livingston and East Baton Rouge parishes—and perhaps Ascension Parish—and in the Pontchartrain and Mississippi river basins. (LDWF 2015g)

#### 3.6.1.5.8 Mixed Hardwood-Loblolly Pine Forest

Mixed hardwood-loblolly pine forest is evenly distributed in a variety of ecological settings statewide on broad ridgetops and gentle side slopes in terrace uplands; on middle and lower slopes between uplands and stream bottoms; and at the heads of drainages along small, intermittent streams. Soils in this community are acidic sandy loams, silt loams, and silty clays; hydrology ranges from mesic-wet to dry-mesic. Loblolly pine accounts for 20 percent or more of the overstory, associated with various hardwood species. Available pine needle fuel indicates that regular fire was a process essential to maintaining a significant pine component and, without fire, forest succession is toward hardwood dominance. (LDWF 2015h)

This natural community is not as imperiled as many others in the state. Mixed hardwood-loblolly pine forest is estimated to have occupied 500,000 to 1,000,000 acres historically with the same amount thought to remain today. However, older, more natural examples of this habitat are threatened by conversion to pine plantations, agriculture, or other land uses. Other threats include construction of roads, pipelines, or utilities; invasive and exotic species; fire suppression; physical damage from timber harvesting; and contamination by chemicals (herbicides, fertilizers). Mixed hardwood-loblolly pine forest occurs in the upper and lower West Gulf Coastal Plain, and also in the East and upper East Gulf Coastal Plains of Louisiana. (LDWF 2015h)

#### 3.6.1.5.9 Hackberry-American Elm-Green Ash Forest

Hackberry-American elm-green ash forest occurs in floodplains of major rivers on low ridges, flats, and sloughs in first bottoms. Soils are seasonally inundated or saturated periodically for 1 to 2 months during the growing season. Such conditions occur with frequency ranging from 51 years to 100 years per 100 years. (LDWF 2015f, page 23)

Hackberry, American elm, and green ash are co-dominants. Common associates are water hickory, Nuttall oak, willow oak (*Quercus phellos*), water oak, overcup oak, sweet gum, box elder (*Acer negundo*), winged elm (*Ulmus alata*), red maple, water locust (*Gleditsia aquatica*), and American sycamore (*Plantanus occidentalis*). Understory species include swamp dogwood, hawthorn (*Crataegus* spp.), and red mulberry. Many vines and herbaceous plants are also present in this natural community. (LDWF 2015f, page 23)

Typical threats to hackberry-American elm-green ash forest include urban expansion, residential and commercial development, land disturbance operations, introduction of exotic species, and many other human and some natural disturbance factors (LDWF 2015f, page 2).

#### 3.6.1.5.10 Hardwood Slope Forest

Hardwood slope forest is more or less evenly distributed in uplands statewide, occurring on slopes (often steep) rising out of small stream floodplains. This natural community is dominated by hardwood tree species, with a generally sparse herbaceous layer; loblolly pine may be present but infrequent. Soils in hardwood slope forest are typically rich, mesic, silt loams, and silty clay loams with a pH range from acidic to circumneutral. (LDWF 2015i)

This natural community is estimated to have occupied 100,000 to 500,000 acres historically and, of that, an estimated 25 to 50 percent still remains. Fire occurred very rarely in hardwood slope forests, and insect and pathogen outbreaks are likely more important disturbance vectors in this community. Habitat conversion to pine plantations or residential uses; invasive and exotic species; construction of roads, pipelines, or utilities; and use of off-road vehicles all currently threaten long-term viability of these forests. Hardwood slope forest occurs in portions of the East Gulf Coastal Plain, upper West Gulf Coastal Plain, and lower West Gulf Coastal Plain. (LDWF 2015i)

#### 3.6.1.5.11 Southern Mesophytic Forest

Southern mesophytic forest developed on deep, fertile, circumneutral to slightly alkaline loessial deposits. These are highly erodible loess soils that have worn over thousands of years to form a characteristic well-dissected landscape of high, narrow ridges, steep slopes, and deep ravines. Topographic characteristics of the region create a relatively cool, moist micro-climate on the slopes and in the ravines. The landscape of this community is interlaced with streams of intermittent to continuous flow. Sustained localized populations of some characteristic Appalachian species, principally herbaceous, are thought to have originally migrated south ahead of advancing glaciers in the past ice-age. (LDWF 2015j)

Currently, only about 25 percent (50,000 to 100,000 acres) of Louisiana's southern mesophytic forests remain intact. Clearing for agriculture, timber harvesting, and development in West Feliciana Parish brought about loss, degradation, and fragmentation of these forests. The southern mesophytic forest type is extremely susceptible to soil damage, particularly erosion stemming from any form of disturbance, such as timber harvest, road building, and off-road vehicle use, which exposes bare soil. In such cases, the very steep slopes and loess soil result in frequent landslides. Invasive and exotic species, particularly Chinese parasol tree (*Firmiana simplex*), and residential development currently threaten long-term viability of these forests. Southern mesophytic forest in Louisiana is restricted to the northwestern Florida parishes, specifically the upper East Gulf Coastal Plain in West Feliciana Parish, Louisiana. (LDWF 2015j)

#### 3.6.1.5.12 Prairie Terrace Loess Forest

Prairie terrace loess forest is endemic to the flat to gently rolling Pleistocene prairie terraces of the western Florida parishes in Louisiana. This natural community is restricted to slowly permeable, relatively poorly drained, and somewhat acid to circumneutral, silt loam soils overlying loess deposits associated with the Mississippi River. Prairie terrace loess forest canopy is dominated by hardwood species with spruce pine as an occasional associate. This natural community is also characterized by high plant species diversity and shares many woody taxa in common with the closely related southern mesophytic forest. (LDWF 2015k)

Historically more widespread, intact occurrences of the prairie terrace loess forest have now become relatively rare, following initial conversion to agricultural uses and then more recent clearing for residential, commercial, and industrial development. Pre-settlement acreage was estimated at 500,000 to 1,000,000 acres with only 1 to 5 percent currently remaining. Other major factors threatening this natural community include hydrological alterations; construction of roads, pipelines, or utilities; and invasive exotic species. Prairie terrace loess forest is restricted to the East Gulf Coastal Plain in Louisiana, occurring in a very narrow range in Livingston and East Baton Rouge parishes—and perhaps Ascension Parish. (LDWF 2015k)

#### 3.6.1.5.13 Wetlands

As discussed in Section 3.6.4, the LMR once was dominated by swamps, marshes, and bottomland forests. Today, the ecoregion is heavily converted, with just under half of the ecoregion covered by forest. One-third has been converted to agriculture, and the remaining areas are composed of water, wetlands, urban, and barren areas. (FEOW 2014) The primary wetland types are freshwater emergent and freshwater forest/shrub. Wetlands are discussed in greater detail in Section 3.6.5.1.

#### 3.6.1.5.14 Regional Animal Communities

Historical changes in the vegetation have impacted the contemporary animal communities present in the region. Animals that occur in the region also are typically found on RBS property if appropriate habitats are available. Animals that may be commonly found on or in the vicinity of RBS property are presented in Table 3.6-1 and described in Section 3.6.7.

### 3.6.2 Site and Vicinity

RBS is located in the southeastern corner of West Feliciana Parish in eastern Louisiana near the southwest corner of Mississippi and approximately 16 miles south of the Louisiana-Mississippi border. The site is near the east bank of the Mississippi River, extending from RM 262 to 265

(Figure 3.5-1), approximately 24 miles north-northwest of Baton Rouge, Louisiana. (EOI 2008a, Section 2.1) Figure 3.0-4 shows the location of the RBS site in relation to the parishes and counties and larger cities and towns within the region. The community of St. Francisville is approximately 3 miles northwest of the RBS site, the town of New Roads is approximately 7 miles southwest of the RBS site, and the vicinity of the RBS site is mostly rural (EOI 2008a, Section 2.1).

The property boundary shown in Figure 3.0-1 encompasses the approximately 3,342 acres that compose the RBS site. There are no apparent erosion issues on the Mississippi River bank that would reduce the acreage of the RBS site (EOI 2008a, Section 2.1). Along this area of the Mississippi River, banks on outside bends of the river have been stabilized by rock and concrete structures called revetments. The inside bends have been stabilized by wing dams or dikes. Together, these structures serve to keep Mississippi River flow within the main river channel and prevent erosion of the banks. (EOI 2008a, Section 2.1)

The RBS site and its environs, consisting primarily of farmland and forests, lie within the Southern Hills section of the Gulf Coastal Plain physiographic province approximately 85 miles from the Gulf of Mexico. The entire Gulf Coastal Plain is a generally flat to gently sloping sedimentary plain. The predominant feature in this region is the Mississippi River with its approximately 45-mile-wide floodplain. At the RBS site, the river's natural levee has an elevation of about 46 feet amsl; the ground surface slopes downward toward the valley wall to the east, where its elevation is approximately 35 feet amsl. The southern portion of the RBS site (in the undeveloped areas surrounding the plant and its facilities) is rough and irregular, with steep slopes and deep-cut stream valleys and drainage courses. Ground elevations in this portion of the plant site range from approximately 35 amsl to more than 95 feet amsl inland. Elevations up to 150 feet amsl occur on the hilltops; most hilltop areas are at elevations near 100 feet amsl. (EOI 2008a, Section 2.1)

### 3.6.3 Potentially Affected Water Bodies

Aquatic resources at or in the vicinity of the RBS site with the potential to be affected by plant operations are the LMR, Alligator Bayou, and Grants Bayou (EOI 2008a, Section 2.4.2.1). These waterbodies and their resources are characterized in Section 3.6.6.

### 3.6.4 Ecological Resources History

The LMR ecoregion once was dominated by swamps, marshes, and bottomland forests (primarily oak-hickory-pine forests). Although these areas still exist in many places, they are not as extensive as in pre-settlement times. (FEOW 2014)

Ten thousand years ago, the Mississippi River was a continuum typical of a floodplain river. Beginning as a small stream in the forested headwaters of Lake Itasca, Minnesota, the river flowed through virgin forests and unbroken prairie to its deltaic outlet into the Gulf of Mexico in Louisiana. From headwaters to the mouth, the river increased in size and discharge, and decreased in slope. Initially, the young river flowed through a small valley bordered by wetlands and lakes. Along its downstream course, the river changed from a single to a braided channel in its mid-reaches and finally to a meandering, constantly changing channel downstream. Its valley changed rather steadily from a narrow floodplain flanked by tall bluffs upstream to a vast, flat floodplain downstream. (Schramm 2004, page 303)

Historically, the LMR overflowed onto a 30- to 125-mile-wide alluvial valley and, along with its tributaries, encompassed the largest floodplain fishery in North America. Because the river was continually creating and abandoning channels in its 15- to 30-mile-wide meander belt, the area was interspersed with permanent and seasonal wetlands. These wetlands flooded shallowly for extended periods almost annually, and there was a great diversity of aquatic habitat types. More than 150 species of fish were present. (USFWS 2015a)

Following European exploration and settlement of the area, sugarcane and cotton cultivation became the primary economic activities that affected the landscape, along with increased settlement (Section 3.7). Floods in 1849 and 1850, which caused widespread damage in the Mississippi River valley, revealed the national interest in controlling the mighty river. By 1879, the need for improvement of the Mississippi River had become widely recognized. The necessity for coordination of engineering operations through a centralized organization had finally been accepted and, accordingly, in that year the U.S. Congress established the Mississippi River Commission. (USACE 2015)

Major floods occurred again in 1912, 1913, and 1927. The flood of 1927 was the most disastrous in the history of the LMR valley at the time: an area of about 26,000 square miles was inundated; levees were breached; cities, towns, and farms were laid waste; crops were destroyed; and industries and transportation paralyzed. Out of that flood event grew the Flood Control Act of 1928, which committed the federal government to a definite program of flood control. (USACE 2015)

In its present form, the Mississippi River changes dramatically and rather incrementally along its journey from headwaters to the Gulf of Mexico. Dams have been built to form 11 small reservoirs and modify the elevation and discharge of several natural river lakes. These dams variously function for flood control, electricity generation, water supply, or recreation. (Schramm 2004, page 303) As a result, river-control structures (Section 3.5.1) have largely locked the river in place. Construction of levees along the Mississippi River and many of its tributaries has severed the floodplain from the river; throughout the LMR, the levees have severed connection of the river from 90 percent of its floodplain (Schramm 2004, page 305), denying fish and other aquatic species access to millions of acres of foraging, spawning, and nursery habitat. Virtually no new habitat is being created while existing floodplain lakes and secondary channels are gradually being lost due to sedimentation.

The LMR is particularly prone to point-source pollution because, over time, Arkansas and Louisiana have become home to many highly polluting industries (Janvrin 2009). In terms of human health, nitrate is the only nutrient compound that represents a problem in the Mississippi River system likely due to extensive agricultural areas adjacent to the Mississippi River basin. In addition to the public health question, nitrate represents an ecological problem as well. Because it is not removed quickly, nitrate is accumulating in the Gulf of Mexico. (Antweiler et al. 1995) Based on USGS monitoring, nitrate levels continue to increase in the Mississippi River, including the Mississippi's outlet to the Gulf of Mexico. Contributing factors to these increases include fertilizer use, livestock waste, agricultural management practices, and wastewater treatment. (USGS 2015i)

Natural catastrophes have also had considerable impact on the terrestrial communities in the site area. These disturbances have taken the form of meteorological phenomena, such as tropical storms or hurricanes. Hurricane winds have damaged a great deal of vegetation by blowing over trees and shrubs; spread salt or brackish water over large areas of freshwater marshes or land; and increased the spread of animals such as nutria (*Myocastor coypus*), a large semiaquatic rodent that consumes approximately 25 percent of its weight daily, feeding on the base of plant stems and digging for roots and rhizomes, and may construct burrows in levees, dikes, and embankments. (Entergy 2016j, Section 3.6.4; LDWF 2016)

As previously discussed, today the swamps, marshes, wetlands, and bottomland forests are not as extensive as in pre-settlement times. The LMR region is heavily converted, with just under half of the area covered by forest. One-third has been converted to agriculture and the remaining area comprises water, wetlands, urban, and barren areas. (FEOW 2014)

### 3.6.5 Places and Entities of Special Ecological Interest

On and within the vicinity of the RBS property are places and entities of special interest. These include wetlands and WMAs as described below.

#### 3.6.5.1 Wetlands

Wetlands historically have been prevalent throughout southern Louisiana. Wetlands are defined as those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. (USACE 1999) Wetlands are regulated by the USACE under Section 404 of the FWPCA and are delineated on the basis of the *Corps of Engineers Wetlands Delineation Manual* (EOI 2008a, Section 2.4.1.1.1).

Based on National Wetlands Inventory (NWI) data (USFWS 2015b), there are approximately 17,871 acres of wetlands within a 6-mile radius of RBS composed of the following types (Figure 3.6-1):

- Freshwater emergent wetlands covering approximately 465 acres (2.6 percent).
- Freshwater forested/shrub wetlands covering approximately 11,964 acres (66.9 percent).

- Riverine area covering approximately 4,552 acres (25.5 percent).
- Ponds and lakes covering approximately 890 acres (5.0 percent).

The property on which the RBS plant is located is a rather trapezoidal-shaped parcel that lies adjacent to the Mississippi River on the southwest side and is roughly bounded on the east by LA-10 and to the north by US-61. The RBS site is generally wooded except for developed areas. There is an extensive freshwater forested/shrub wetlands complex adjacent to the Mississippi River. Based on NWI data (USFWS 2015b), there are also two small parcels of freshwater emergent wetlands in the northwest portion of the property adjacent to a small pond (Figure 3.6-2). Just east of this complex is a small freshwater forested/shrub wetland. There are four small ponds scattered around the property: one in the southeast part of the RBS property and three scattered along the northern property boundary (Figure 3.6-2).

Based on NWI data (USFWS 2015b), there are approximately 726.3 acres of wetlands on the RBS property composed of the following types:

- Freshwater forested/shrub wetlands covering approximately 700.4 acres (96.4 percent).
- Freshwater emergent wetlands covering approximately 18.6 acres (2.6 percent).
- Freshwater ponds encompassing approximately 7.3 acres (1.0 percent).

#### 3.6.5.2 Wildlife Management Areas

In West Feliciana Parish there are several WMAs. These include Tunica Hills WMA, which has several biking and hiking trails through steep ravines, creek bottoms, and bluffs to the river and offers a wide variety of green growth and wildlife; Mary Ann Brown Preserve, owned by The Nature Conservancy of Louisiana, which consists of 109 acres of deep ravines, loblolly forest, and meadows; and Cat Island National Wildlife Refuge, which consists of 9,623 acres of wildlife refuge open to hiking, canoeing, birding, photography, and hunting and fishing. (City of St. Francisville 2015)

As discussed in Section 3.1.3, the RBS site is part of the LDWF-designated RBS Natural Area, a 550-acre portion of the site that contains one of the most species-rich, upland hardwood forests in the nation.

### 3.6.6 Aquatic Communities

Aquatic resources at or in the vicinity of the RBS site with the potential to be affected by plant operations are expected to be limited to a portion of the LMR, Alligator Bayou, and Grants Bayou (EOI 2008a, Section 2.4.2.1) (Figure 3.0-2). The subsections below address these aquatic resources and their associated biological characteristics. Because West Creek, which flows intermittently, is an onsite manmade drainage ditch that begins on the RBS property, and is not fed by any offsite streams, it is not being included in this discussion (EOI 2008a, Section 2.3.1.1.2).

### 3.6.6.1 Lower Mississippi River

The LMR comprises a vast alluvial valley that directs the Mississippi River and its tributaries to the Gulf of Mexico. The Mississippi Alluvial Plain is a broad, gently sloping floodplain that lies between Cairo, Illinois, and Baton Rouge, Louisiana. The Deltaic Plain is a complex system of distributaries and natural levees that extend out from the main stem of the Mississippi River and are associated with forested swamps and coastal marshes. The areas above and below Baton Rouge are two distinct components of the LMR, as described herein. Above Baton Rouge, the river ecosystem is quite variable; the main channel is deep with numerous meanders and floodplain habitats are present. Approximately 55 percent of the aquatic habitat is deep, swift channels, and 45 percent is slack waters. Dikes and revetments are common. Below Baton Rouge, the river channel is deeper and narrower with fewer meanders. Approximately 85 percent of the aquatic habitat is deep, swift channels. Revetments are used extensively in this section of the river to help prevent erosion. (EOI 2008a, Section 2.4.2.2.1)

RBS is located along the St. Francisville reach of the LMR. Bank width along this reach of the LMR ranges from 1,700 feet at RM 264 (northwest edge of the site) to 4,300 feet at RM 260 (southern edge of the site). Maximum depth is approximately 100 feet based on the average annual water level of 20.4 feet amsl. River gauge data collected at RM 228.4, just south of the RBS site from 2000 to 2007 indicate that the average river state is approximately 23 feet amsl. (EOI 2008a, Section 2.4.2.2.1)

River flow varies substantially throughout the year, and water levels fluctuate an average of 33 feet. Evaluations of the river flow near RBS, conducted in conjunction with the RBS3 COL application, indicate that the average velocity of the LMR is 3.88 fps, although historic hydrographic surveys performed at the RBS site recorded flows as high as 8.3 fps in the main channel of the LMR. Other hydrographic surveys performed on the LMR (RM 129.5) indicated that average seasonal flows are estimated to be 580,000, 650,000, 280,000, and 240,000 cfs for winter, spring, summer, and fall, respectively. The velocity in this portion of the river averages as high as 3.9 fps in April and as low as 1.1 fps (39-year average) in September. (EOI 2008a, Section 2.4.2.2.1)

A seasonal analysis of the ambient LMR temperature recorded at St. Francisville (RM 266) over a 27-year period (1980–2007) indicates that the lowest river temperatures occur in late winter months (January and February), and the highest river temperatures occur in mid-to-late summer months (July and August). Historic physicochemical surveys performed at RBS (1972–1977) documented surface water river temperatures ranging from 37.6°F to 88.7°F, with low and peak temperatures occurring in January and August, respectively. General characterizations of the LMR indicate annual temperature ranges, on average, from 64.4°F to 84.2°F in habitats near the RBS site. (EOI 2008a, Section 2.4.2.2.1)

Surface-to-depth dissolved oxygen profiles documented the highest dissolved oxygen concentrations under cooler water temperature conditions and lowest dissolved concentrations under warmer water temperature conditions. Because dissolved oxygen concentration is inversely related to water temperature (warmer water has a lower ability to retain oxygen than cooler water), seasonal fluctuations of dissolved oxygen are expected. LMR characterization studies indicate that average annual dissolved oxygen concentrations can range from 6 to 12 milligrams per liter (mg/L). Studies conducted during the period 2006–2007 downstream of the RBS at RM 129.5 documented similar seasonal fluctuations in water temperature and dissolved oxygen: cooler temperatures and higher dissolved oxygen concentrations occurred in winter months, and higher temperatures and lower dissolved oxygen concentrations occurred in summer months. Minimum and maximum recorded temperatures in this study were 43.52°F and 90.86°F, respectively. (EOI 2008a, Section 2.4.2.2.1)

The Mississippi River has always carried sand and sediment to the Gulf of Mexico. Agricultural development of the Mississippi River basin has increased sediment inputs; however, for the LMR, some increases have been offset by impoundment of the Upper Mississippi River, the Ohio River and, principally, the middle Missouri River. (Schramm 2004, page 319)

Sediment is transported by the Mississippi River as either a bed load or a suspended load. The amount of material in suspension is generally a function of river discharge, turbulence, particle size, and whether or not the flow is increasing or decreasing also appears to influence suspended sediment concentrations. During high flow, the sediment concentration generally increases downstream; the converse is true for low flows. Sediment size varies with depth, river mile, and discharge. In general, the percentage of coarser particles increases with increasing depth and river discharge. At a given discharge rate and depth, particle size decreases with increasing distance downstream. (Entergy 2016j, Section 3.6.6)

The Mississippi River is a highly turbid water body, with high current velocity and low habitat diversity. The productivity of the system is limited by light penetration and high suspended solids concentration, as well as the stability and habitability of the substrate. The Mississippi River food chain is considered to be detrital based, because phytoplankton occur in low densities and do not seem to be the major energy source that they constitute in more lake-like environments. This is typical of larger rivers in the Southeast and Midwest. (Entergy 2016j, Section 3.6.6)

Historic benthic studies conducted at the RBS site indicated that documented photic zone depths ranged from 8 to 21 inches. The most turbid water was found during the rising river stages, and there was generally a gradual change in benthic substrate moving across the river. In the deepest zones, coarsely textured sands were present, with gravel present in benthic zones exposed to repeated scouring. Medium-textured sand lined the channel slopes, with fine sand in shoal areas. Silt accumulation to 18 inches on top of fine sand or sandy mud was associated with slackwater zones. Firm clays occurred along the river banks adjacent to deep channels, while soft, organically rich mud was present along the west bank and along portions of the east bank. This type of sediment structure is common in large floodplain rivers. More recent river sediment characterizations performed for the Audubon Bridge project documented similar findings. (EOI 2008a, Section 2.4.2.2.1)

Attached aquatic vegetation is rare in the river because of the strong flows and heavy sediment loads characteristic of the LMR, which constantly scour benthic habitat. Vegetation is almost entirely limited to filamentous algae, which become established on floating and anchored objects, such as fallen tree trunk bases that are grounded along the banks. Willow seedlings (*Salix* spp.) and cockleburs (*Xanthium strumarium*) are common along the west bank of the LMR from RM 262 to RM 263 (near the RBS site). When these areas become inundated as a result of high water levels, these plants temporarily serve as cover for certain fish and invertebrates. Similar temporary stands of inundated vegetation, composed of willows and various grasses, were documented as occurring in small embayments along the east bank. (EOI 2008a, Section 2.4.2.2.1)

The populations of aquatic organisms in the LMR appear to be limited mainly by the poor spawning habitats and the effects of high turbidity, high concentrations of total suspended solids, high current velocities, and fluctuating water levels. The high turbidities restrict phytoplankton and periphyton growth due to very limited light penetration. Productivity of the phytoplankton is further limited by the high turbulence and mixing in the Mississippi River, which may prevent phytoplankton from remaining in the euphotic zone for sufficient lengths of time to effectively photosynthesize. High concentrations of suspended solids and high current velocities result in scouring of fish eggs and larvae (in nests or attached to submerged objects), scouring of benthic and periphyton communities, clogging of filter feeding mechanisms of invertebrates, and shifting bottom sediments. Resultant sediment deposition in areas with slower currents smother fish eggs and larvae as well as benthic organisms (both fauna and flora), further limiting their composition and density. (Entergy 2016j, Section 3.6.6)

The LMR is distinguished by its extraordinary species richness with regard to fish (FEOW 2014). Plentiful habitat is available for fish that thrive in swiftly flowing water, but few species can tolerate the high current velocities of the upper and middle water column of the channel. (Entergy 2016j, Section 3.6.6) The LMR is noted for its assemblages of large river fish, which include lamprey species (*Petromyzontidae*), sturgeon (*Acipenseridae*), the North American paddlefish (*Polyodon spathula*), gar (*Lepisosteus* spp.), and the bowfin (*Amia calva*). Many of these large river fish exhibit adaptations for the constantly turbid character of the Mississippi River. (FEOW 2014) Species less tolerant of high current velocities likely inhabit areas near the banks and channel bottom where the current is less severe (Entergy 2016j, Section 3.6.6).

As discussed in Section 3.5.4.1, RBS is located on segment 070201 of the Mississippi River that stretches from the Old River Control Structure to Monte Sano Bayou. This segment of the river is classified as suitable for primary contact recreation, secondary contact recreation, fish and wildlife propagation, and drinking water supply. Based on the LDEQ's 2014 *Louisiana Water Quality Inventory: Integrated Report Fulfilling Requirements of the Federal Clean Water Act, Sections 305(b) and 303(d)*, which was finalized in 2015, the Mississippi River segment on which RBS is located is not impaired (LDEQ 2015, Appendix A, page 66).

Aquatic habitats found in the LMR near the RBS site include seasonally inundated floodplains along the river levee, revetment banks, natural steep banks, and channels. A manmade, shallow-cut embayment houses the intake structure and barge slip. This area is most similar to the lotic sandbar habitat, because conditions in this habitat are quite similar to those of the channel habitat. Substrate in the embayment is predominant coarse sand and sandy muds, and this area is frequently disturbed for routine maintenance dredging. The seasonally inundated floodplains are heavily forested, except in those areas immediately adjacent to and in front of the intake pump house, barge landing area, and bermed access roads. These areas are mechanically cleared during plant ground maintenance activities. (EOI 2008a, Section 2.4.2.2.1.1)

The floodplain habitat comprises forested wetland communities and isolated sloughs that are infrequently flooded seasonally (flooding in these habitats is more commonly caused by the Alligator and Grants bayous watersheds). The natural steep bank habitats are located approximately 70 feet from the main bank inside the intake embayment. Otherwise, natural steep bank habitat is flush with the river bank. The manmade embayment is the dominant habitat for the intake structure. As previously mentioned, this habitat is similar to lotic sandbar habitat, consisting of moderate to high river flows, relatively cool water temperatures, high turbidities, and high suspended solids. Bank habitats in the vicinity of the RBS site are supported by various forms of revetment banking. Concrete mats, commonly referred to as revetment mattresses, support the upstream and downstream banks. Riprap and small boulders are interspersed along the bank-line of the manmade embayment and near the discharge outfall. (EOI 2008a, Section 2.4.2.2.1.1)

Aquatic populations in the LMR near the RBS site are categorized as vascular aquatic plants, invertebrates, benthic invertebrates (macroinvertebrates), and fish. They are discussed below.

#### 3.6.6.1.1 LMR Vascular Aquatic Plants near RBS

As discussed in Section 3.6.6.1, aquatic vegetation is rare in the river because of the strong flows and heavy sediment loads characteristic of the LMR, which constantly scour benthic habitat. Vegetation is almost entirely limited to filamentous algae, which become established on floating and anchored objects, such as fallen tree trunk bases that are grounded along the banks. For these reasons, macrophytes are sparse in the region of the site.

#### 3.6.6.1.2 LMR Invertebrate Populations near RBS

Plankton are small organisms that float throughout a water body. They can be broadly characterized as phytoplankton (autotrophic organisms), zooplankton (heterotrophic organisms), and ichthyoplankton (fish or invertebrate eggs and larvae). (Entergy 2016j, Section 3.6.6.1.2)

<u>Phytoplankton</u>

Phytoplankton communities of the Mississippi River main channel from Cairo, Illinois, to the Gulf of Mexico are limited due predominantly to high turbidity (Entergy 2016j, Section 3.6.6.1.2). An inverse relationship exists between phytoplankton density and turbidity. This is a common phenomenon in rivers and is due in part to the reduced light available for photosynthesis in highly turbid water. Most of the algae documented in historic studies (1974–1977) performed in the

LMR at the RBS site were periphytic or benthic forms that had been washed from substrates and had become suspended. True planktonic species within the LMR probably enter the river from bayous and other standing water areas. Others may originate in slower backwater areas and eddies upstream of the RBS area. Regardless of the source, these algae act as primary producers in the river, forming an important component of the aquatic food chain. It is important to emphasize, however, that the LMR is considered a detrital-based system. Phytoplankton are considered to be primary producers, but they do not compose the main source of energy for the food web in the LMR. (EOI 2008a, Section 2.4.2.2.1.1)

Since 1972, more than 110 taxa of planktonic algae have been collected from the river at the RBS site. In larger rivers like the LMR, phytoplankton speciation is often dominated by diatoms (*Bacillariophyceae*). This is thought to result from an interaction of hydrodynamic and biotic factors by which organisms of certain sizes and shapes are more likely to remain in suspension in the turbulent river waters. (EOI 2008a, Section 2.4.2.2.1.1)

Surveys documenting phytoplankton diversity and density in the LMR indicate wide variations in seasonal speciation and abundance. Plankton densities tend to be lowest in the winter and highest during the summer, with green (*Chlorophyta*) and blue-green (*Cyanophyta*) algae dominating in the summer and early fall, and golden algae dominant in the winter and spring. Diatoms are consistently abundant throughout the year. Distribution of phytoplankton within the river is extremely variable, although densities are usually greatest along the western shore (opposite the RBS site), particularly during low river stages. (EOI 2008a, Section 2.4.2.2.1.1)

Dominant plankton genera documented in this study are similar to those listed as being the most frequently encountered true plankton in larger rivers. Commonly occurring genera include diatoms, such as *Cyclotella*, *Celosira*, *Fragilaria*, *Synedra*, *Asterionella*, *Navicula*, and *Nitzchia* spp.; green algae, such as *Chlorococcales*, *Scenedesmus*, *Chlorella*, *Ankistrodesmus*, *Tetraedron*, and *Crucigenia* spp.; and blue-green algae, such as *Microcystis* and *Anacystis* spp. (members of *Cyanophyta*). (EOI 2008a, Section 2.4.2.2.1.1) Phytoplankton collected in the LMR at RBS are listed in Table 3.6-2.

<u>Zooplankton</u>

More than 140 invertebrate taxa have been identified in zooplankton samples of the LMR near the RBS site. In the historic surveys conducted at the RBS site that characterized the zooplankton community of the LMR (1974–1977), rotifers were identified as the dominant organism in the samples collected. Rotifers are a highly diverse class of aquatic microorganisms, with more than 100 species characterized as completely planktonic (most species are sessile or benthic). Densities in freshwater systems commonly range from 20 to 30 organisms per liter; however, productive systems have documented rotifer densities upwards of 25,000 organisms per liter (25 million organisms per cubic meter [m3]) and much greater. Common species include *Brachionus*, *Keratella*, *Polyarthra*, *Synchaeta*, and *Trichocera*. (EOI 2008a, Section 2.4.2.2.1.1)

The historic surveys performed at the RBS site (1974–1977) included two separate data analyses: one quantitatively characterizing the zooplankton community in the LMR near the RBS site, and the other examining zooplankton speciation in the vicinity of the RBS cooling water intake and discharge. As previously mentioned, rotifers dominated plankton tows conducted in the LMR. Other documented species included water fleas (cladocerans), copepods (mainly Diaptomidae and Cyclopidae), dipterans (midges), hydroids and bryozoan fragments, and Ohio River shrimp (*Macrobrachium ohione*) larvae. Highest densities were noted in late summer and early fall (July to September) months. Samples collected at the cooling water intake and discharge structures were dominated by copepods (members of Diaptomidae, Cyclopidae, and Temoridae), cladocerans (water flea, *Daphnia* spp.), and hydroid fragments. While Ohio River shrimp larvae were present in samples, they did not compose greater than 1 percent of the overall sample speciation (number per 100 $m^3$). This study also documented higher plankton densities in western bank samples than mid-channel and eastern bank (RBS site) locations. It was assumed that this difference could be attributed to slower river currents on the west side of the river (slight slackwater area formed along the west bank due to the easterly curve in the LMR). (EOI 2008a, Section 2.4.2.2.1.1)

Other plankton surveys performed downstream of the RBS site on the LMR documented high numbers of rotifers, cladocerans (*Daphnia* and *Ceriodaphnia* spp.), and copepods (members of Eucopedoda, Calanoida, and Cyclopodia). Plankton densities were highly variable from year to year; however, speciation remained relatively constant. (EOI 2008a, Section 2.4.2.2.1.1)

Ichthyoplankton

With the exception of a few channel dwelling and open water spawning species, most fish common to the LMR utilize backwater habitats for spawning activities. Larval fish (ichthyoplankton) are typically swept into the LMR during flooding and high water periods, because they have limited swimming capabilities and are usually distributed with the water currents. (EOI 2008a, Section 2.4.2.2.1.1)

Ichthyoplankton surveys characterizing both speciation and distribution of larval fishes (1974–1977) documented 45 species in the LMR near the RBS site. Four families: Sciaenidae (drums), Clupeidae (herrings), Cyprinidae (minnows), and Catostomidae (suckers) accounted for approximately 95 percent of the ichthyoplankton collected in these studies. Of these four families, freshwater drum (*Aplodinotus grunniens*) composed approximately 43 percent of the total fish documented. Gizzard and threadfin shad (*Dorosoma cepedianum* and *D. petenense*) were the second most abundant fish collected, representing 26 percent of the sample. The highest species diversity was documented in late spring and early summer months, corresponding with the spawning periods for most common LMR fish. (EOI 2008a, Section 2.4.2.2.1.1)

Ichthyoplankton density tended to be greater at shoreline stations than in the mid-river samples. Shoreline stations with higher surface velocities (eastern shore near the site, western shore upriver of the site) tended to have higher concentrations of ichthyoplankton. Shad, however, displayed very little horizontal variation at transects near the site and were more abundant along the shores at the upstream transects. Carp (*Cyprinus carpio*) were more abundant along the west shore and differed very little in distribution between transects. Minnows and shiners were also more abundant at shoreline stations with swift surface currents. (EOI 2008a, Section 2.4.2.2.1.1)

Diel distribution of ichthyoplankton was also documented during this study. Although no significant day-night differences in the total fish larval density were documented, certain taxa did exhibit periodicity. Suckers and threadfin shad were more abundant at night, while gizzard shad and drum were more abundant during the day. It was noted that differences in density between the stations were fewer at night, suggesting that net avoidance may have occurred at the slackwater shoreline stations during the day, possibly accounting for the higher densities reported for the swiftly flowing shoreline stations. (EOI 2008a, Section 2.4.2.2.1.1)

Ichthyoplankton studies conducted in the LMR near RM 133 at LaPlace (2002) investigated the relative abundance of egg and larval stages of fish that occur in natural steep bank and shallow-to mid-depths of the Mississippi River. Blue catfish (*Ictalurus furcatus*) accounted for 52.3 percent of all species collected, followed by freshwater drum at 11.5 percent. Channel catfish (*I. punctatus*) composed 4.2 percent of the catch. Centrarchids, including redear sunfish (*Lepomis microlophus*), longear sunfish (*L. megalotis*), largemouth bass (*Micropterus salmoides*), and white and black crappie (*Pomoxis annularis* and *P. nigromaculatus*), made up 0.5 percent of the relative abundance. (EOI 2008a, Section 2.4.2.2.1.1)

Additional literature searches yielded no more recent ichthyoplankton studies than those reported here.

#### 3.6.6.1.3 LMR Benthic Invertebrate Populations

Larger invertebrate animals that live in association with the bottom or submerged substrates, benthic macroinvertebrates, are the least studied organisms of the LMR (Entergy 2016j, Section 3.6.6.1.3). Limited studies in the region indicate this ecoregion supports a moderate number of unionid mussel and crayfish species compared to the Tennessee, Cumberland, and Teays-Old Ohio ecoregions to the north, but an impressive 58 percent of its crayfish species are endemic (FEOW 2014).

One of the best assessments of stream or water body integrity is the examination of its biological inhabitants. Because biological communities incorporate and reflect the quality of their surroundings, the presence or absence of certain types of organisms can be utilized as an ecological measure of fluctuating environmental conditions. (EOI 2008a, Section 2.4.2.6)

Stressor sensitive and tolerant species provide an effective mechanism to assess the condition of a water body. One such tool of aquatic macroinvertebrate community condition is the richness measure, the Ephemeroptera, Plecoptera, Tricoptera (mayflies, stoneflies, caddisflies) (EPT) index that is utilized as a measure of the degradation status of a site by documenting the presence or absence of key indicator species. (EOI 2008a, Section 2.4.2.6)

Other assessment tools for both aquatic macroinvertebrate and fish communities include the comparisons between reference/sample site conditions and upstream/downstream conditions measuring taxa richness and abundance. These assessments of benthic macroinvertebrates and fish provide insight into the relative condition of a water body. Because of their relative limited migration patterns or sessile mode of life, benthic invertebrates are well suited for assessing site-specific effects. Fish are good indicators of longer-term effects and broad habitat conditions because they are relatively long-lived and mobile. (EOI 2008a, Section 2.4.2.6)

Benthic macroinvertebrates representing 8 phyla, 57 families, and 145 species were identified from Alligator Bayou. This list included a wide range of organisms from tolerant to intolerant; feeding groups-scrapers, predators, collector-gatherers, collector-filterers, and shredders; and habitat categories for movement and positioning-swimmers, clingers, sprawlers, climbers, and burrowers. Fourteen of the 145 species (10 percent) were representative of the richness measure, EPT, indicating a low perturbation response. Fifty-one families from 8 phyla (representing 73 species) were documented from the Mississippi River near the RBS site. Twelve of the 73 species composed the EPT index measure and indicate a low perturbation response in the Mississippi River. Alligator Bayou, with its higher number of total taxa, was probably indicative of an increase in available habitat. Both systems appeared to be in relatively good condition, based upon these measures of biological integrity. (EOI 2008a, Section 2.4.2.6)

Diversity within the benthic communities can be directly related to substrate composition. Higher densities of benthic macroinvertebrates, such as oligochaetes, chironomids, and amphipods, are common to shallow depths with porous sediments, such as soft organic mud. Firm clays tend to limit benthic community diversity, due in part to the lack of organic elements for food and the compactness of soil particles. As previously described, soft muds are fairly common along the shoreline of the LMR near the RBS site, while sediments in the main channel of the LMR consist mainly of firm clays interspersed with gravel patches. This type of sediment distribution limits benthic community diversity to shoreline habitats, where suitable softer substrate is available. (EOI 2008a, Section 2.4.2.2.1.1)

Dominant benthic invertebrate communities within habitats of the LMR have been documented. As previously described, habitats types near the RBS site consist of channel, revetment bank, steep natural bank, and floodplain habitat. Oligochaetes (*Oligochaeta*) and midges (Chironomidae) are common throughout all habitat types. (EOI 2008a, Section 2.4.2.2.1.1)

From 1972 to 1977, benthic samples were collected quarterly at three locations on three transects across the LMR at the RBS site to characterize the spatial distribution of the benthic community. More than 70 taxa of benthic invertebrates were documented in this study. (EOI 2008a, Section 2.4.2.2.1.1)

Aquatic oligochaetes represented more than 58 percent of the organisms documented in these samples. All species identified in this study are universally distributed in freshwater habitats. Distribution within the LMR near the RBS site was documented to be patchy, with the largest organism concentration found in shoreline collections and fewer specimens captured in mid river samples. This is likely due to a lack of appropriate benthic habitat for these organisms in the main channel of the LMR, as previously discussed. Oligochaetes are demersal organisms that typically feed by burrowing into and ingesting the substrate. These organisms compose a large portion of the diets of bottom-feeding fish such as the freshwater drum. (EOI 2008a, Section 2.4.2.2.1.1)

Mayfly (Ephemeridae) larvae accounted for approximately 30 percent of benthic organisms collected in this study. These organisms were almost exclusively documented in areas near the east and west banks of the river. Mayflies are common to a variety of substrate types. Other dominant genera noted in the surveys included caddisfly (*Trichoptera*) and midge larvae. These species prefer calmer habitats, as evidenced by higher numbers collected in west bank samples, and are important in the diets of benthic-feeding fish. (EOI 2008a, Section 2.4.2.2.1.1)

It has been noted that seasonal fluctuations in overall benthic populations tend to be heavily influenced by river flow. Overall densities were generally lowest in the spring, when river flow was greatest and, therefore, most disruptive to the benthic substrates. In studies performed both during and after severe river flooding events, marked increases in the relative abundance of benthic animals were noted in the years following the flood event. Most of these increases were attributed to exceptionally high densities of oligochaete worms and mayfly larvae. The eastern banks of the LMR at the RBS site sustained significant damage during the documented flooding event. These banks slowly reverted to pre-flood conditions in the years following, resulting in the restoration of more stable clay substrates. (EOI 2008a, Section 2.4.2.2.1.1)

Harrison and Morse (2012) studied the food habits of sturgeon in the LMR to assess benthic macroinvertebrates. In 75 young-of-year sturgeon stomachs and guts, they found a total of 215 taxa of invertebrates representing nine classes, including 10 taxa not previously reported from the Mississippi River. Chironomids were the best represented family in the study.

Macrocrustaceans

The documented macrocrustacean community of the LMR in the vicinity of the RBS site consists of three main genera: river shrimp (*Macrobrachium* sp.), crayfish (*Procambarus* spp.), and grass shrimp (*Palaemonetes* spp.). Crayfish are of significant commercial importance in Louisiana; however, the commercial crayfish industry is more significant in waters of the Atchafalaya Basin rather than the LMR. (EOI 2008a, Section 2.4.2.2.1.1)

The Ohio River shrimp and grass shrimp dominated invertebrate seine catch in historic studies performed at the RBS site (1974–1977) and were repeatedly documented to dominate invertebrate catch in biological surveys performed on the LMR. Of the several species of grass shrimp, only two, *Palaemonetes paludosus* and *P. kadiakensis*, are common throughout Louisiana in the Mississippi River. The Ohio River shrimp is the most widely distributed and abundant river shrimp in the United States and is collected throughout Louisiana. (EOI 2008a, Section 2.4.2.2.1.1)

Mollusks

The Asian clam (*Corbicula manilensis*) and the zebra mussel (*Dreissena polymorpha*), both considered invasive aquatic (nuisance) species, and an unidentified unionid were the only three species of mollusks documented in biological surveys conducted on the LMR from the early 1970s to 2007 (EOI 2008a, Section 2.4.2.2.1.1). Zebra mussels are discussed further in Section 3.6.8.1. Because distribution of Asian clams is limited in Louisiana, with few species documented in benthic collections taken near the RBS site (EOI 2008a, Section 2.4.2.5), Asian clams are not discussed further in Section 3.6.8.1.

Additional literature searches yielded no more recent benthic invertebrate studies than those reported here.

3.6.6.1.4 LMR Fish Populations near RBS

Limited biological data for the LMR are available due to lack of appropriate sampling equipment and the availability of inland boats sized to handle a water body as vast as the Mississippi River. High water velocities, heavy boat and barge traffic, and the presence of obstacles and debris in the water column and on the bottom are common in the LMR and create safety concerns for routine sampling efforts. (Entergy 2016j, Section 3.6.6.1.4) Although no thorough ichthyofaunal surveys have been conducted in at least the past 30 years, additional inventories have been compiled since 1989 (Schramm 2004, page 307). Because the LMR is so large, has swift currents, and carries a significant amount of barge traffic, it is very dangerous to collect fish samples of any type. In particular, ichthyofaunal sampling would be both very difficult and dangerous. In more recent times, there has been little interest in undertaking such dangerous fisheries sampling.

The LMR provides plentiful habitat for fish that thrive in swiftly flowing water, but few species can tolerate the high current velocities of the upper and middle water columns of the channel. Most fish inhabit areas near the banks and the channel bottom where the current is slower. Several fish species forage in the floodplain of the LMR when it is inundated by high water levels; these species include gar, bowfin, common carp, buffalo (*Ictiobus* sp.), river carpsucker (*Carpiodes carpio*), channel catfish, blue catfish, white bass (*Morone chrysops*), crappies, and freshwater drum. Many fish also use the inundated floodplain for spawning. Densities of larval fish in the LMR are highest in backwaters, which are important nurseries for fish and contain a larval fish assemblage differing from that of the main stem river. (EOI 2008a, Section 2.4.2.2.1.1)

Spatial differences in population densities are caused by many factors, including habitat, water depth, and velocity. Most studies show higher fish densities at the channel bank and backwaters compared to the main channel. This is primarily due to increased habitat area, shallow water depths, and reduced river velocities. Most fish species found in the channel prefer the channel bottom where the current is slower. These species are usually represented by larger specimens of these species, such as freshwater drum, buffalo, common carp, and catfish. Most fish likely inhabit areas near the banks, and most generally prefer the shallow, slower inside edge of a river as opposed to the deeper, faster current of the cut-bank edge. Because many fish exhibit a specific preference for certain types of habitat, stream or river locations with diverse habitats may be expected to contain more fish species than locations with fewer habitat types. (EOI 2008a, Section 2.4.2.2.1.1)

Vertical distribution of fish is patchy, with the highest numbers at the river surface and at the bottom, while the mid-depth is virtually devoid of fish, probably because of the very high currents located mid-depth. Large floodplain rivers like the Mississippi are dynamic and made up of several diverse ecosystems composed of several habitats, including the main channel, side channel, floodplain, and backwater lakes that allow a diverse assemblage of organisms to persist. A total of 195 species of freshwater fish have been recorded as occurring in the main stem of the Mississippi and Atchafalaya rivers, representing almost one-third of the freshwater fish species in North America. Sixty-seven species inhabit the headwaters, 132 species inhabit the Upper Mississippi River, and approximately 150 species inhabit the LMR and Atchafalaya River. Other studies have estimated that 91 species of freshwater fish inhabit the LMR, with 30 or more other species present intermittently. The most common freshwater species in the LMR include the gizzard shad, threadfin shad, goldeye (*Hiodon alosoides*), carp, river carpsucker, smallmouth buffalo (*Ictiobus bubalus*), blue catfish, channel catfish, flathead catfish (*Pylodictis olivaris*), river shiner (*Notropis blennius*), and freshwater drum. Bluegill (*Lepomis macrochirus*), largemouth bass, and black and white crappie are also fairly common. In addition to the fish, river shrimp, grass shrimp, and crayfish are abundant. (EOI 2008a, Section 2.4.2.2.1.1)

Two major conclusions can be drawn from extensive literature review regarding fisheries in the LMR: (1) population density and diversity are higher in the channel border and backwaters than in the main channel, and (2) the overall fisheries in the LMR have not changed substantially since the 1970s. The following are detailed descriptions of several site-specific quantitative fisheries studies supporting these conclusions. (EOI 2008a, Section 2.4.2.2.1.1)

1972–1977 Study

Eighty-eight species were documented in the historic studies (1972–1977) performed in the LMR at the RBS site, with 39 species noted as common to abundant. Fish documented in this study are similar to those identified in other studies characterizing fish of the LMR. (EOI 2008a, Section 2.4.2.2.1.1)

Several gear types were utilized in sample collection. Gizzard shad and freshwater drum were most commonly captured in the trammel net samples, with blue catfish, white crappie, bowfin, carp, and flathead catfish also documented in these catches. Hoop and trap net collections yielded freshwater drum, gizzard shad, and flathead catfish. Seine collections yielded a variety of shiners such as river shiner, blacktail shiner (*Cyprinella venusta*), emerald shiner (*Notropis atherinoides*), and silverband shiner (*Notropis shumardi*), as well as other smaller bodied fish, such as mosquitofish (*Gambusia affinis*) and chubs, not well represented in hoop net and trammel net collections. Fish diversity was highest in the spring and summer, and summertime catches yielded the highest numbers of fish. Samples collected during periods of high river flow yielded a higher diversity in fish speciation that is likely due to an influx of extra-riverine species resulting from increased connectivity to floodplain and backwater habitats. (EOI 2008a, Section 2.4.2.2.1.1)

Spatial distribution of adult fish was also examined in this study. Although the specific locality of habitat was not described, some details as to the habitat types that commonly documented species were associated with were recorded. Blue catfish, goldeye, mooneye (*Hiodon*), speckled chub (*Macrhybopsis aestivalis*), sauger (*Sander canadensis*), and shovelnose sturgeon (*Scaphirhynchus platorynchus*) were commonly associated with swiftly flowing areas containing clean, fine sand substrate. Shad (*Alosa sapidissima)*, silvery minnows (*Hybognathus nuchalis*), striped mullet (*Mugil cephalus*), and river carpsucker were common to shallow embayments near sandbars and in calm pools downstream of sandbars. Carp, pugnose minnows (*Opsopoeodus emiliae*), bullhead minnows (*Pimephales vigilax*), bowfin, needlefish (*Strongylura* sp.), mosquitofish, silversides (*Labidesthes sicculus* and *Menidia beryllina*), and sunfish (*Lepomis* sp.) were common in slackwater habitats. (EOI 2008a, Section 2.4.2.2.1.1)

1991 Study

Based on a 1991 study, there were a total of 63 species of fish associated with natural steep banks and channels, 49 species with sandbars, and 70 species within the seasonally inundated floodplains that include oxbow lakes, sloughs, and barrow pits documented in the LMR. The smaller seasonally inundated floodplain areas (i.e., flooded areas lacking ponds) are similar; however, they commonly support fewer permanent species. Of the 63 species associated with natural steep banks and channels, 25 species appear to be common to abundant in natural steep bank habitats, and 13 are common to abundant in channel habitat. Similarly, 24 are common to abundant in the floodplain areas. A review of the data collected at and near the RBS site during the periods 1974–1979 and 2000–2001 suggests that the common to abundant species documented during the study are not significantly different from those previously characterized. (EOI 2008a, Section 2.4.2.2.1.1)

2002 Study

Habitat types were analyzed in 2002 at Mississippi River RM 132.2 as part of the 316(b) demonstration study for a new power plant and cooling water intake structure. It was determined that although there are 13 distinct habitat types found in the LMR, only a few dominate the river's landscape in the lower reaches. Researchers used previously developed habitat indices to determine a species' abundance potential in the study area. They defined 13 habitat zones as "habitat zone distribution," which is the correlation of a species to its preferred habitat throughout its life cycle. Preferred habitat also includes "habitat range distribution," which is the water column distribution most favored by the species throughout its life cycle. (EOI 2008a, Section 2.4.2.2.1.1)

Gizzard shad were noted as abundant to common in all habitat zones except for the channel, where they are considered uncommon. Threadfin shad are considered abundant or common in most habitats except lotic sandbars (similar to the manmade embayment habitat) where they are considered uncommon. No ranking was given for threadfin shad in the channel. Freshwater drum are considered abundant or common in all habitats except floodplain ponds where they were not given a ranking. Freshwater drum are considered common in the channel. (EOI 2008a, Section 2.4.2.2.1.1)

By examining habitat types available for fish in the LMR near the RBS site, general assumptions can be made about the speciation of fish communities residing in the area. As previously discussed, four habitat types (channel, natural steep bank, revetment bank, and manmade embayment) are available to fish at the RBS site. (EOI 2008a, Section 2.4.2.2.1.1) Table 3.6-3 lists fish species of the LMR commonly found near RBS and common to these types of habitats. Species commonly found at the RBS site (documented in both historic and recent surveys) are similar to those documented in the 1991 study as common to these types of habitats, as well as those species documented in other studies. This finding emphasizes that the fish community of the LMR is fairly stable and that current fish speciation would be similar to documented historic populations. (EOI 2008a, Section 2.4.2.2.1.1)

As discussed above, the manmade intake embayment, which houses the intake structure, is similar in habitat dynamics to the lotic sandbar habitat. Because strong currents and mobile bed materials characterize this type of habitat, few fish are adapted to survive in these types of conditions; therefore, it is likely that fish populations would be limited in the intake embayment area. (EOI 2008a, Section 2.4.2.2.1.1)

2007 Comparative Study

A comparative analysis of 1977–1979 and 2000–2001 fish samples collected near St. Francisville and the RBS site (RM 240 to RM 273) was performed in 2007. The studies examined for this analysis documented 79 species of fish as common to scarce; no threatened or endangered species were encountered in either set of samples. A variety of gear was utilized during sampling efforts to ensure completeness of qualitative samples. Minnows (blackspotted topminnow [*Fundulus olivaceus*], silvery minnow, emerald shiner, mimic shiner [*Notropis volucellus*]), and shad were the most commonly collected species in both sets of samples examined, consistent with other studies conducted on the LMR (specifically, the historic RBS studies). Additionally, samples collected in the immediate vicinity (less than 1 mile radius) of the RBS site were split out to highlight the fish captured. Minnows and shad were again the most abundant species documented. Several statistical analyses were performed to aid in a more even comparison of the two studies. Final conclusions stated that the fish communities identified in both historic and recent surveys are similar, indicating that the fish community of the LMR near the RBS site is relatively stable, and speciation of common fish has not changed significantly since historic studies (1970s) were performed. (EOI 2008a, Section 2.4.2.2.1.1)

2014 Study

In a study by Miranda and Killgore (2014) to identify patterns in fish benthic distribution along depth gradients in the LMR, fish were collected over 14 years in depths down to 88 feet. Fish exhibited non-random depth distributions that varied seasonally and according to species. Species richness was highest in shallow water, with about 50 percent of the 62 species no longer collected in water deeper than 26 feet, and about 75 percent no longer collected in water deeper than 39 feet. Although richness was highest in shallow water, most species were not restricted to shallow water. Rather, most species used a wide range of depths. A weak depth zonation occurred, not as strong as that reported for deep oceans and lakes. Larger fish tended to occur in deeper water during the high-water period of an annual cycle, but no correlation was evident during the low-water period.

3.6.6.1.5 LMR Commercially Important Species

The freshwater commercial industry in the LMR corridor naturally depends on the Mississippi River. However, most of the freshwater catch takes place away from the main stem of the Mississippi. The strong and fast moving current of the river, along with heavy commercial navigation traffic, puts fishing vessels and fishing equipment at high risk. Consequently, most freshwater commercial fishing takes place on LMR tributaries. (IEC 2014, page 2-12) Table 3.6-4 lists the commercially important fish species in the vicinity of RBS.

Except for Louisiana, the LMR states do not report freshwater fishing data at county/parish level. Louisiana's landing from the LMR parishes in 2011 was 8.8 million pounds of crayfish and almost 11 million pounds of finfish, producing $13.2 million total in revenues. (IEC 2014, page 2-12) These harvest amounts vary from those reported in 2004.

In 2004 as now, the largest freshwater fishing harvest in the LMR was in Louisiana. Crayfish (approximately 14 million pounds, valued at about $7.1 million) and catfish (approximately 6 million pounds, valued at about $2.2 million) were the two most prominent commercial species harvested in Louisiana. Other significant commercial species reported in 2004 include buffalo (1.35 million pounds, valued at about $318,000) and gar (393,000 pounds, valued at about $427,000). The total economic value of the freshwater harvest in Louisiana reported for 2002 was approximately $10.3 million. (IEC 2004, page 2-9)

<u>Fish</u>

Commercial harvest in the upper Mississippi River is dominated by four groups of fish including the common carp, buffalo (bigmouth and smallmouth), catfish (channel and flathead), and freshwater drum, which together represent 95 percent of the total commercial catch in the upper Mississippi River and 99 percent of the monetary value. The common carp has ranked first among species in commercial catch for decades. (EOI 2008a, Section 2.4.2.3)

The same species harvested in the upper Mississippi River also dominate the commercial fisheries for the freshwater portions of the LMR. Commercial harvest of fish in the LMR is difficult to assess because of inconsistencies in methods of gathering and reporting data; however, limited information indicates commercial harvest is increasing. Neither the commercial nor recreational fisheries appear to be over harvested; however, future fisheries production may be threatened by loss of aquatic habitat, altered spatial and temporal aspects of floodplain inundation, and nuisance invasions. In addition, navigation traffic affects fish survival and recruitment via direct impacts and habitat alteration and is expected to increase in the future. (EOI 2008a, Section 2.4.2.3)

Historic catch data (1976) indicated that commercial landings of finfish for Pointe Coupee and West Feliciana parishes totaled less than 500,000 pounds, approximately 6 percent of the Louisiana inland landings for that year. The principal commercial fish in the area are shad, buffalo, and catfish. No data are available on sport fisheries in this area; no organization in the state compiles creel census information or estimates sport fishing effort. Blue catfish, flathead catfish, and freshwater drum are most likely the most popular sport catches in this area of the river. (EOI 2008a, Section 2.4.2.3)

National Marine Fisheries Service (NMFS) statistics for 1954 to 1977 show catches of approximately 13.2 to 26.5 million pounds and increasing over time in the LMR. Landings of blue catfish and flathead catfish have increased substantially, while harvests of common carp, buffalo, channel catfish, and freshwater drum have been highly variable. Currently, in Louisiana, the commercial catch is measured, but not assigned to specific waters. (EOI 2008a, Section 2.4.2.3)

Schramm (2004, page 318) reported that estimated fish harvests from the Mississippi River fell within the realm of expected harvests, based on global harvest-drainage area and harvest-river length relationships developed for large rivers. Further, small and trendless variations in catch over 25 years (1954–1977) and stable catch at varying effort levels have led to the conclusion that the Mississippi River was harvested at near optimal levels. The average harvest for the LMR was 12,125 tons, and average effort was 7,000–8,000 fishers per year during the 25-year period. At this time, the commercial fish stocks in the Mississippi River appear stable and, at least in portions of the LMR, may support additional harvest.

Current commercial and recreational fish catch data are not available for West Feliciana Parish; landings data (LMR or otherwise) have not been recorded by the LDWF (EOI 2008a, Section 2.4.2.3).

<u>Macrocrustaceans</u>

The Ohio River shrimp is the most common freshwater shrimp in Louisiana and can be found in the LMR, where almost all of the current production is used for bait. However, little documented information is available on commercial or recreational catches, as the NMFS and the LDWF no longer maintain catch records for this species in Louisiana. (EOI 2008a, Section 2.4.2.3)

Crayfish are exploited for use as food, scientific specimens, and fish bait. An estimated 90 to 95 percent of crawfish produced for consumption are generated in Louisiana, mostly through aquaculture; commercial fishing of wild crawfish accounts for less than 20 percent of Louisiana crawfish production. The LDWF is charged with the management of Louisiana wild crayfish stocks; most wild production is supported by the Atchafalaya Basin. Only limited sport fishing for crayfish, mainly by local residents, is known to occur in the West Feliciana Parish. (EOI 2008a, Section 2.4.2.3)

Current commercial and recreational crustacean catch data are not available for West Feliciana Parish; landing data (LMR or otherwise) have not been recorded by the LDWF. (EOI 2008a, Section 2.4.2.3)

#### 3.6.6.1.6 LMR Recreationally Important Species

Fishing on the main LMR channel with its deep waters, fast current, and commercial navigation traffic is challenging. However, there are numerous options for LMR anglers to fish in tributaries, secondary channels, oxbows, backwaters, and along sandbars. The main species of sportfish fish in the LMR corridor include bass (*Micropterus* sp.), freshwater drum, sunfish, crappie, bluegill, and catfish. Catfish are probably the most popular fish among anglers on the LMR, and include blue catfish, channel catfish, and flathead catfish. (IEC 2014, pages 3-5 and 3-6) Table 3.6-4 lists the recreationally important fish species in the vicinity of RBS.

Schramm (2004, page 319) reported that although the Mississippi River is a bountiful recreational fishing resource, the recreational fishery has not been measured in the LMR reaches of the open river. Personal observations (i.e., by Schramm) on the LMR suggest that freshwater fishing catch rates are relatively high, but effort and thus catch and harvest, are extremely low. Because of the large size, swift, and dangerous currents, the presence of large commercial craft, and lack of public access, recreational fishing on the LMR has been largely discouraged. Providing access is difficult because of the large annual fluctuations in river level and separation of many of the remaining floodplain lakes from the river during low water stages.

Although catfish are important to both recreational and commercial fisheries, and channel catfish suffered overfishing before increasing the minimum length limit, recreational fish stocks do not presently appear overfished and, especially in the LMR, can withstand increased harvest. (Schramm 2004, page 319)

### 3.6.6.2 Alligator Bayou

The upper portion of Alligator Bayou is formed by Alexander Creek as it flows into the floodplain and Wickliffe Creek. The bayou widens as it enters Needle Lake (also known as Grassy Lake) and continues intermittently southward where it is joined by Grants Bayou before flowing into Thompson Creek. The Alligator Bayou system is an organically rich system that is subject to periodic inundation by the Mississippi River from overbank flooding and backwater from Thompson Creek. The bayou is completely flooded by the Mississippi River when the river level exceeds 37 feet amsl because river water flows over the levee directly into the bayou. Partial flooding of the bayou can be expected during high river stages because of backflow into the bayou from Thompson Creek. Bayou flooding as a result of high river stage can last for extended periods of time, while rainfall-induced flooding typically subsides after 12 hours. (EOI 2008a, Section 2.4.2.2.2)

The biota of the bayou is highly productive due to material deposited during periods of inundation or runoff. Alligator Bayou is littered with natural detritus and forest debris, which contributes to the high organic load of Alligator Bayou as it slowly decomposes. Substrate throughout the bayou consists of thick mud to mud-muck, interspersed with logs and stumps. (EOI 2008a, Section 2.4.2.2.2)

Shallow embayments along Alligator Bayou contain dense stands of rooted aquatic vegetation. Thick mats of stonewort (*Nitella* sp.) and strands of water starwort (*Callitriche heterophylla*) are present from late winter to early summer; perennial emergents, such as hedge hyssop (*Gratiola virginica*), pickerelweed (*Pontederia cordata*), giant cutgrass (*Zizaniopsis miliacea*), arrowhead (*Sagittaria* spp.), sedges (Cyperaceae), and rushes (Juncaceae), are present year-round. These are an important refuge for young salamanders, fish, crayfish, and a variety of other aquatic species. Panic grass (*Panicum gymnocarpon*) grows as an emergent aquatic plant and is the predominant ground cover throughout the bayou. Also important in the area is the epiphytic liverwort (*Porella* sp.), which grows on inundated parts of living wood and is particularly partial to the roots, trunks, and knees of the bald cypress. Scattered specimens of lizard's tail (*Saururus cernuus*) and smartweed (*Polygonum* spp.) are also present. (EOI 2008a, Section 2.4.2.2.2)

Benthos

The Alligator Bayou watershed exhibits a more diverse benthic community than that of the LMR near the RBS site, as more than 150 taxa of invertebrates were collected during historic studies (1972–1977). Dominant benthic organisms in the bayou areas surveyed include aquatic oligochaetes and dipteran (mainly midge and phantom midge) larvae. (EOI 2008a, Section 2.4.2.2.2)

The Alligator Bayou watershed provides a diversity of habitats, ranging from Alexander Creek (flowing stream areas) to Needle Lake (standing water with dense aquatic vegetation). The bayou is also less subject to the frequent scouring and high turbidity that are common in the LMR. (EOI 2008a, Section 2.4.2.2.2)

Macrocrustaceans

Crayfish are the most abundant macrocrustacean documented in the Alligator Bayou watershed. They are common inhabitants in most types of running, shallow water in lakes, ponds, sloughs, swamps, underground waters, and even wet meadows and ditches. During the day, adults remain hidden in their burrows under stones or debris, or half-buried in small depressions in the substrate. As opportunistic omnivores, crayfish feed primarily on detritus and its associated microbiota and animal material, with feeding occurring between dusk and dawn. When vegetation is not abundant, crayfish can become scavengers and are effective predators of gastropods. Crayfish are a major food item in the diet of reptiles, amphibians, fish, birds, and mammals. (EOI 2008a, Section 2.4.2.2.2)

Fish

Sixty-four fish species have been documented to occur in Alligator Bayou. More than 50 percent of the species documented in Alligator Bayou are considered common to abundant in the Alligator Bayou watershed. Juvenile and sub-adult freshwater drum, river carpsuckers, and various buffalo species were commonly collected, with few adults documented, indicating that these species probably utilize the bayous for nursery and rearing grounds, moving out to the LMR as adults. (EOI 2008a, Section 2.4.2.2.2)

Ichthyoplankton sampling data emphasize the greater diversity and abundance of larval and early juvenile fish in the inundated floodplain compared to the main river channel. These data support the hypothesis that floodplains tend to be relatively more important as spawning and/or nursery areas than main stream channels. Bowfin, gizzard shad, and carp were captured traversing the culverts. Nine more species and three times as many fish occurred below the access road than above it. Besides shad, the migratory shortnose gar (*Lepisosteus platostomus*), skipjack herring (*Alosa chrysochloris*), common carp, buffalo, and white bass were found less often and in much lower numbers per unit of effort above the access road. (EOI 2008a, Section 2.4.2.2.2)

#### 3.6.6.3 Grants Bayou

Grants Bayou is an intermittent stream comprising three segments (east fork, west fork, and bayou proper) that flow south to join Alligator Bayou approximately 1.5 miles above Thompson Creek. The west fork of Grants Bayou and the bayou proper join together and flow through the RBS site. The east fork joins the bayou proper below the RBS site, where the bayou continues on for 2 miles. The predominant substrate for all three segments is shifting sand, with occasional patches of fine gravel and infrequent exposures of firm clay. (EOI 2008a, Section 2.4.2.2.3)

Winter and spring bring continuous flows through the entire bayou system. The channel width ranges between 3 and 30 feet, and depths can reach 3.5 feet, although the bayou is typically less than 1 foot deep and subject to intermittent pooling throughout the remainder of the year. During flood events on the LMR, Grants Bayou is not directly affected by river waters, with the exception of areas of the bayou's confluence with Alligator Bayou. (EOI 2008a, Section 2.4.2.2.3)

Fish

Twenty-three fish species (among them gizzard shad, shiner, minnow, mosquitofish, sunfish, bluegill, and largemouth bass) have been documented as occurring in Grants Bayou. Studies have determined that, because of the intermittent nature of the bayou and its associated streams, few species are able to maintain populations in the pools during dry periods. At times, several of the sites set for sampling dried entirely; however, the few species associated with these areas were quick to recolonize the streams upon return of water flow. (EOI 2008a, Section 2.4.2.2.3)

### 3.6.7 Terrestrial Communities

The RBS region overlaps the Mississippi Valley Alluvial Plain and the Mississippi Valley Loess Plains ecoregions. The Mississippi Alluvial Plain ecoregion consists of a broad, flat alluvial plain with the main features of relief being river terraces, swales, and levees. Soils of the alluvial plain are fine-textured and poorly drained. Where the land has not been cleared for agriculture or other development, bottomland deciduous forest dominates the landscape.

The Loess Plains (wind-deposited) consist of gently rolling coastal plains that are moderately dissected by low gradient streams with silt and sand bottoms. The Loess soils are slightly coarser and better drained than those of the alluvial plain. Oak-hickory and oak-hickory-pine forests were the natural vegetation of this ecoregion. Today, the area is a mosaic of cleared or brushy pastures, young cut-over forest, pine plantations, and only small parcels of natural forest. (EOI 2008a, Section 2.4.1)

### 3.6.7.1 Principal Plant Communities

Figure 3.1-1 illustrates the extent and location of the terrestrial habitats and developed areas of the RBS site. Naturally occurring non-forested areas are essentially not present on the site. Non-forested areas, aside from developed areas, include small areas of open water, mowed lawns, maintained transmission line corridors, and a few areas cleared in the past but now in the early stages of succession; these areas are dominated by mostly planted grasses and invasive shrubs. Most of the RBS site was logged in the past with some areas cultivated, which accounts for the lack of large specimen trees on the site and the overall reduced diversity of plants found in previously disturbed portions of the site. (EOI 2008a, Section 2.4.1.1.1)

Preoperational studies conducted in the 1970s of the flora at the RBS site identified approximately 150 species present. This should be considered a conservative number of taxa because, in many instances, plants were not identified beyond genus. For example, smartweed is represented on the site by at least three species; sedge (*Carex* sp.) could be represented by 10 or more species; long-leaf spikegrass (*Chasmanthium sessiliflorum*) was not listed, yet is common in the upland forested areas. None of the species newly listed herein for the site are considered rare or otherwise unusual, and many are introduced or otherwise weedy species. The following paragraphs describe the terrestrial habitats at the RBS site on the basis of these surveys. (EOI 2008a, Section 2.4.1.1.1)

#### 3.6.7.1.1 Bottomland Forest

The bottomland forest region of the RBS site occupies approximately 19 percent of the property. Wetlands compose the majority of the area according to USACE guidelines, based on the vegetation, soils, and hydrology present. In this discussion, the bottomland forest is divided into four areas: Bottomland Developed, Bottomland Forest (Bald Cypress/Tupelogum), Bottomland Forest (Tupelogum/Hackberry), and Bottomland Forest (Hackberry/Boxelder/Ash). (EOI 2008a, Section 2.4.1.1.1)

#### 3.6.7.1.2 Bald Cypress/Tupelogum

In this area, the soils are mostly permanently saturated. The plant community is adapted to inundation, but is capable of withstanding periods of drought. Bald cypress and tupelo gum dominate the forest. Red maple and green ash are much less common, but are sometimes found in the area. Buttonbush is a fairly common shrub, especially where the canopy is broken. In areas where there is permanent standing water, there may be dense blooms of watermeal (*Wolffia* spp.) and duckweed (*Lemna* spp.) floating on the surface. (EOI 2008a, Section 2.4.1.1.1)

#### 3.6.7.1.3 Tupelogum/Hackberry

The bottomland hardwood communities such as the tupelo gum/hackberry and hackberry/ boxelder/ash intergrade with each other on the floodplain. Tupelo gum/hackberry communities tend to occur in low-lying, poorly drained flats and often are in close proximity to bald cypress. Tupelo gum and sugarberry (*Celtis laevigata*) dominate, but red maple, green ash, and oaks (*Quercus* spp.) as well as other tree species are present. Herbaceous vegetation varies depending on how an area has been subjected to inundation, scouring, or prolonged drought. For instance, smartweed could dominate an area subjected to early season inundation and summer drawdown, while sedges and rushes might dominate an area that is usually wet but not inundated. (EOI 2008a, Section 2.4.1.1.1)

#### 3.6.7.1.4 Hackberry/Boxelder/Ash

Compared to the tupelo gum/hackberry community, this community occurs in slightly elevated areas where soils are better drained. However, the community is subject to periodic flooding. The tree canopy dominating the community includes sugarberry, box elder, and green ash, but many other species, such as eastern cottonwood (*Populus deltoides*), black willow (*Salix nigra*), oaks, and sweetgum occur. The understory tends to be brushy with saplings of the same tree species and vines, such as grapes (*Vitis* spp.) and briars (*Smilax* spp.). (EOI 2008a, Section 2.4.1.1.1)

#### 3.6.7.1.5 Upland Forest

Upland forest dominates the Loess Plains in the RBS region. The canopy of this hardwood forest is not dominated by a few species, but rather co-dominated by a variety of species, such as the tulip tree (*Liriodendron tulipifera*), water oak, Shumard's oak (*Quercus shumardii*), red mulberry, and sweetgum. Although pines (*Pinus* spp.) are present on the RBS site, they are not native. The diversity of species found in the understory and as ground cover varies across the site and is largely dependent on the extent to which and how recently the area was disturbed. In general, areas to the immediate east of Powell Station Road have little ground cover and, in some cases, support a remarkable variety of introduced shrubs and vines, such as privet (*Ligustrum* spp.), barberry (*Berberis thunbergii*), and Japanese honeysuckle (*Lonicera japonica*). West of Powell Station Road, the forest is slightly more mature. The introduced species are present, but the overall canopy and understory are increased and ground cover is more common. Ground cover may include Christmas fern (*Polystichum acrostichoides*), may-apple (*Podophyllum peltatum*), snakeroot (*Sanicula* sp.), Dutchman's pipe or Virginia snakeroot (*Aristolochia serpentaria*), and rattlesnake fern (*Botrychium virginianum*). Long-leaf spikegrass is perhaps the most common grass found within or near the edges of the forest. (EOI 2008a, Section 2.4.1.1.1)

#### 3.6.7.1.6 Upland Forest Palustrine Wetland

Immediately west of Powell Station Road is an area of approximately 4 acres of wetland. The central portion is inundated emergent wetland, where rushes, sedges, and wetland forbs are present. Surrounding the emergent wetlands is wetland forest, where bald cypress is common and sweetgum and water oak are scattered. (EOI 2008a, Section 2.4.1.1.1)

#### 3.6.7.1.7 Upland Fields

Historically, these areas were upland forest, but were cleared of vegetation as recently as 1985 as a result primarily of activities associated with the construction of RBS. Grass areas are generally dominated by broomsedge bluestem (*Andropogon virginicus*), Bermudagrass (*Cynodon dactylon*), panic grasses (*Dichanthelium* sp.), and a variety of weedy forbs, such as hop-clover (*Trifolium dubium*). In most instances, these areas are occasionally or regularly mowed. Most areas categorized as upland shrubs/pine were previously used for construction equipment laydown for earlier construction at RBS. These areas are now dominated by eastern saltbush (*Baccharis halimifolia*) thickets and, in some cases, have been planted with loblolly pine. (EOI 2008a, Section 2.4.1.1.1)

#### 3.6.7.1.8 Developed Areas

Developed areas of the RBS site (approximately 12.7 percent) include buildings, parking areas, equipment storage areas, and roads. Also included in this category are the transmission line corridors. While the largest portion of these corridors is vegetated, the natural condition of the vegetation is quite poor. Regular maintenance within the corridors clears the areas of tall brush and trees. Consequently, the upland corridors are generally dominated by a low tangle of undesirable brush, mostly McCartney rose (*Rosa bracteata*), eastern saltbush, and poison ivy, which are introduced or otherwise undesirable species. The same scenario exists for the herbaceous species present. (EOI 2008a, Section 2.4.1.1.1)

In the bottomland corridor, trees have been removed, and most of the area is dominated by broom-sedge, baccharis, poison ivy, sweet joe-pye weed (*Eutrochium purpureum*), and numerous other invasive or otherwise weedy species. The soils in this area vary from ponded to drained. (EOI 2008a, Section 2.4.1.1.1)

### 3.6.7.2 Wildlife at the RBS Site

The RBS site provides a relatively significant diversity of habitats, as described in the previous discussion of vegetation at the site. Adding to the diversity of habitat in the area are the wet cypress forest and the proximity and influence of the Mississippi River. The area surrounding RBS is a mosaic of developed land, mowed grass, woodlots, and second generation forests that do not appear to provide significant travel corridors as might be found along water courses or entry/exit locations for desirable foraging or resting habitats. (EOI 2008a, Section 2.4.1.1.1)

The RBS site was extensively surveyed for wildlife prior to the construction of RBS and again following construction. Observations of wildlife present were made during pedestrian surveys of the site between December 2006 and November 2007. Direct observation and indirect evidence (e.g., scat and tracks) were used to assess species present; detailed plot sampling was not conducted. Night surveys are not normally conducted unless an unusual species is known or suspected to occur in the RBS area. No such wildlife is suspected at RBS, and no night surveys were conducted. (EOI 2008a, Section 2.4.1.1.1) Table 3.6-1 provides a list of common animals occurring or within the vicinity of the RBS site.

#### 3.6.7.2.1 Amphibians and Reptiles

The Louisiana Gulf Coast Herpetological Society recognizes 130 species of amphibians and reptiles in Louisiana. RBS may support as many as 79 known species, including 26 frogs and salamanders, 9 lizards, 29 snakes, and 15 turtles. The largest reptile present is the American alligator (*Alligator mississippiensis*), which is occasionally seen in the wet, bottomland forest area of the site. (EOI 2008a, Section 2.4.1.1.1) Table 3.6-1 lists some of the more common species present on the RBS site.

#### 3.6.7.2.2 Birds

Bird populations in the area include year-round residents, seasonal residents, and transients (birds stopping briefly during migration). A large percentage of the bird species in southern Louisiana are migratory. While there are resident bird populations, the region serves as a pass-through area for semi-annual migrations of Neotropical birds that may range between South America and Canada, as well as seasonal migrations of waterfowl. (Entergy 2016j, Section 3.6.7.3) Bird populations on the RBS property would be representative of those found in the region (Table 3.6-1).

The LMR corridor is a part of the Mississippi Flyway, a major bird migratory route. The Mississippi Flyway leads across the United States from the Gulf of Mexico to Canada following the general path of the Mississippi River. It is estimated that about 40 percent of all waterfowl migration in the United States takes place along this flyway. The LMR corridor provides suitable winter habitats for a variety of waterfowl from the Prairie Pothole and Great Lakes. The naturally flooded forests of the Delta region offer desirable conditions for millions of mallards (*Anas platyrhynchos*), wood ducks (*Aix sponsa*), and other waterfowl. The coastal marshes of Louisiana provide winter habitats for northern pintail (*Anas acuta*), gadwall (*Anas strepera*), American wigeon (*Anas americana*), and green-winged teal (*Anas crecca*). (IEC 2014, page 3-6)

Avian surveys were made in the early 1970s. Based on these surveys, approximately 177 species have been recorded in the RBS vicinity, including permanent residents, seasonal residents, and transients. No additional species were encountered during the pedestrian surveys made between December 2006 and November 2007. (EOI 2008a, Section 2.4.1.1.1) Following are brief discussions of bird groups encountered.

Forest Community Birds

Forest community birds include year-round and seasonal residents. Examples include the American robin (*Turdus migratorius*), blue jay (*Cyanocitta cristata*), white-eyed vireo (*Vireo griseus*), red-bellied woodpecker (*Sphyrapicus thyriideus*), and Carolina wren (*Thryomanes ludovicianus*). (EOI 2008a, Section 2.4.1.1.1)

Water-Dependent Birds

These birds are mostly found in the bottomland forest or otherwise associated with the Mississippi River. The great blue heron (*Ardea herodias*), belted kingfisher (*Ceryle alcyon*), red-winged blackbird (*Agelaius phoeniceus*), and great egret (*Ardea alba*) can be regularly observed. The wood duck is a permanent resident but, during the winter months, a wide variety of other ducks and waterfowl may be present. Examples of other waterfowl species expected to occur in the area include mallard, northern pintail, blue-winged teal (*Anas discors*), green-winged teal, and others. (EOI 2008a, Section 2.4.1.1.1)

Birds of Prey

Birds of prey observed on or near the RBS site include permanent residents such as the turkey vulture (*Cathartes aura*), Cooper's hawk (*Accipiter cooperii*), and great horned owl (*Bubo virginianus*). Winter residents can include the red-tailed hawk (*Buteo jamaicensis)*, short-eared owl (*Asio flammeus*), and occasionally the bald eagle (*Haliaeetus leucocephalus*). These birds mostly utilize the ecotone between wooded and open areas, hunting or fishing in the open areas and roosting and nesting in the forest edge. (EOI 2008a, Section 2.4.1.1.1)

Game Birds

The mourning dove (*Zenaida macroura*), northern bobwhite (*Colinus virginianus*), wild turkey (*Meleagris gallopavo*), and wood duck are year-round residents at RBS. During winter, a variety of ducks may occur in the area. The American woodcock (*Scolopax minor*) also winters in the area. (EOI 2008a, Section 2.4.1.1.1)

3.6.7.2.3 Mammals

Table 3.6-1 lists some of the more common mammals likely to occur at the RBS site. Forty-four mammal species of the approximately 62 species found in Louisiana may occur at or in the vicinity of RBS (EOI 2008a, Section 2.4.1.1.1).

The Louisiana black bear (*Ursus americanus luteolus*) was removed from the U.S. Fish and Wildlife Service's (USFWS's) federal list of endangered and threatened wildlife in 2016 because threats to this species have been eliminated or reduced, adequate regulatory mechanisms exist, and populations are now stable. (81 FR 13124) No bear or evidence of bear was observed during the 2006 and 2007 field investigations at the RBS site (EOI 2008a, Section 2.4.1.1.1). In addition, there have been no bear sightings on the RBS property since the 2006 and 2007 field investigations (Entergy 2016n). The potential for the Louisiana black bear to be present in the RBS vicinity appears to be remote (EOI 2008a, Section 2.4.1.1.1).

Because the RBS property boundary is unfenced, animals have ready access. White-tailed deer (*Odocoileus virginianus*), for instance, are frequently seen on site. The varied habitats around the site, however, are well suited to small mammals such as the coyote (*Canis latrans*), northern raccoon (*Procyon lotor*), eastern cottontail (*Sylvilagus floridanus*), and eastern fox squirrel (*Sciurus niger*). None of the mammal species observed or reported at the site (Table 3.6-1) is unusual for the region.

### 3.6.8 Invasive Species

The prominent invasive species likely occurring on the RBS property or near the withdrawal or discharge points into the Mississippi River are described below. Although there have been some observations of zebra mussels in plant systems, normal water treatment activities have prevented this species from developing into significant infestations. Therefore, there has been no need to implement management controls for this invertebrate, or any of the other invasive species discussed below, because they do not interfere with plant operations.

#### 3.6.8.1 Invertebrates

Zebra Mussel

Zebra mussels have spread throughout the Great Lakes and the Mississippi River and are now in other rivers and inland lakes. Zebra mussels cause problems in intake structures when the veligers attach to the interior of an intake structure. As the zebra mussel grows and others accumulate, the intake structure may become clogged with organisms that are tightly attached to the structure. (MNDNR 2015)

A zebra mussel monitoring and control program is currently in place at the RBS site to monitor the occurrence and relative densities of zebra mussels in the LMR, the clarifier influent and effluent, and the clarifier internals. When zebra mussels are suspected or apparent, inspection and/or sampling of the adult populations in the LMR near the intake piping are performed, and the intake screens and adjacent piping are cleaned when deemed necessary. (EOI 2008a, Section 2.4.2.5)

#### 3.6.8.2 Fish

Common Carp

Although a freshwater fish, carp are able to withstand brackish waters in their native range. Their non-native range in the Gulf of Mexico is not limited by temperature; the Gulf of Mexico region's temperate waters are suitable habitat for this fish. An omnivore, carp will consume both zooplankton and phytoplankton, and will frequently disturb bottom sediments while feeding. (CBR 2005, page 48)

The increased turbidity and dislodging of plants disturb habitat for native species that require rooted vegetation and clear waters. Common carp also adversely impact native fishes by consuming fish eggs and larvae. Most abundant in manmade water bodies, common carp are also plentiful in waters polluted by sewage and agricultural runoff. Common carp are widely distributed throughout Louisiana. (CBR 2005, page 48)

### 3.6.8.3 Terrestrial Plants

Broomsedge Bluestem

Broomsedge bluestem is a native, warm-season, herbaceous, perennial bunch grass that begins its growth when the average daytime temperature is between 60°F and 65°F. It is typically found on the edges of forests and disturbed areas. Broomsedge bluestem might have some allelopathic properties and may cause some other plants to not grow. (USDA 2015g)

Chinese Privet

Chinese privet (*Ligustrum sinense*) is an evergreen shrub with spreading branches, typically found near streams and in old fencerows. This species is an aggressive and troublesome invasive, often forming dense thickets, particularly in bottomland forests and along fencerows, thus gaining access to forests, fields, and ROWs. (TIO 2008a)

Bigleaf Periwinkle

Bigleaf periwinkle (*Vinca major*) is an evergreen to semi-evergreen vine, somewhat woody, trailing or scrambling to 3 feet long and upright to 1 foot. This invasive species is typically found around old home site plantings and scattered in open to dense canopied forests. It forms dense stands that exclude other herbs and creates a problem in areas where it competes with native herbs. It is also a particular threat to the understory of riverine vegetation, as it will spread from plant fragments carried by high flows. This could potentially result in the formation of dense mats that would smother all native groundcover vegetation and prevent regeneration of trees and shrubs, which could result in the eventual loss of native tree and shrub cover leading to erosion. (TIO 2008b)

Eastern Saltbush

Eastern saltbush also referred to as Groundsel-tree, is a shrub that grows in moist sites on soils with a high organic content including pond and bay margins, swamps, wet prairies, marshes, raised portions of salt marshes, and everglades hammocks. It also grows on anthropogenic sites, such as fencerows and abandoned fields. Eastern saltbush is unpalatable to cattle and often displaces more palatable forage. (USDA 2015h)

Japanese Honeysuckle

Japanese honeysuckle is a semi-evergreen to evergreen woody vine that is high climbing and trailing to 80 feet long. It branches and often forms arbors in forest canopies and/or ground cover under canopies, and also forms long woody rhizomes that sprout frequently. This species typically occurs as dense infestations along forest margins and ROWs, as well as under dense canopies and as arbors high in canopies. (TIO 2004)

Its evergreen to semi-evergreen nature gives it an added advantage over native species in many areas. Shrubs and young trees can be killed by girdling when vines twist tightly around stems and trunks, cutting off the flow of water through the plant. Dense growths of honeysuckle covering vegetation can gradually kill plants by blocking sunlight from reaching their leaves. Vigorous root competition also helps Japanese honeysuckle spread and displace neighboring native vegetation. (TIO 2004)

Kudzu

Kudzu (*Pueraria montana var. lobata*) is a climbing, deciduous vine capable of reaching lengths of over 100 feet in a single season. Preferred habitat includes open, disturbed areas such as roadsides, ROWs, forest edges, and old fields. This variant of kudzu often grows over, shades out, and kills all other vegetation, including trees. It was widely planted throughout the eastern United States in an attempt to control erosion. (Entergy 2016j, Section 3.6.8.2.1)

McCartney Rose

McCartney rose is an evergreen, thorny, climbing or trailing shrub that invades open, disturbed areas throughout the southern United States. Plants often grow in clumps, and stems are arching canes with recurved thorns. McCartney rose can form dense, impenetrable thickets in open forests and pastures. Infestations restrict cattle and wildlife use of land and displace native species. (USDA 2014)

Poison Ivy

Poison ivy is a woody plant that shows a tremendous variation in growth pattern and leaf characteristics. It can flourish in the woods where soil moisture is plentiful or in very dry sites on the most exposed hillsides. Usually, it is found in the vine form, but growth may be either as an erect shrub; a vine climbing by aerial rootlets on fences, walls or trees; or it may lie prostrate on the ground. (UConn 2004)

Sweet Joe-Pye Weed

Sweet joe-pye weed is a perennial plant that can grow in part shade or sun. It is typically found in open woods, woodland edges, thickets, wet meadows, and ravines. The plant can grow to a height of 4 to 6 feet. (MNW 2015)

#### 3.6.8.4 Animals

Feral Hog

Feral hogs (*Sus scrofa*) are sometimes hybrids of wild boars and domestic livestock. Feral hogs prefer wooded areas, flat coastal plains, swamps, marshes, and other habitats with plentiful water. Louisiana's warm and moist subtropical climate allows for reproduction almost year-round, and nutrient-rich soils and diverse ecosystems abundantly produce the hogs' favorite foods: roots, leaves, nuts, tubers, snails, insects, frogs, snakes, and rats. Besides competing with deer, bears, rabbits, and other native species for habitat and food, feral hogs can pose a risk to humans. In their quest for food, feral hogs have been known to tear up hurricane protection levees with their snouts and hooves, causing scars which could erode, expand, and weaken the flood-prevention structures. Feral hogs are also vectors for bovine tuberculosis and swine brucellosis, a potential human pathogen which could affect agriculture. (CBR 2005, page 60)

### 3.6.9 Procedures and Protocols

Entergy relies on administrative controls and other regulatory programs to ensure that habitats and wildlife are protected as a result of a change in plant operations (i.e., water withdrawal increase, new LPDES discharge point, wastewater discharge increase, air emissions increase), or prior to ground-disturbing activities. The administrative controls, as discussed in Section 9.6, involve reviewing the change, identifying effects (if any) on the environmental resource area (i.e., habitat and wildlife), establishing BMPs, modifying existing permits, or acquiring new permits as needed to minimize impacts. Existing regulatory programs that the site is subject to, as discussed in Chapter 9, also ensure that habitats and wildlife are protected. These are related to programs such as the following: stormwater management for controlling the runoff of pollution sources such as sediment, metals, or chemicals; spill prevention to ensure that BMPs and structural controls are in place to minimize the potential for a chemical release to the environment; USACE permitting programs to minimize dredging impacts; and management of herbicide applications to ensure that the intended use will not adversely affect the environment.

### 3.6.10 Studies and Monitoring

Other than monitoring associated with the site's REMP described in the RBS ODCM, and the zebra mussel monitoring program previously discussed in Section 3.6.8.1, there are currently no other active aquatic and terrestrial monitoring programs conducted at the site.

However, during preparation of the RBS3 COL application, pedestrian surveys were conducted between December 2006 and November 2007, to identify terrestrial, wildlife, and avian species present on the RBS site (EOI 2008a, Section 2.4.1.1.1). The results of these surveys are discussed in the RBS3 COL application ER.

In addition, ecological assets and river shrimp studies were conducted at RBS in 2002 and 2011, respectively. The 2002 ecological assets study involved identifying potential ecological assets at the RBS site that could be preserved, enhanced, created, or restored to generate value from either management, donation, or sale of all or parts of the property (EPRI 2002). The 2011 river shrimp study involved the female downstream-hatching migration of the river shrimp in the LMR system (Olivier and Bauer 2011).

## 3.6.11 Threatened, Endangered, and Protected Species, and Essential Fish Habitat

### 3.6.11.1 Federally Listed Species

Portions of East Baton Rouge, East Feliciana, Pointe Coupee, and West Feliciana parishes fall within a 6-mile radius of RBS. Within these four parishes, there are four federally listed species which are either threatened or endangered as discussed further below. These species are Alabama heelsplitter mussel (*Potamilus inflatus*), Atlantic sturgeon (gulf subspecies—*Acipenser oxyrinchus desotoi*), pallid sturgeon (*Scaphirhynchus albus*), and West Indian manatee (*Trichechus manatus*). (USFWS 2017a; USFWS 2017b) Status of these federally listed species and the parishes in which they are listed are provided in Table 3.6-5.

The implementing regulations for Section 7(a)(2) of the Endangered Species Act (ESA) define "action area" as all areas affected directly or indirectly by the federal action and not merely the immediate area involved in the action [50 CFR 402.02]. The action area effectively bounds the analysis of ESA-protected species and habitats because only species that occur within the action area may be affected by the federal action.

For the purposes of this ER analysis, Entergy considers the action area to be the RBS site (Sections 3.1 and 3.6) and the portion of the Mississippi River that would be affected by water withdrawal and discharge effluent (Section 3.6.6). Entergy expects all direct and indirect effects of the proposed action to be contained within these areas.

#### 3.6.11.1.1 Mollusks

Alabama Heelsplitter (Inflated Heelsplitter)

The Alabama heelsplitter, which is referred to as the inflated heelsplitter in the species recovery plan, is a large (sometimes reaching more than 5.5 inches in length) freshwater mussel with a brown to black shell with green rays in young individuals. Like other freshwater mussels, the Alabama heelsplitter feeds by filtering food particles from the water column. The specific food habits of the species are unknown, but other juvenile and adult freshwater mussels have been documented to feed on detritus, diatoms, phytoplankton, and zooplankton. The diet of Alabama heelsplitter glochidia, like other freshwater mussels, comprises water (until encysted on a fish host) and fish body fluids (once encysted). (USFWS 2015c)

The preferred habitat of this species is soft, stable substrata in slow to moderate currents. It has been found in sand, mud, silt, and sandy gravel, but not in large or armored gravel. It is usually collected on the protected side of bars and may occur in depths greater than 20 feet. The occurrence of this species in silt does not necessarily indicate that the species can be successful in that substratum. Adult mussels may survive limited amounts of silt, whereas juveniles would suffocate. (USFWS 2015c)

The Alabama heelsplitter was known historically from the Amite and Tangipahoa rivers in Louisiana; the Pearl River in Mississippi; and the Tombigbee, Black Warrior, Alabama, and Coosa rivers in Alabama. The presently known distribution is limited to the Amite River in Louisiana, and five sites in the Tombigbee and Black Warrior rivers in Alabama. This species is not abundant within any known habitat. (USFWS 2015c)

The Alabama heelsplitter mussel is unlikely to occur in the "action area," because there are no documented known/possible occurrences in West Feliciana Parish, and the Mississippi River would not provide suitable habitat for this species.

3.6.11.1.2 Fish

Atlantic Sturgeon

Atlantic sturgeon (gulf subspecies) are long-lived (20–25 years on average but up to 60 years), estuarine dependent, anadromous fish inhabiting coastal rivers from Louisiana to Florida during the warmer months, and the Gulf of Mexico and its estuaries and bays in the cooler months. As benthic feeders, they typically forage on macroinvertebrates, including brachiopods, mollusks, worms, and crustaceans. All foraging occurs in brackish or marine waters of the Gulf of Mexico and its estuaries; sturgeon do not forage in riverine habitat. This subspecies can grow to approximately 8 feet long and weigh up to 200 pounds. Adults migrate into and spawn in freshwater in the spring; spawning occurs in areas of clean substrate composed of rock and rubble. They migrate into marine waters in the fall to forage and overwinter. Juveniles stay in the river for about the first 2–3 years. These sturgeon return to their natal stream to spawn. Riverine habitats where the healthiest populations are found include long, spring-fed, free-flowing rivers, typically with steep banks, a hard bottom, and an average water temperature of 60–72°F. (NOAA 2016b)

Historically, the Atlantic sturgeon gulf subspecies was threatened by overharvesting throughout most of the 20th century. Current threats include construction of water control structures such as dams and sills (mostly after 1950, which exacerbated habitat loss); dredging; groundwater extraction; irrigation; flow alterations; poor water quality; and contaminants (primarily from industrial sources). (NOAA 2016b)

Other than a transitory presence during the migration spawning season, the gulf subspecies of the Atlantic sturgeon is unlikely to occur in the "action area" because there are no documented known/possible occurrences in West Feliciana Parish, and the Mississippi River by itself would not provide suitable habitat for this species.

Pallid Sturgeon

Pallid sturgeon are a bottom-oriented, large-river obligate fish inhabiting the Missouri and Mississippi rivers and some tributaries from Montana to Louisiana. Pallid sturgeon evolved in the diverse environments of the Missouri and Mississippi river systems. Floodplains, backwaters, chutes, sloughs, islands, sandbars, and main channel waters formed the large-river ecosystem that met the habitat and life history requirements of pallid sturgeon and other native large-river fishes. Pallid sturgeon have been documented over a variety of available substrates, but are often associated with sandy and fine bottom materials. (USFWS 2015d)

Substrate association appears to be seasonal. During winter and spring, a mixture of sand, gravel, and rock substrates are used. During the summer and fall, sand substrate is most often used. In the middle Mississippi River, pallid sturgeon transition from predominantly sandy substrates to gravel during May, which may be associated with spawning. In these river systems and others, pallid sturgeon appear to use underwater sand dunes. (USFWS 2015d)

Across their range, pallid sturgeon have been documented in waters of varying depths and velocities. Depths at collection sites range from about 2 feet to greater than 65 feet, though there may be selection for areas at least 2.6 feet deep. Despite the wide range of depths associated with capture locations, one commonality is apparent: this species is typically found in areas where relative depths (the depth at the fish location divided by the maximum channel cross section depth expressed as a percent) exceed 75 percent. Bottom water velocities associated with collection locations are generally less than 4.9 fps, with reported averages ranging from 1.9 to 2.9 fps. (USFWS 2015d)

Pallid sturgeon can be long-lived, with females reaching sexual maturity later than males. Based on wild fish, estimated age at first reproduction was 15 to 20 years for females and approximately 5 years for males. Like most fish species, water temperatures influence growth and maturity. Female hatchery-reared pallid sturgeon maintained in an artificially controlled environment can attain sexual maturity at age 6, whereas female pallid sturgeon subject to colder winter water temperatures reached maturity around age 9. Thus, age at first reproduction likely is variable and dependent on local conditions. Females do not spawn each year. (USFWS 2015d)

Spawning appears to occur between March and July, with lower latitude fish spawning earlier than those in the northern portion of the range. Adult pallid sturgeon can move long distances upstream prior to spawning, and females likely are spawning at or near the apex of these movements. This behavior can be associated with spawning migrations. Spawning appears to occur over firm substrates, in deeper water, with relatively fast, turbulent flows, and is driven by several environmental stimuli including flow, water temperature, and day length. (USFWS 2015d)

Although this species could occur within the "action area", the pallid sturgeon is a deepwater, channel-dwelling species. Therefore, it is expected to be unaffected by RBS water withdrawals and effluent discharges into the Mississippi River.

#### 3.6.11.1.3 Mammals

West Indian Manatee

Manatees range freely between marine and freshwater habitats. Specific habitat types/use areas include foraging and drinking sites, resting areas, travel corridors and others. Manatees, living at the northern limit of the species' range, have little tolerance for cold. Historically, this species has sought out natural, warm-water sites, including springs, deep water areas, and areas thermally influenced by the Gulf Stream, as refuges from the cold. In the 1930s and 40s, industrial plants, including power plants, paper mills, etc., were built along coastal and riverine shoreline areas. Plants discharging large volumes of heated discharge water into areas accessible to manatees have attracted large numbers of wintering manatees to these warm-water sites ever since. In the spring, manatees leave the warm-water sites and may travel great distances during the summer, only to return to warm water sites in the fall. (USFWS 2015e)

Manatees are herbivores that feed opportunistically on a wide variety of marine, estuarine, and freshwater plants, including submerged, floating, and emergent vegetation. Common forage plants include, but are not limited to, cord grass, algae, turtle grass, shoal grass, manatee grass, eel grass, and other plant types. Calves initially suckle and may start feeding on plants when a few months of age. Weaning generally takes place within a year of birth. Manatees also require sources of freshwater, obtained from both natural and anthropogenic sources. (USFWS 2015e)

Manatees mature at 3 to 5 years of age. Mating activity can occur throughout the year. While calving primarily peaks in the spring, calves may be born at any time of the year. (USFWS 2015e)

The West Indian manatee is unlikely to occur in the "action area" because there are no documented known/possible occurrences in West Feliciana Parish, and because this species prefers calm waters, which do not exist in the Mississippi River adjacent to the RBS property.

### 3.6.11.2 State-Listed Species

Portions of East Baton Rouge, East Feliciana, Pointe Coupee, and West Feliciana parishes fall within a 6-mile radius of RBS. As shown in Table 3.6-6, the LDWF has listed 33 plants and 32 animals as species of special concern within these four parishes. Although some of these species could occur within the project area, none were recorded as being present on the RBS property during the development of the RBS3 COL application (EOI 2008a, Sections 2.4.1.2.1 and Appendix 9B, Section B.1.4.3.1).

### 3.6.11.3 Essential Fish Habitat

Essential fish habitat (EFH) is evaluated under the authority of the Magnuson-Stevens Fishery Conservation and Management Act of 1976, as amended [16 USC 1801-1882]. EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." These waters are generally found in estuaries and tidally influenced sections of rivers that flow into estuaries. The tidally influenced portion of the LMR extends from its confluence with the Gulf of Mexico approximately up to RM 228, just below Baton Rouge, Louisiana. (EOI 2008a, Section 2.4.2.10) Because RBS is located upstream beyond tidal influence, there are no federally managed species that would be affected by the renewal of the RBS OL.

In addition, RBS is not listed in the NRC's 2013 GEIS as one of the 17 nuclear plants for which EFH "may be a consideration" (NRC 2013b, Table 3.6-3). Therefore, no EFH considerations or consultation requirements are needed.

### 3.6.11.4 Other Acts

#### Species Protected Under the Bald and Golden Eagle Protection Act

In addition to being a state-listed species, bald eagles are also protected under the Bald and Golden Eagle Protection Act. Although there are no known nests on the RBS property, bald eagles are in the immediate vicinity of the site, and they could occasionally transit the RBS property. As discussed in Section 9.5.15, there are currently no Bald and Golden Eagle Protection Act permitting requirements associated with RBS operations.

#### Species Protected Under the Migratory Bird Treaty Act

In addition to the six bird species listed in Table 3.6-6, there are several bird species that are protected under the Migratory Bird Treaty Act (MBTA), as shown in Table 3.6-1, which may occur on or within the vicinity of the RBS property. As discussed in Section 9.5.13, RBS maintains a federal migratory bird depredation permit to manage primarily two species that transit the site: swallows (barn and cliff) and vultures (black and turkey). To minimize the lethal taking of these species, non-lethal control measures utilized by RBS include nest removal and harassment. In addition, a report is submitted to the USFWS annually regarding depredation activities that occur at the site.

**Table 3.6-1**
**Common Animals Occurring on or in the Vicinity of RBS Site**

| Common Name[(a)] | Scientific Name |
|---|---|
| **Amphibians** | |
| Bullfrog | *Rana catesbeiana* |
| Eastern spadefoot toad | *Scaphiopus holbrookii* |
| Peeper | *Hyla crucifer* |
| Southern chorus frog | *Pseudacris nigrita* |
| Southern leopard frog | *Rana sphenocephala* |
| Woodhouse's toad | *Bufo woodhousei* |
| **Reptiles** | |
| American alligator | *Alligator mississippiensis* |
| Canebrake rattlesnake | *Crotalus horridus* |
| Corn snake | *Elaphe guttata* |
| Eastern garter snake | *Thamnophis scripta elegans* |
| Southern copperhead | *Agkistrodon contortrix contortrix* |
| Stinkpot | *Sternotherus odoratus* |
| Western cottonmouth | *Agkistrodon piscivorus leucostoma* |
| Yellow-bellied water snake | *Nerodia erythrogaster flavigaster* |
| **Birds[(b)]** | |
| American coot | *Fulica americana* |
| American robin | *Turdus migratorius* |
| American woodcock | *Scolopax minor* |
| American wigeon | *Anas americana* |
| Bald eagle | *Haliaeetus leucocephalus* |
| Barn swallow | *Hirundo rustica* |
| Barred owl | *Strix varia* |
| Black-crowned night heron | *Nycticorax nycticorax* |
| Black vulture | *Coragyps atratus* |

**Table 3.6-1 (Continued)**
**Common Animals Occurring on or in the Vicinity of RBS Site**

| Common Name[a] | Scientific Name |
|---|---|
| Blue jay | *Cyanocitta cristata* |
| Belted kingfisher | *Ceryle alcyon* |
| Blue-winged teal | *Anas discors* |
| Bufflehead | *Bucephala albeola* |
| Cardinal | *Cardinalis cardinalis* |
| Carolina wren | *Thryomanes ludovicianus* |
| Cattle egret | *Bubulcus ibis* |
| Cliff swallow | *Petrochelidon pyrrhonota* |
| Common crow | *Corvus brachyrhynchos* |
| Common snipe | *Gallinago gallinago* |
| Cooper's hawk | *Accipiter cooperii* |
| Double-crested cormorant | *Phalacrocorax auritus* |
| Downy woodpecker | *Picoides pubescens* |
| Eastern meadowlark | *Sturnella magna* |
| European starling | *Sturnus vulgaris* |
| Gadwall | *Anas strepera* |
| Great blue heron | *Ardea herodias* |
| Great egret | *Ardea alba* |
| Great horned owl | *Bubo virginianus* |
| Green heron | *Butorides virescens* |
| Green-winged teal | *Anas crecca* |
| Hooded merganser | *Lophodytes cucullatus* |
| House sparrow | *Passer domesticus* |
| Killdeer | *Charadrius vociferus* |
| Mallard | *Anas platyrhynchos* |
| Mourning dove | *Zenaida macroura* |

## Table 3.6-1 (Continued)
## Common Animals Occurring on or in the Vicinity of RBS Site

| Common Name[a] | Scientific Name |
|---|---|
| Northern mockingbird | *Mimus polyglottos* |
| Northern pintail | *Anas acuta* |
| Northern bobwhite | *Colinus virginianus* |
| Red-bellied woodpecker | *Sphyrapicus thyriideus* |
| Red-tailed hawk | *Buteo jamaicensis* |
| Red-winged blackbird | *Agelaius phoeniceus* |
| Short-eared owl | *Asio flammeus* |
| Snow goose | *Chen caerulescens* |
| Sprague's pipit | *Anthus spragueii* |
| Turkey vulture | *Cathartes aura* |
| White-eyed vireo | *Vireo griseus* |
| White ibis | *Eudocimus albus* |
| Yellow-billed cuckoo | *Coccyzus americanus* |
| Wild turkey | *Meleagris gallopavo* |
| Wood duck | *Aix sponsa* |
| **Mammals** | |
| American beaver | *Castor canadensis* |
| Big brown bat | *Eptesicus fuscus* |
| Bobcat | *Lynx rufus* |
| Common muskrat | *Ondatra zibethicus* |
| Coyote | *Canis latrans* |
| Eastern cottontail | *Sylvilagus floridanus* |
| Eastern fox squirrel | *Sciurus niger* |
| Eastern gray squirrel | *Sciurus carolinensis* |
| Gray fox | *Urocyon cinereoargenteus* |
| Hispid cotton rat | *Sigmodon hispidus* |

**Table 3.6-1 (Continued)**
**Common Animals Occurring on or in the Vicinity of RBS Site**

| Common Name[a] | Scientific Name |
|---|---|
| Least shrew | *Cryptotis parva* |
| Marsh rice rat | *Oryzomys palustris* |
| Nine-banded armadillo | *Dasypus novemcinctus* |
| North American mink | *Mustela vison* |
| Northern raccoon | *Procyon lotor* |
| Nutria | *Myocastor coypus* |
| Red fox | *Vulpes vulpes* |
| Striped skunk | *Mephitis mephitis* |
| Swamp rabbit | *Sylvilagus aquaticus* |
| Virginia opossum | *Didelphis virginiana* |
| White-tailed deer | *Odocoileus virginianus* |

(Species' likely presence derived from Section 9.5.13 of this ER and the following reference sources: Dundee and Rossman 1989; Entergy 2016j, Section 3.6.4; EOI 2008a, Section 2.4; LDWF 2015l; Vuilleumier 2009)

a. This is not a comprehensive list of all animals that may be found on or in the vicinity of RBS.

b. With the exception of the European starling, house sparrow, northern bobwhite and wild turkey, all bird species are protected under the MBTA.

## Table 3.6-2
## Phytoplankton Collected in the Lower Mississippi River at the RBS Site

| Common Name | Scientific Name |
|---|---|
| Green algae | *Carteria* |
| Green algae | *Chlamydomonas* |
| Green algae | *Chlorogonium* |
| Green algae | *Eudorina* |
| Green algae | *Pandorina* |
| Green algae | *Pleodorina* |
| Green algae | *Volvox* |
| Green algae | *Gloeocystis* |
| Green algae | *Sphaerocystis* |
| Green algae | *Chlorosarcina* |
| Green algae | *Dispora* |
| Green algae | *Ourococcus* |
| Green algae | *Binucleria* |
| Green algae | *Geninella* |
| Green algae | *Ulothrix* |
| Green algae | *Microspora* |
| Green algae | *Bulbochaete* |
| Green algae | *Chlorococcum* |
| Green algae | *Golenkinia* |
| Green algae | *Micratinium* |
| Green algae | *Dictyosphaerium* |
| Green algae | *Characium* |
| Green algae | *Schroederia* |
| Green algae | *Pediastrum* |
| Green algae | *Ceolastrum* |
| Green algae | *Ankistrodesmus* |
| Green algae | *Chlorella* |
| Green algae | *Closteriopsis* |
| Green algae | *Franceia* |
| Green algae | *Kirchneriella* |
| Green algae | *Lagerheima* |

**Table 3.6-2 (Continued)**
**Phytoplankton Collected in the Lower Mississippi River at the RBS Site**

| Common Name | Scientific Name |
|---|---|
| Green algae | *Oocystis* |
| Green algae | *Plantosphaeria* |
| Green algae | *Quadriqula* |
| Green algae | *Selenastrum* |
| Green algae | *Tetraedron* |
| Green algae | *Treubaria* |
| Green algae | *Actinastrum* |
| Green algae | *Crucigenia* |
| Green algae | *Scenedesmus* |
| Green algae | *Tetradesmus* |
| Green algae | *Tetrastrum* |
| Green algae | *Mougeotia* |
| Green algae | *Spirogyra* |
| Green algae | *Anthrodesmus* |
| Green algae | *Closterium* |
| Green algae | *Cosmarium* |
| Green algae | *Euastrum* |
| Green algae | *Hyalotheca* |
| Green algae | *Micraterius* |
| Green algae | *Penium* |
| Green algae | *Spondylosium* |
| Green algae | *Staurastrum* |
| Euglena | *Euglena* |
| Euglena | *Lepocinclis* |
| Euglena | *Phacus* |
| Euglena | *Trachelomonas* |
| Golden algae | *Ophiocytium* |
| Golden algae | *Tribonema* |
| Golden algae | *Centritractaceae* |
| Golden algae | *Dynobryon* |
| Golden algae | *Cosinodiscus* |

**Table 3.6-2 (Continued)
Phytoplankton Collected in the Lower Mississippi River at the RBS Site**

| Common Name | Scientific Name |
|---|---|
| Golden algae | *Cyclotella* |
| Golden algae | *Melosira* |
| Golden algae | *Stephanodiscus* |
| Golden algae | *Bidduphia* |
| Golden algae | *Tabellaria* |
| Golden algae | *Meridion* |
| Golden algae | *Diatoma* |
| Golden algae | *Opephora* |
| Golden algae | *Asterionella* |
| Golden algae | *Fragilaria* |
| Golden algae | *Synedra* |
| Golden algae | *Eunotia* |
| Golden algae | *Achnanthes* |
| Golden algae | *Cocconeis* |
| Golden algae | *Rhoicosphenia* |
| Golden algae | *Bebissonia* |
| Golden algae | *Frustulia* |
| Golden algae | *Gyrosigma* |
| Golden algae | *Mastogloia* |
| Golden algae | *Navicula* |
| Golden algae | *Neidium* |
| Golden algae | *Pinnularia* |
| Golden algae | *Pleurosigma* |
| Golden algae | *Stauroneis* |
| Golden algae | *Gomphonema* |
| Golden algae | *Amphora* |
| Golden algae | *Cymbella* |
| Golden algae | *Rhopalodia* |
| Golden algae | *Hantzschia* |
| Golden algae | *Nitzschia* |
| Golden algae | *Cymatopleura* |

**Table 3.6-2 (Continued)
Phytoplankton Collected in the Lower Mississippi River at the RBS Site**

| Common Name | Scientific Name |
|---|---|
| Golden algae | *Surirella* |
| Dinoflagellate | *Gymnodiniaceae* |
| Dinoflagellate | *Glenodinium* |
| Dinoflagellate | *Ceratium* |
| Blue-green algae | *Agmenellum* |
| Blue-green algae | *Anacystis* |
| Blue-green algae | *Aphanocapsa (Anacystis)* |
| Blue-green algae | *Aphanothece (Coccochloris)* |
| Blue-green algae | *Chroococcus (Anacystis)* |
| Blue-green algae | *Coelosphaerium* |
| Blue-green algae | *Dactylococcopsis* |
| Blue-green algae | *Gomphosphaeria* |
| Blue-green algae | *Microcystis (Polycystis)* |
| Blue-green algae | *Phormidium* |
| Blue-green algae | *Spirulina* |
| Blue-green algae | *Anabaena* |
| Blue-green algae | *Nodularia* |

(EOI 2008a, Table 2.4-10)

## Table 3.6-3
## Fishes of the Lower Mississippi River near RBS

| Common Name | Scientific Name[a] |
|---|---|
| Alligator gar | *Atractosteus spatula* |
| American eel | *Anguilla rostrata* |
| Bigmouth buffalo | *Ictiobus cyprinellus* |
| Black buffalo | *Ictiobus niger* |
| Black crappie | *Pomoxis nigromaculatus* |
| Blacktail redhorse | *Moxostoma poecilurum* |
| Blacktail shiner | *Cyprinella venusta* |
| Blue catfish | *Ictalurus furcatus* |
| Bluegill | *Lepomis macrochirus* |
| Bluehead chub | *Nocomis leptocephalus* |
| Bluntnose minnow | *Pimephales notatus* |
| Bowfin | *Amia calva* |
| Bullhead minnow | *Pimephales vigilax* |
| Carp | *Cyprinus carpio* |
| Chain pickerel | *Esox niger* |
| Channel catfish | *Ictalurus punctatus* |
| Chestnut lamprey | *Ichthyomyzon castaneus* |
| Creek chubsucker | *Erimyzon oblongus* |
| Dollar sunfish | *Lepomis marginatus* |
| Emerald shiner | *Notropis atherinoides* |
| Fathead minnow | *Pimephales promelas* |
| Flathead catfish | *Pylodictis olivaris* |
| Flathead chub | *Platygobio gracilis* |
| Freshwater drum | *Aplodinotus grunniens* |
| Gizzard shad | *Dorosoma cepedianum* |
| Golden shiner | *Notemigonus crysoleucas* |
| Goldeye | *Hiodon alosoides* |
| Green sunfish | *Lepomis cyanellus* |
| Gulf pipefish | *Syngnathus scovelli* |
| Largemouth bass | *Micropterus salmoides* |
| Longnose gar | *Lepisosteus osseus* |

## Table 3.6-3 (Continued)
## Fishes of the Lower Mississippi River near RBS

| Common Name | Scientific Name[a] |
|---|---|
| Mimic shiner | *Notropis volucellus* |
| Mississippi silverside | *Menidia audens* |
| Mosquitofish | *Gambusia affinis* |
| Pugnose minnow | *Opsopoeodus emiliae* |
| Red shiner | *Cyprinella lutrensis* |
| Redear sunfish | *Lepomis microlophus* |
| Redfin pickerel | *Esox americanus* |
| River carpsucker | *Carpiodes carpio* |
| River shiner | *Notropis blennius* |
| Sauger | *Sander canadensis* |
| Shortnose gar | *Lepisosteus platostomus* |
| Shovelnose sturgeon | *Scaphirhynchus platorynchus* |
| Silver chub | *Macrhybopsis storeriana* |
| Silverband shiner | *Notropis shumardi* |
| Silvery minnow | *Hybognathus nuchalis* |
| Skipjack herring | *Alosa chrysochloris* |
| Smallmouth buffalo | *Ictiobus bubalus* |
| Southern brook lamprey | *Ichthyomyzon gagei* |
| Speckled chub | *Macrhybopsis aestivalis* |
| Spotted bass | *Micropterus punctulatus* |
| Spotted gar | *Lepisosteus oculatus* |
| Spotted sucker | *Minytrema melanops* |
| Steelcolor shiner | *Cyprinella whipplei* |
| Striped bass | *Morone saxatilis* |
| Threadfin shad | *Dorosoma petenense* |
| White bass | *Morone chrysops* |
| White crappie | *Pomoxis annularis* |
| Yellow bass | *Morone mississippiensis* |

(Douglas 1974)

a. Scientific names are taken from Page et al. 2013.

**Table 3.6-4**
**Commercial and Recreational Fish Species in the Vicinity of RBS**

| Common Name | Scientific Name | Commercial Importance | Use |
|---|---|---|---|
| Alligator gar | *Atractosteus spatula* | Commercial fishery | Sportfish |
| Bigmouth buffalo | *Ictiobus cyprinellus* | Commercial fishery | Sportfish |
| Blacktail redhorse | *Moxostoma poecilurum* | Food species | Food species |
| Blue catfish | *Ictalurus furcatus* | Food species | Sportfish |
| Bluegill | *Lepomis macrochirus* | Food species | Sportfish |
| Carp | *Cyprinus carpio* | Commercial fishery | Sportfish |
| Channel catfish | *Ictalurus punctatus* | Commercial fishery | Sportfish |
| Fathead minnow | *Pimephales promelas* | NA | Baitfish |
| Flathead catfish | *Pylodictis olivaris* | Commercial fishery | Sportfish |
| Freshwater drum | *Aplodinotus grunniens* | Commercial fishery | Sportfish |
| Gizzard shad | *Dorosoma cepedianum* | NA | Baitfish |
| Green sunfish | *Lepomis cyanellus* | NA | Sportfish |
| Largemouth bass | *Micropterus salmoides* | Food species | Sportfish |
| Longnose gar | *Lepisosteus osseus* | Food species | Sportfish |
| Redear sunfish | *Lepomis microlophus* | NA | Sportfish |
| River carpsucker | *Carpiodes carpio* | NA | Sportfish |
| River shiner | *Notropis blennius* | NA | Baitfish |
| Shortnose gar | *Lepisosteus platostomus* | Commercial fishery | Sportfish |
| Skipjack herring | *Alosa chrysochloris* | NA | Baitfish |
| Smallmouth buffalo | *Ictiobus bubalus* | Commercial fishery | Sportfish |
| Striped bass | *Morone saxatilis* | NA | Sportfish |
| White crappie | *Pomoxis annularis* | NA | Sportfish |

(Species' likely presence is derived from Douglas 1974; scientific names from Page et al. 2013.)

NA: Indicates a fish which is not commercially important in the vicinity of the RBS site.

**Table 3.6-5**
**Federally Listed Species in East Baton Rouge, East Feliciana, Pointe Coupee, and West Feliciana Parishes**

| Group | Species | Parish | Occurrence | Status |
|---|---|---|---|---|
| Mollusk | Alabama heelsplitter | EBR/EF | Known to or are believed to occur in this parish | Threatened |
| Fish | Atlantic sturgeon (gulf subspecies) | EBR/EF | Known to or are believed to occur in this parish | Threatened |
| Fish | Pallid sturgeon[(a)] | EBR/EF/PC/WF | Known to or are believed to occur in this parish | Endangered |
| Mammal | West Indian manatee | EBR | Known to or are believed to occur in this parish | Threatened |

(USFWS 2017a; USFWS 2017b)

a. This species could occur in the "action area," although the pallid sturgeon is a deepwater, channel-dwelling species.

EBR: East Baton Rouge
EF: East Feliciana
PC: Pointe Coupee
WF: West Feliciana

**Table 3.6-6**
**State-Listed Species in East Baton Rouge, East Feliciana, Pointe Coupee, and West Feliciana Parishes**

| Group | Species[a] | Scientific Name | Parish | Status |
|---|---|---|---|---|
| Plant | Allegheny-spurge | *Pachysandra procumbens* | WF | S2 |
| Plant | American alumroot | *Heuchera americana* | WF | S2 |
| Plant | American ginseng | *Panax quinquefolius* | WF | S1 |
| Plant | Canada wild-ginger | *Asarum canadense* | WF | S1 |
| Plant | Carolina gentian | *Frasera caroliniensis* | WF | SH |
| Plant | Carpenter's ground-cherry | *Physalis carpenteri* | WF | S1 |
| Plant | Carpenter's square | *Silphium perfoliatum* | WF | S1? |
| Plant | Climbing bittersweet | *Celastrus scandens* | WF | S1 |
| Plant | Crested coral-root | *Hexalectris spicata* | WF | S2 |
| Plant | Dwarf filmy-fern | *Trichomanes petersii* | EBR/EF | S2 |
| Plant | Elliott sida | *Sida elliottii* | EBR/EF | SH |
| Plant | Enchanter's nightshade | *Circaea lutetiana* ssp. *canadensis* | EF/WF | S2 |
| Plant | Fairy wand | *Chamaelirium luteum* | WF | S2S3 |
| Plant | Glade fern | *Diplazium pycnocarpon* | WF | S2 |
| Plant | Low erythrodes | *Platythelys querceticola* | EBR/EF/WF | S1 |
| Plant | Nodding pogonia | *Triphora trianthophora* | WF | S2 |
| Plant | Powdery thalia | *Thalia dealbata* | EBR/EF | S2S3 |
| Plant | Pyramid magnolia | *Magnolia pyramidata* | WF | S2 |
| Plant | Riverweed | *Podostemum ceratophyllum* | EF | S1 |
| Plant | Rooted spike-rush | *Eleocharis radicans* | EF | S1? |
| Plant | Scarlet woodbine | *Schisandra glabra* | EF/WF | S3 |

**Table 3.6-6 (Continued)**
**State-Listed Species in East Baton Rouge, East Feliciana, Pointe Coupee, and West Feliciana Parishes**

| Group | Species[a] | Scientific Name | Parish | Status |
|---|---|---|---|---|
| Plant | Shadow-witch orchid | *Ponthieva racemosa* | WF | S2 |
| Plant | Silky camellia | *Stewartia malacodendron* | EBR/EF | S2S3 |
| Plant | Silvery glade fern | *Deparia acrostichoides* | WF | S2 |
| Plant | Single-head pussytoes | *Antennaria solitaria* | EF | S2 |
| Plant | Southern shield wood-fern | *Dryopteris ludoviciana* | EBR/EF/WF | S2 |
| Plant | Southern shield wood-fern hybrid | *Dryopteris x australis* | EBR | SH |
| Plant | Square-stemmed monkey flower | *Mimulus ringens* | EBR/EF | S2 |
| Plant | Starry campion | *Silene stellata* | EF | S2 |
| Plant | Virginia saxifrage | *Saxifraga virginiensis* | WF | SH |
| Plant | Water-purslane | *Didiplis diandra* | EF | S2? |
| Plant | White baneberry | *Actaea pachypoda* | WF | S2 |
| Plant | Wolf spikerush | *Eleocharis wolfii* | EBR/EF | S3 |
| Invertebrate | Six-banded longhorn beetle | *Dryobius sexnotatus* | PC | S1 |
| Invertebrate | Yellow brachycercus mayfly | *Brachycercus flavus* | WF | S2 |
| Mussel | Alabama hickorynut | *Obovaria unicolor* | EF | S1 |
| Mussel | Elephant ear | *Elliptio crassidens* | EF | S3 |
| Mussel | Inflated heelsplitter | *Potamilus inflatus* | EBR/EF | S1 |
| Mussel | Mississippi pigtoe | *Pleurobema beadleianum* | EF | S2 |
| Mussel | Rayed creekshell | *Anodontoides radiatus* | EBR/EF | S2 |
| Mussel | Southern hickorynut | *Obovaria jacksoniana* | EBR/EF | S1S2 |
| Mussel | Southern pocketbook | *Lampsilis ornata* | EBR/EF | S3 |

**Table 3.6-6 (Continued)**
**State-Listed Species in East Baton Rouge, East Feliciana, Pointe Coupee, and West Feliciana Parishes**

| Group | Species[a] | Scientific Name | Parish | Status |
|---|---|---|---|---|
| Mussel | Southern rainbow | *Villosa vibex* | EBR/EF | S2 |
| Fish | Alabama shad | *Alosa alabamae* | EBR/EF | S1 |
| Fish | Bluntface shiner | *Cyprinella camura* | EF/WF | S2 |
| Fish | Broadstripe topminnow | *Fundulus euryzonus* | EF | S2 |
| Fish | Central stoneroller | *Campostoma anomalum* | WF | S2 |
| Fish | Pallid sturgeon | *Scaphirhynchus albus* | EBR/EF/PC/WF | S1 |
| Fish | Rainbow darter | *Etheostoma caeruleum* | WF | S2 |
| Amphibian | Four-toed salamander | *Hemidactylium scutatum* | EBR/EF | S1 |
| Amphibian | Webster's salamander | *Plethodon websteri* | WF | S1 |
| Reptile | Eastern glass lizard | *Ophisaurus ventralis* | EBR/EF | S3 |
| Reptile | Rainbow snake | *Farancia erytrogramma* | EBR/EF | S2 |
| Bird[b] | American redstart | *Setophaga ruticilla* | WF | S3B |
| Bird[b] | American swallow-tailed kite | *Elanoides forficatus* | EBR/PC | S1S2B |
| Bird[b] | Bald eagle | *Haliaeetus leucocephalus* | EBR/EF/PC/WF | S3 |
| Bird[b] | Interior least tern | *Sternula antillarum athalassos* | EBR/EF/PC/WF | S4BT1 |
| Bird[b] | Louisiana waterthrush | *Seiurus motacilla* | EF/WF | S3S4B |
| Bird[b] | Worm-eating warbler | *Helmitheros vermivorus* | EF/WF | S3B |
| Mammal | Eastern harvest mouse | *Reithrodontomys humulis* | EBR/EF | S3 |
| Mammal | Eastern spotted skunk | *Spilogale putorius* | WF | S1 |
| Mammal | Long-tailed weasel | *Mustela frenata* | EBR/EF/WF | S3 |
| Mammal | Louisiana black bear | *Ursus americanus luteolus* | PC/WF | S3 |

**Table 3.6-6 (Continued)**
**State-Listed Species in East Baton Rouge, East Feliciana, Pointe Coupee, and West Feliciana Parishes**

| Group | Species[(a)] | Scientific Name | Parish | Status |
|---|---|---|---|---|
| Mammal | Southeastern shrew | *Sorex longirostris* | EBR/EF/WF | S2 |
| Mammal | West Indian manatee | *Trichechus manatus* | EBR/EF | S1N |

(LDWF 2017)

a. None of these species have been identified on the RBS site.

b. Species also protected under the MBTA.

EBR: East Baton Rouge
EF: East Feliciana
PC: Pointe Coupee
WF: West Feliciana

**State Status Ranks**

S1 = critically imperiled in Louisiana because of extreme rarity (5 or fewer known extant populations) or because of some factor(s) making it especially vulnerable to extirpation.

S2 = imperiled in Louisiana because of rarity (6 to 20 known extant populations) or because of some factor(s) making it very vulnerable to extirpation.

S3 = rare and local throughout the state or found locally (even abundantly at some of its locations) in a restricted region of the state, or because of other factors making it vulnerable to extirpation (21 to 100 known extant populations).

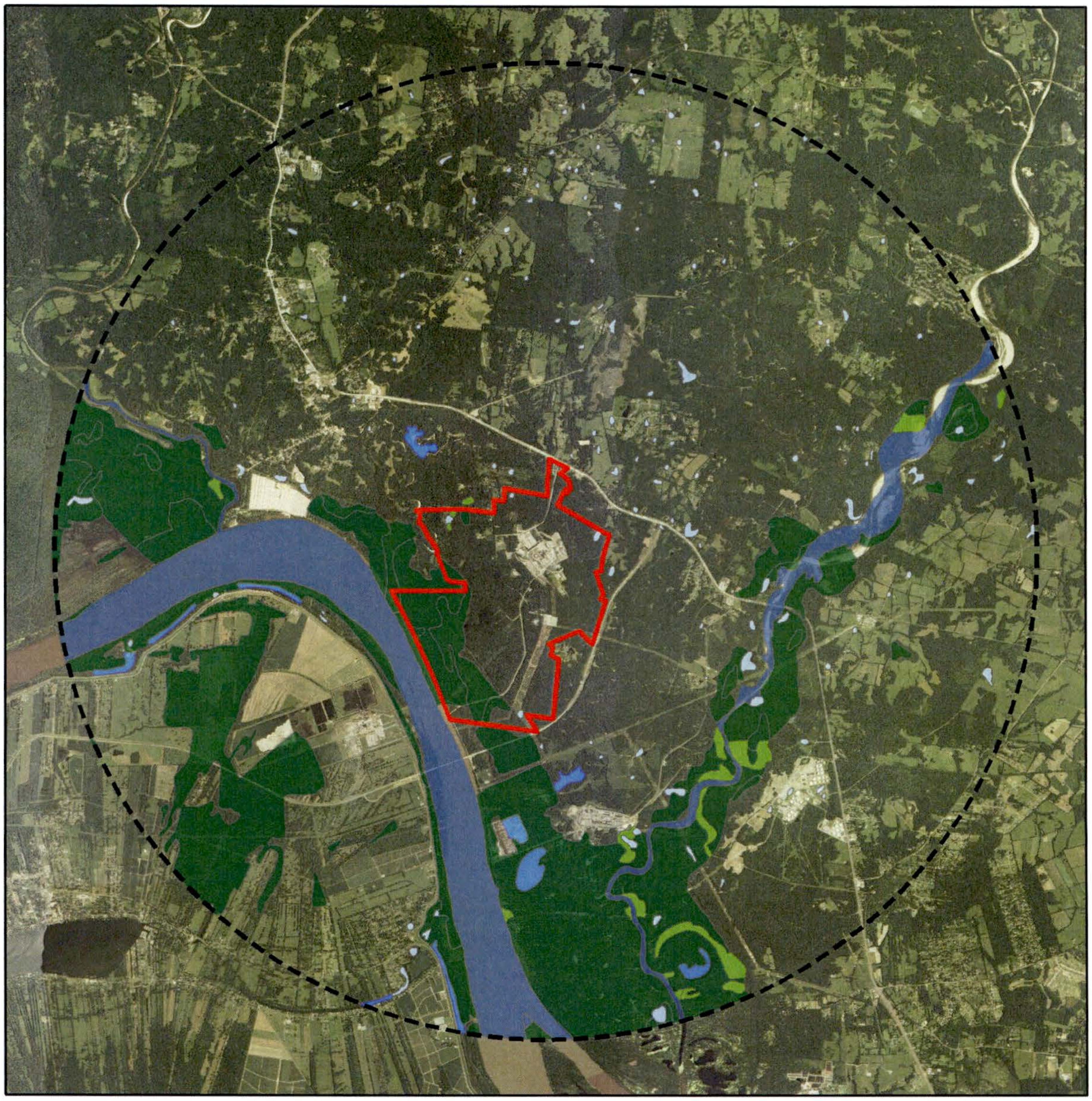
S4 = apparently secure in Louisiana with many occurrences (100 to 1000 known extant populations).

S5 = demonstrably secure in Louisiana (1000+ known extant populations).

(B or N may be used as qualifier of numeric ranks and indicating whether the occurrence is breeding or nonbreeding).

SH = of historical occurrence in Louisiana, but no recent records verified within the last 20 years; formerly part of the established biota, possibly still persisting.

T = subspecies or variety rank (e.g., G5T4 applies to a subspecies with a global species rank of G5, but a subspecies rank of G4).



(EOI 2008a, Figure 2.1-3; USFWS 2015b)

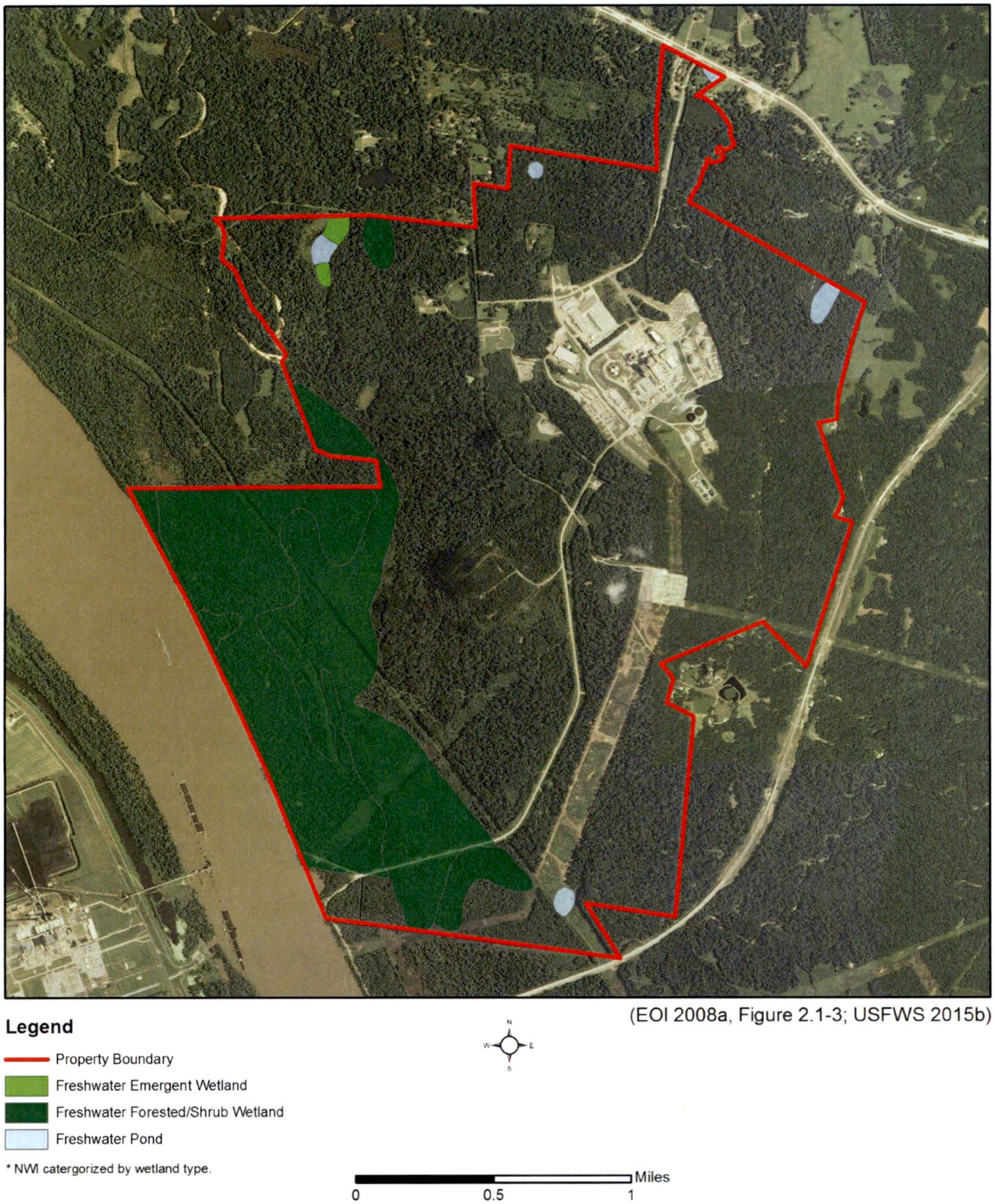
**Legend**

- Property Boundary
- 6-Mile Radius
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Riverine

* NWI catergorized by wetland type.

0 2 4 Miles

**Figure 3.6-1**
**Wetlands, 6-Mile Radius of RBS**




(EOI 2008a, Figure 2.1-3; USFWS 2015b)

**Figure 3.6-2**
**Wetlands, RBS Property**

## 3.7 Historic and Cultural Resources

The approximately 3,342-acre RBS property consists primarily of dense forest and wetlands, with developed areas around the station. The land within a 6-mile radius (from the reactor center point) is primarily wetlands and forest (Figure 3.1-2). For the purpose of license renewal, the area of potential effects (APE) is defined as the entire RBS property, transmission lines up to the first substation, and everything within a 6-mile radius that may be affected by license renewal and land-disturbing activities associated with continued reactor operations. As discussed in Section 2.2.5.1, the first substation (the 230-kV/500-kV Fancy Point Substation) is located on RBS property.

In support of license renewal, Entergy contracted for a study in 2015 to develop a report summarizing the results of a background literature search conducted of previous archaeological investigations made on the RBS property, a review of archival and secondary historical sources, and a property walkover. These data sets were used to develop an archaeological sensitivity analysis of the RBS property and to identify all known archaeological sites within a 6-mile radius, as well as properties listed on the National Register of Historic Places (NRHP) within that same radius. (CEI 2015)

Although construction of the existing RBS facility itself would have impacted any archaeological resources that may have been located within its footprint (Figures 3.7-1, 3.7-2, 3.7-3, and 3.7-4), much of the surrounding area remains largely undisturbed. Twelve archaeological sites have been identified on the RBS property; none of these sites are listed on the NRHP, nor have any been determined to be eligible for inclusion on the NRHP. Only three of the sites identified have been examined sufficiently to determine their NRHP eligibility. At least two of these sites likely contain *in situ* archaeological deposits: the Magnolia Plantation Sugarhouse (16WF36) and Cottonmouth Mound (16WF61). In addition, an unnamed, historic-period cemetery is known to be located on the property. Archival research has also identified the potential of late 18th-century occupation of the property, as well as 19th- and 20th-century occupations. (CEI 2015)

The results of the 2015 cultural resource assessment and previous assessments show that within the 3,342-acre APE and 6-mile radius, there are 25 resources that are either NRHP-listed, determined eligible, or recommended eligible for the NRHP, or have the equivalent eligibility or potential eligibility under national heritage or legacy commission designations. These 25 resources include 14 aboveground properties (two of which include a single NRHP archaeological deposit and one of which includes two NRHP archaeological deposits) and 11 archaeological sites (16EBR42, 16EF7, 16EF68, 16PC62, 16WF34, 16WF39, 16WF89, 16WF101, 16WF156, 16WF175, and Bayou Sara-Baton Rouge Road) as shown in Tables 3.7-1 and 3.7-2. Two of the 14 aboveground properties (Port Hudson Battlefield and Rosedown Plantation) are also listed as National Historic Landmarks. None of these 25 resources are located on the RBS property (Figure 3.7-5), and none will be affected by the renewal of the RBS OL. (CEI 2015)

Remaining archaeological resources within a 6-mile radius of RBS that have been determined ineligible (69), partially ineligible/unknown (9), unknown (37), or destroyed (1), are shown in

Table 3.7-1. No traditional cultural properties have been suggested to date by research or by potentially interested parties for the RBS property or within a 6-mile radius of RBS. (CEI 2015)

To provide early consultation for the Section 106 process, Entergy contacted the Louisiana Division of Historic Preservation (LDHP) for informal consultation concerning the RBS LRA and potential effects on cultural resources within the approximately 3,342-acre RBS property and on historic properties within a 6-mile radius of the site (Attachment C). Native American groups recognized as potential stakeholders were also consulted by Entergy with the opportunity for comment (Attachment C).

### 3.7.1 Land Use History

The RBS property and surrounding region hold evidence of both prehistoric and historic occupation by Native Americans and Euroamericans. Archaeological records suggest that the RBS property and the surrounding area were potentially occupied by Native American populations for the Paleo-Indian Period (prior to 6000 BC), the Archaic Period (6000 BC to 1500 BC), the Woodland Period (1500 BC to AD 1200), and the Mississippi Period (AD 1200 to 1450). The principal aboriginal groups encountered by European explorers in what is now the RBS region were the Bayagoula, Chaouacha, Chitimacha, Houma, Mugulasha, Ofogoula, Okelousa, Ouacha, and Tunica. (CEI 2015)

The National Park Service's (NPS's) Native American Consultation Database, developed as part of NPS's national program for compliance with the Native American Graves Protection and Repatriation Act of 1990, identified no federally recognized Indian tribes with judicially established land claims within East Baton Rouge, East Feliciana, Pointe Coupee, and West Feliciana parishes (NACD 2015).

The regional historic era cultural background begins with European exploration and settlement by the French in the late 17th century, followed by Spanish control west of the Mississippi and British control east of the Mississippi in the mid-18th century. In 1800, control reverted to France, which in turn sold the possession to the United States as the Louisiana Purchase in 1803. West Florida, whose capital was Baton Rouge, remained a Spanish possession until 1810. After a brief period of independence (with the capital in St. Francisville), West Florida, along with the rest of Louisiana, became the 18th state in 1812. Soon after, Feliciana County was reduced in size to form Feliciana Parish and, in 1824, it was subdivided to create the current East Feliciana and West Feliciana parishes. (CEI 2015)

The core of the RBS facility land was surveyed in October 1798, either for Thomas Green or Frederick Kimball, who was residing on the property by 1799. Kimball's property would have included much of the north half of the project area (Figure 3.7-6). By the 1840s, the RBS property made up portions of various plantations, including Troy Plantation, Magnolia Plantation, and Forest Plantation. (CEI 2015)

Plantation agriculture centered on cotton cultivation was the primary economic activity in West Feliciana Parish. The construction of the West Feliciana Railroad, completed in 1842, led to increased development of West Feliciana as a cotton and sugar cane producer. Plantation agriculture in West Feliciana reached its zenith in the two decades prior to the Civil War, then virtually disappeared during Reconstruction. (CEI 2015)

In January 1861, Louisiana seceded from the Union with the rest of the Confederacy, and the American Civil War began in April of the same year. Despite the fact that nearby Port Hudson was the site of one of the pivotal battles of the Civil War, there was only limited action in West Feliciana Parish. The area that saw the most conflict was the community of Bayou Sara, which was virtually leveled by Union gunboats from 1862 to 1863. (CEI 2015)

Following the Civil War, the parish's economy was virtually destroyed. The lack of a cheap, dependable labor force in the form of slaves, combined with a lack of capital, left planters without a means to operate their plantations. To further add to the poor economic conditions of the parish, a boll weevil infestation in about 1909 destroyed the cotton crop. Many of the large plantations were replaced by smaller tenant farms focused on raising cattle, dairying, and cultivating sweet potatoes. Settlement patterns changed dramatically from relatively isolated clusters of slave dwellings to sparsely scattered tenant homes. The growth of the road system in the parish reflects this change in settlement patterns, with many small country lanes being established during the late 19th century. (CEI 2015)

By the early 20th century, unimproved roads crisscrossed the project area, and scattered houses could be found along many of the ridge tops. One of the few undeveloped areas was in the vicinity of what is now the main complex at RBS. A large, relatively flat ridge top, that area likely consisted of agricultural fields. Also passing through the property was the Louisiana Railway and Navigation Company rail line, which closely followed the bluff edge. The Woodville Branch of the Yazoo and Mississippi Valley Railroad passed somewhat further east, connecting the original West Feliciana Railroad at Bayou Sara to Slaughter in East Feliciana Parish. Passing through Powell (Powell Station), that line roughly bisected the project area. By the 1960s, that line formed part of the Illinois Central Railroad (Figure 3.7-7). By then, the Louisiana Railway and Navigation Company railroad had been abandoned and the tracks removed. (CEI 2015)

As the 20th century progressed, many of the earlier homes and outbuildings scattered about the area were removed. As a result, much of the area was uninhabited by the 1950s, and former agricultural fields had been turned into pastures or reverted back to forest. (CEI 2015)

As early as 1968, Gulf States Utilities Company (GSU) (now Entergy Louisiana, LLC) began evaluating future energy sources for the region and 2 years later selected the present RBS site for the construction of a two-unit, nuclear-powered electric generating plant. GSU received a limited construction permit from the NRC in September 1975, which allowed the beginning of site clearing and excavation, development of road and rail access to the site, and construction of fire protection facilities. (CEI 2015)

To facilitate construction of the reactors at the 50-acre plant site, it was necessary to excavate the area to a depth of 80 feet. By August 1976, those excavations had removed 60 feet of soil. At the same time, a spur was constructed to connect the site to the nearby Illinois Central Gulf

Railroad (formerly Illinois Central Railroad). Construction activities associated with RBS Unit 1 were completed in 1984. RBS Unit 1 received its full-power license in 1985, and it became operational in 1986. Construction of Unit 2 was cancelled in 1984. (CEI 2015)

### 3.7.2 Cultural History

#### 3.7.2.1 Paleo-Indian Period (Prior to 6000 BC)

Initial human occupation of this region occurred in the Paleo-Indian period. The early portion of the period is characterized by the widespread fluted-point tradition generally dated prior to 8500 BC. A few of these points have been found in the parishes north of Lake Pontchartrain, and they are generally made of exotic materials. The later Paleo-Indian period is marked by the divergence of the fluted-point tradition into distinct subtraditions. (CEI 2015)

#### 3.7.2.2 Archaic (6000 to 1500 BC)

##### 3.7.2.2.1 Early Archaic Period, 6000–5000 BC

This period represents a time of adaptation to the changing environments associated with early post-glacial climatic regimes. While there is a distinct technological break with the earlier fluted-point tradition during this period, there are obvious continuities with transitional complexes such as San Patrice. The side-notched point style that appeared in the latter becomes one of the marker traits of the Early Archaic. Corner-notched types such as Palmer and Jude developed during this period, as did stemmed types such as Kirk and Hardin. In southeast Louisiana, archaeologists have proposed the St. Helena phase based on surface finds of Kirk and Palmer points in St. Helena Parish and adjacent parishes north of Lake Pontchartrain. (CEI 2015)

##### 3.7.2.2.2 Middle Archaic Period, 5000–3000 BC

This period is characterized by widespread regional differentiation of cultures and a number of developments in ground stone technology. The latter includes grooved axes, atlatl weights, and pendants, as well as more extensive use of grinding stones, which first appeared in the previous period. There are also indications of increased sedentism and more complex social organization during this period in the form of increased site size, midden development, the use of storage pits, utilization of local raw materials, and an increase in the number of burials. Additionally, evidence of Middle Archaic mound building has been found at several sites in southeast Louisiana. (CEI 2015)

##### 3.7.2.2.3 Late Archaic Period, 3000–1500 BC

Cultivation involving several native seed plants, including sumpweed, chenopod, and sunflower, as well as squash, which is now thought to have been independently domesticated in eastern North America, began during this period. The only Late Archaic phase identified in southeast Louisiana to date is the Pearl River phase, which is based on material from a series of oyster shell middens located near the mouth of the Pearl River. (CEI 2015)

### 3.7.2.3 Woodland (1500 BC to AD 1200)

#### 3.7.2.3.1 Poverty Point Period, 1500–500 BC

This time interval transitions from Archaic hunting and gathering cultures to Woodland cultures characterized by food production, pottery manufacture, and mound building. In the Lower Mississippi Valley, this transition is marked by the development of the distinctive Poverty Point culture. Among the material characteristics of this culture are baked clay balls or Poverty Point objects, microlith and lapidary industries, and earthworks. Pottery is not abundant, but fiber-tempered and sand-tempered wares have been found at several sites. (CEI 2015)

#### 3.7.2.3.2 Tchula Period, 500 BC–AD 1

This period in the Lower Mississippi Valley is characterized by the integration of pottery manufacture and mound building into a single cultural system. In the southern portion of the valley, these developments take place in an archaeological culture called Tchefuncte. The diagnostic artifacts of this and most of the succeeding prehistoric cultures of the Lower Mississippi Valley are the distinctive ceramics. Tchefuncte pottery is characterized by a laminated paste that appears to lack tempering. (CEI 2015)

Mound construction is presently only known from one Tchefuncte site, the Lafayette Mounds (16SM17). Data suggest that the mound was built during the Tchefuncte occupation of the site. Evidence was also found for Tchefuncte mounds at three other sites: Coulee Crow (16SM17), located on the Vermilion River, and Lake Louis (16CT24) and Boothe Landing (16CT31), both located on the lower Ouachita River. (CEI 2015)

#### 3.7.2.3.3 Marksville Period, AD 1–400

This period is marked by extensive interregional contact through a phenomenon labeled the Hopewell Interaction Sphere. The focal points of this interaction sphere were societies in the Ohio River and Illinois River valleys which acquired large quantities of exotic raw materials, including obsidian, copper, mica, shark's teeth, and marine shells, in exchange for specialized finished goods such as copper panpipes and ear spools. Within the Lower Mississippi Valley, the culture that participated in this interaction sphere is termed Marksville. Two Marksville period phases, Labranche and Gunboat Landing, have been defined in the vicinity of RBS. (CEI 2015)

#### 3.7.2.3.4 Baytown Period, AD 400–700

Troyville culture dominated the southern half of the Lower Mississippi Valley during this period, from the northern Tensas and southern Yazoo basins down to the Gulf of Mexico. Troyville ceramics are characterized by the persistence of certain Marksville types, but in more "broken-down" varieties. Small chipped stone points begin to supplant larger dart points during this period, heralding the arrival of the bow and arrow. Mound construction continued in the Baytown Period. (CEI 2015)

The Troyville-like culture present on the Louisiana coast during Baytown times is poorly understood. Most sites yielding examples of painted pottery on a Baytown Plain paste have been assigned to this time frame. The Whitehall phase, named for the Whitehall site (16LV19) on the Amite River, is presently the only phase identified in the vicinity of RBS. (CEI 2015)

3.7.2.3.5 Coles Creek Period, AD 700–1200

During this period, the use of incised, stamped, and punctuated pottery types in which the decorative zone is largely restricted to a band around the rim of the vessel, and by the construction of small platform mounds around plazas, occurred. Three sequential Coles Creek phases (Bayou Cutler, Bayou Ramos, and St. Gabriel) are currently recognized for southeast Louisiana. (CEI 2015)

3.7.2.4 Mississippi Period (AD 1200 to 1450)

This period represents the apex of Native American social development. Mississippian culture was characterized by the presence of shell-tempered ceramics and a settlement pattern featuring large, often fortified villages, and mound centers which were the focus of ceremonial and political life for a region. In the lower Mississippi Valley, Mississippian culture encountered an indigenous non-Mississippian culture, and a hybridization of the two occurred. The resident culture is considered to have been Plaquemine, an outgrowth of Coles Creek culture that began about AD 1000. Several of the Plaquemine ceramic types appear to be direct outgrowths of Coles Creek types. Mound construction continued on an even greater scale than in the previous period, as the mounds became larger, there were more at each site, and there were more sites. (CEI 2015)

3.7.2.5 Protohistoric and European Contact (AD 1450 to 1700)

In 1682, French explorers traveled downriver from Canada to the mouth of the Mississippi. Their attempt to establish a colony in the region was unsuccessful, and it was not until 1699 that the French were able to successfully occupy what would later become Louisiana. In that same year, a French settlement on Biloxi Bay (Mississippi) was established and French exploration of the lower Mississippi River began. Based on the accounts of these explorations, a number of Native American groups resided along the lower Mississippi River and its western tributaries. The principal aboriginal groups encountered in the study region (Figure 3.7-8) by these expeditions were the Bayagoula, Chaouacha, Chitimacha, Houma, Mugulasha, Ofogoula, Okelousa, Ouacha, and Tunica. (CEI 2015)

3.7.2.6 Historic Era

3.7.2.6.1 French Colonial Period, 1700–1763

In 1719, the capital of Louisiana was moved from Mobile to Ocean Springs, Mississippi, and in 1720 to Biloxi. Following a 1722 hurricane, the French abandoned both Biloxi and Pensacola and moved their capital to New Orleans, which had been established just 4 years earlier. Much of the settlement of the colony during these early years was focused on large concessions granted along the Mississippi River above (i.e., upriver of) New Orleans. (CEI 2015)

One of the largest grants made in the region was the Sainte Reyne concession, located opposite False River in present-day West Feliciana Parish. In January 1720, two concessions were organized under the appellation Sainte Reyne Colony: one near Thompson Creek in West Feliciana Parish, and one in Jefferson Parish. These concessions were part of a larger effort begun by a consortium of French nobility interested in developing the colony of Louisiana. Like virtually all of the other concessions, Sainte Reyne met with almost instant financial disaster, the monetary notes issued to fund the colony considerably depreciating within a year of its charter. (CEI 2015)

By 1724, the Pointe Coupee concessions were virtually non-extant. Many of the inhabitants of both Sainte Reyne and Ecores Blanc who were unable to return to France (particularly the engagées whose repatriation efforts were often blocked) left the concessions and moved into the surrounding area. Though it is not known precisely where these families resided, they most likely were living in present-day Pointe Coupee Parish. (CEI 2015)

In 1716, the French established Fort Rosalie among the Natchez. Following the deaths of several pro-French Natchez chiefs between 1725 and 1728, pro-English leaders took control of the tribe. Under their leadership, the Natchez destroyed Fort Rosalie and killed settlers and soldiers, including many at the nearby Sainte Catherine concession. One result of the war was the establishment of eight protective forts or posts, one of which was located at Pointe Coupee. (CEI 2015)

During the early colonial period, both sides of the river were under French control and under the religious jurisdiction of the Bishop of Quebec. In 1763, as a result of the Seven Years War, France ceded all of her holdings east of the Mississippi River and north of the Isle of Orleans to Great Britain, and all of the remainder of Louisiana to Spain. The 1763 Treaty of Paris brought the war to an official end and resulted in Spain turning all of Florida over to Britain. All of the lands east of the Mississippi River, with the exception of the Isle of Orleans, were placed under British control, while all of those west of the river were placed under Spanish control. (CEI 2015)

3.7.2.6.2 British West Florida, 1763–1783

During this period, Florida was divided into East Florida and West Florida. Like the French, the British were not very successful in attracting settlement in much of West Florida, despite the fact that they granted 1,000-acre tracts to those who would settle the property and cultivate it. The British were successful, however, in granting a number of patents in the Bayou Sara and Thompson Creek areas, most of which were never developed (Figure 3.7-9). Despite the small but growing European population of the area, a number of Native Americans were still present in the general vicinity into the 1770s, including the Ofogoula and Tunica, as well as the recently transplanted Biloxi and Pascagoula (Figure 3.7-10). (CEI 2015)

After Spain allied itself with France and the American Colonies in the American Revolution, war was declared against Britain. Britain constructed Fort New Richmond at Stephen Watts and Samuel Flower's Plantation in Baton Rouge. By the end of September, the Spanish captured the fort in the first Battle of Baton Rouge. As a result of the battle, Spain controlled the Mississippi River south of Natchez. The Spanish also seized the British posts at Manchac and Pensacola, effectively ending British control of West Florida. (CEI 2015)

#### 3.7.2.6.3 Spanish West Florida, 1783–1810

During much of her ownership of West Florida, Spain considered the northern boundary of the colony to be north of Natchez, Mississippi. Spain subdivided the Natchez District and created the Feliciana District, composed of both East and West Feliciana parishes. Based upon early land claims, the population of the Feliciana parishes expanded rapidly following the signing of the treaty of San Lorenzo del Escorial, which placed the boundary between Spanish West Florida and the American-held Mississippi Territory at its present location at the 31st parallel. Settlement of the area, particularly by those of Anglo descent, continued until about 1798, when it leveled off somewhat until about 1802. (CEI 2015)

In October 1800, the Treaty of San Ildelfonso was secretly negotiated between Spain and France. As a result of this treaty, the territory of Louisiana, which did not include West Florida, was ceded back to France. Three years later, the United States bought Louisiana from France as the Louisiana Purchase. West Florida remained a Spanish possession until 1810. The plantation economy of the region continued to grow under Spanish rule, but by the 1790s persistent problems with the indigo crop and technological advances in the granulation of sugar, as well as the ginning of cotton, led to a shift toward sugar and cotton as the principal commercial crops. (CEI 2015)

By 1800, many West Feliciana residents, particularly those of British descent, were dissatisfied with Spanish rule, as they felt that they should be entitled to a representative form of government. By 1810, revolution was imminent. Sensing this, the governor secretly sent a request to Pensacola requesting troops to quell the unrest. Intercepting the letters, the revolutionaries convened a secret council, deposed the governor, declared West Florida an independent republic, and set about seizing Fuerte San Carlos. Taking the fort in September 1810, the revolutionaries also captured the governor and the garrison of the fort without any losses to themselves. (CEI 2015)

The West Florida Republic, with its capital at St. Francisville, was officially declared to be independent 3 days later. In December 1810, the Louisiana territorial governor officially took control of the fledgling republic for the United States. The governor subsequently divided the republic into six parishes, of which Feliciana was one. (CEI 2015)

#### 3.7.2.6.4 Early American Period, 1810–1861

Around January 1811, Feliciana County was formed. The county, which included the project area, initially consisted of all of the North Shore and extended eastward from the Mississippi

River to the Perdido River. However, that portion of Feliciana County east of the Pearl River was soon partitioned off. (CEI 2015)

After a brief period of independence, West Florida, along with the rest of Louisiana, was officially recognized as the 18th state of the United States in 1812. Soon after, Feliciana County was reduced in size to form Feliciana Parish. The newly created parish consisted of both present-day East Feliciana and West Feliciana parishes. With its seat at Jackson, Feliciana Parish survived for only a very short period, being subdivided in 1824 to form the current East and West Feliciana parishes. (CEI 2015)

By the time West Feliciana Parish was formed, plantation agriculture in the area was largely dependent on cotton, which had replaced indigo some 30 years prior as a cash crop. In addition to requiring a large labor force to harvest the crops, cotton agriculture also demanded more efficient transportation to market due to the physical bulk of the cotton bales. Water transportation was not a viable alternative in the interior of West Feliciana Parish as there were no navigable streams to transport goods to the Mississippi River—the main transportation artery. One of the earliest recorded roads in the area was the Camino Real that connected Natchez to Baton Rouge. That road, parts of which still exist as farm roads, crossed the parish north of the present project area. By the mid-1790s, the Camino Real was largely replaced by the St. Francisville-Pinckneyville Road and the Bayou Sara-Baton Rouge Road. The latter road roughly followed the route of present-day US-61 between Alexander Creek and Thompson Creek. (CEI 2015)

The charter for the West Feliciana Railroad Company was granted in 1831 which gave the company the right to construct a railroad from the Mississippi River "at or near" St. Francisville "in the direction" of Woodville and to operate the railroad for a period of 40 years. Construction began in the early months of 1836, and the final section of the new railway was completed by the autumn of 1842. The completion of the railroad led to the increased development of West Feliciana as a cotton and sugar cane producer. Plantation agriculture in West Feliciana reached its zenith in the two decades prior to the Civil War before virtually disappearing during Reconstruction. Concomitant with plantation growth was the growth of slavery. (CEI 2015)

3.7.2.6.5 Civil War and Reconstruction, 1861–1900

In April 1861, Confederate forces opened fire on Fort Sumter in South Carolina. The Union garrison surrendered 2 days later. Despite the importance of New Orleans to the Confederacy, it fell to Union naval forces in April 1862. By that July, Union forces were threatening West Feliciana planters. (CEI 2015)

Despite the fact that nearby Port Hudson was the site of one of the pivotal battles of the Civil War, there was only limited action in West Feliciana Parish. The area that saw the most conflict was the community of Bayou Sara. In August 1862, the U.S. gunboat Essex shelled the town, and the Union navy continued to harass Bayou Sara for 2 weeks, during which time the U.S. ram *Sumter* was burned and Bayou Sara was shelled and burned. Nine months later, federal troops crossed the Mississippi River at Bayou Sara on their way to lay siege to Port Hudson. By that time, Bayou Sara was virtually leveled from shelling by Union gunboats. (CEI 2015)

In June 1863, the town of St. Francisville was shelled and shelled again. During the following months, there were several skirmishes at Bayou Sara and the St. Francisville vicinity, none of which could be considered major actions. (CEI 2015)

When it was originally built, the terminus of the West Feliciana Railroad was located on the west bank of Bayou Sara, necessitating the construction of a trestle across the bayou to connect it with the east bank tracks. Most likely destroyed by Union troops during the Civil War, it would not be until 1875 that the railway would resume operations with a steam locomotive. The railway remained viable until it was abandoned in 1978. (CEI 2015)

#### 3.7.2.6.6 Twentieth Century and Beyond, 1900–2015

Following the Civil War, the parish's economy was virtually destroyed. To further add to the poor economic conditions of the parish, a boll weevil infestation in about 1909 destroyed the cotton crop. Hence, many of the large plantations were replaced by smaller tenant farms that focused on cattle raising, dairying, and sweet potato cultivation. One result was that settlement patterns changed dramatically from relatively isolated clusters of slave dwellings to sparsely scattered tenant homes. (CEI 2015)

Roads during this period were still unimproved, with low-water fords at most creeks rather than bridges. By the 1920s, however, some of the main arteries in West Feliciana had been improved, with concrete bridges replacing many of the smaller fords. (CEI 2015)

By 1900, the community of Bayou Sara's importance declined following the Civil War as the railroads overtook riverine commerce as the primary means of transportation. Flooding by the Mississippi River had also taken its toll on the town during the 19th century. Although already in decline, what remained of the community was effectively destroyed by the flood of 1927. Similarly, the Tunica Swamp area that had been leveed off as early as the mid-18th century was largely abandoned by the late 19th century after a series of successive floods destroyed the levee system there. Today, only camps and soybean fields may be found along the Mississippi River in Tunica Swamp, while there are only a handful of permanent structures at Bayou Sara. (CEI 2015)

St. Francisville, once subordinate in size and importance to Bayou Sara, became the parish seat when West Feliciana Parish was formed in 1824. Three years later, a church was erected there and the community grew in stature. Largely spared from much of the destruction borne by nearby Bayou Sara during the Civil War, the core of St. Francisville was placed on the NRHP in 1980. Much of the remainder of the town was placed on the NRHP when the St. Francisville Historic District was enlarged in 1982. (CEI 2015)

### 3.7.3 Onsite and Offsite Cultural Resources

Onsite cultural resources are those located within the 3,342-acre RBS property. Although no license-renewal-related refurbishment activities have been identified, such that no adverse effects on cultural resources would occur, the RBS property is still considered an APE for the continued operation of the RBS facility for the purpose of Section 106 compliance for the LRA.

Twelve archaeological sites have been identified on the RBS property (Figure 3.7-11; Table 3.7-1). None of these sites are listed on the NRHP, nor have any been determined eligible for inclusion on the NRHP. However, several of these sites contain apparent *in situ* archaeological deposits, most notably the Magnolia Plantation Sugarhouse (16WF36) and Cottonmouth Mound (16WF61) sites. Of the 12 sites, 9 of them (16WF19, 16WF36, 16WF54, 16WF55, 16WF56, 16WF61, 16WF84, 16WF111, and 16WF181) require additional testing to determine their NRHP status. Sites 16WF180 and 16WF182 have both been determined not eligible for inclusion on the NRHP, while the reported location of site 16WF112 was destroyed in the late 1970s. Finally, while site 16WF51, a historic-period cemetery, was purported to be located on RBS property, it is actually located on the adjacent property. (CEI 2015)

The 2015 investigation in support of license renewal produced an archaeological sensitivity analysis based on previous archaeological investigations, a review of archival and secondary historical sources, topography, and a walkover of the property. Five zones of archaeological sensitivity were identified based upon the presence of known cultural remains, geography, and archival documentation of settlement (Figure 3.7-12). (CEI 2015)

Offsite cultural resources are those outside the 3,342-acre RBS property boundary. A background literature search was conducted to locate offsite cultural resources. Lists of known archaeological sites and historic properties within a 6-mile radius of RBS are presented in Tables 3.7-1 and 3.7-2. (CEI 2015)

### 3.7.4 Cultural Resource Surveys

#### 3.7.4.1 <u>Previous RBS Site Studies</u>

##### 3.7.4.1.1 Neuman Study (1971 and 1972)

In 1971, Robert Neuman conducted an archaeological survey for the then-proposed RBS. This survey involved a pedestrian survey of cleared pasture areas, forested slopes, and gully banks. In addition, an aerial survey was conducted that covered the entire project area. This study located a series of small prehistoric sites (16WF19, 16WF54, 16WF55, and 16WF56) (Figure 3.7-11) along the bluffs overlooking the Mississippi River floodplain. In 1972, additional pedestrian surveys for the proposed RBS were conducted; however, no additional archaeological sites were identified. Neuman's 1972 report did not graphically indicate where the pedestrian survey was conducted, nor is there any indication that systematic subsurface testing was conducted within the areas examined. As current Louisiana Division of Archaeology (LDOA)

Phase I survey standards require systematic subsurface testing and it is unclear as to what was surveyed in 1971 and 1972, those investigations are not depicted in Figure 3.7-11. (CEI 2015)

3.7.4.1.2 Heartfield, Price and Greene, Inc. Study (1981)

In 1981, Heartfield, Price, and Greene, Inc., conducted a prehistoric archaeological site inventory for Energy Transpiration System, Inc. The inventory of 24 parishes included West Feliciana Parish. Included in their inventory were sites 16WF19, 16WF54, 16WF55, and 16WF56 (which had previously been identified by Neuman in 1971–1972) within the RBS project area. The work was limited to a records check; no new fieldwork was undertaken. As no fieldwork was conducted for this project, it is not depicted in Figure 3.7-11. (CEI 2015)

3.7.4.1.3 Stuart and Greene Study (1982)

In 1982, David R. Stuart and Jerome A. Greene conducted an archaeological survey for the proposed Bayou Sara Revetment impact area. The survey consisted of a walkover of looping transects that paralleled the Mississippi River and a careful examination of eroding banks, drainages, and disturbed areas. The survey did not include systematic subsurface testing. No cultural resources were identified as a result of the survey. As the 1982 survey did not include systematic subsurface testing, it would not meet current LDOA Phase I survey standards. Consequently, it is not included in Figure 3.7-11. (CEI 2015)

3.7.4.1.4 LDOA (1982)

GSU personnel contacted the LDOA in 1982 about the existence of the remains of historic-period ruins on the RBS property. As a result, the LDOA went to investigate and identified the ruins as the remains of the Magnolia Plantation Sugarhouse (16WF36) (Figure 3.7-11). During its investigation, the LDOA identified two standing brick walls and recommended additional testing to determine whether the site was eligible for inclusion in the NRHP. As the LDOA did not conduct systematic subsurface investigations, it is not depicted in Figure 3.7-11. (CEI 2015)

3.7.4.1.5 Shuman and Orser Study (1983)

In 1983, Malcolm Shuman and Charles Orser conducted a closer examination of the remains of the Magnolia Plantation Sugarhouse (16WF36). The largest feature was "L-shaped" and contained two arched openings. The second was a 3-foot-wide brick wall located parallel to, but northeast of, the L-shaped ruin. The site report does not identify the function of the ruins other than to say that they were associated with a steam-powered sugarhouse. Subsequent research has shown that the Magnolia ruins once supported a cane grinder and the steam engine that powered it. (CEI 2015)

Twenty shovel tests were dug in the immediate vicinity of the Magnolia ruins in 1983, and four produced artifacts other than brick: one square nail; one piece of flat, light green glass; a molded bottle neck; and a fragment of a chicken leg bone. Two other tests encountered intact subsurface features: a probable brick pier and a brick wall or floor remnant aligned with the smaller standing ruin at the site. While the site was of local interest, its architecture was "not remarkable," and it was therefore not recommended for inclusion in the NRHP. However, it was suggested that additional work at the site could reveal more data and, therefore, site 16WF36 should be avoided. The approximate area examined in 1983 is depicted in Figure 3.7-11 (labeled "CR1"). (CEI 2015)

#### 3.7.4.1.6 Surveys Unlimited Research Associates, Inc. (1986)

In 1986, Surveys Unlimited Research Associates, Inc. (SURA), conducted an archaeological survey of the 432.81-acre property of Al Danos, which adjoins the RBS property. Three archaeological sites were recorded during the course of that survey, including 16WF51, an unmarked historic cemetery. The 16WF51 site was recorded as being located on the RBS property; however, this is not likely the location of the site as that area of the RBS property lay outside of the 1986 SURA project area. As site 16WF51 was reported to be within the limits of the RBS property in 1986, its reported location is depicted in Figure 3.7-11; its actual location based upon land forms within SURA's project area east of the RBS property is also provided in Figure 3.7-11. As the 1986 SURA project area did not include any RBS property, that survey area is not depicted in Figure 3.7-11. Similarly, site 16WF51 is not included among the 12 known archaeological sites on RBS property. (CEI 2015)

#### 3.7.4.1.7 Coastal Environments, Inc. Study (1994)

In 1994, Coastal Environments, Inc. (CEI) conducted a cultural resources investigation (pedestrian survey and testing) of the US-61 Four Lane Project Corridor between the community of Bains and Thompson Creek in West Feliciana Parish, Louisiana. A small portion of this survey was conducted on a portion of RBS that fronts US-61 (labeled "CR3" in Figure 3.7-11). No archaeological sites were identified within that portion of the survey. (CEI 2015)

#### 3.7.4.1.8 CEI Study (1994 and 2001)

In 1994 and again in 2001, CEI conducted a Phase I Identification and Assessment Field Survey within the proposed ROW for the Mississippi River Bridge between New Roads and St. Francisville on behalf of the Louisiana Department of Transportation & Development (LADOTD). CEI examined two alignments for the project, of which Alignment "F" passed through the RBS property. This survey identified two archaeological sites, Cottonmouth Mound (16WF61) and the Causeway Site (16WF84), within this area (labeled "CR2" in Figure 3.7-11). (CEI 2015)

Cottonmouth Mound (16WF61), a previously unknown prehistoric mound site, dates from the middle Coles Creek to Mississippian period. The site is located on a narrow, heavily wooded, finger ridge overlooking Grants Bayou (Figure 3.7-11). It consists of a virtually intact platform mound, a small conical mound, rich intact middens, and an extensive surface and subsurface artifact scatter covering the entire width of the finger ridge. The Cottonmouth Mound site (16WF61) is considered to be potentially eligible for listing in the NRHP, but requires further study. (CEI 2015)

The Causeway Site (16WF84), a previously unknown prehistoric site, dates from the Baytown to Mississippian period. This site is located on a ridge southwest of the nearby Cottonmouth Mound (Figure 3.7-11). The site was delineated with 36 shovel tests, 21 of which were positive for artifacts. Insufficient information was gathered to determine if the site is eligible for listing in the NRHP, and its NRHP eligibility status remains unknown. (CEI 2015)

3.7.4.1.9 Hays Study (1996)

In 1996, Christopher Hays reported on several archaeological sites in the project area vicinity in an annual report for the Regional Archaeology Program. As part of that work, Hays examined the personal collections of Nancy Bickham gathered from three sites (16WF110, 16WF111, and 16WF112) and performed related site visits where possible. Of these, only the Grants Bayou site (16WF111) and Leslie Bickham site (16WF112) are located within the present project area (Figure 3.7-11). The Grants Bayou site (16WF111) collection had been made from a prehistoric artifact scatter found at the Bickham's former farm, which once included substantial portions of the RBS property. The collection recovered from the Grants Bayou site indicates a late Coles Creek to Plaquemine prehistoric site occupation. No additional artifacts were recovered from 16WF111 during a site visit made by Hays. The Leslie Bickham site (16WF112) collection had been made at the main RBS site prior to construction, while it was still part of the Bickham's farm. The collection suggests an Archaic and a late Coles Creek to Plaquemine prehistoric site occupation. The site was destroyed by construction of RBS in the mid-1970s and was not visited by Hays. As Hays' reporting of the sites was based upon oral information and because it did not include a systematic survey at either 16WF111 or 16WF112, it is not depicted in Figure 3.7-11. (CEI 2015)

3.7.4.1.10 R. Christopher Goodwin & Associates Study (2007)

In 2007, R. Christopher Goodwin & Associates (RCGA) conducted a Phase I cultural resources survey of the proposed 587.4-acre expansion of RBS (labeled "CR4" in Figure 3.7-11). Prior to fieldwork completion, it was found that a substantial portion of the study area had been previously disturbed. For instance, the area immediately southwest of the main plant facility had been used as a laydown area during site construction, and another area had been used as a landfill for material excavated from the main plant site in the mid-1970s. After consultation with the LDOA, those areas were deemed too disturbed to warrant examination, and the survey was limited to the 312-acre portion of the project area that had not previously been disturbed by plant construction. The 2007 survey included revisiting the Magnolia Plantation Sugarhouse (16WF36) site and the identification of three new sites (16WF180, 16WF181, and 16WF182). (CEI 2015)

At the time, it was noted that the Magnolia Plantation Sugarhouse (16WF36) (Figure 3.7-11) had deteriorated considerably since it had been last visited in 1983. Still, surface finds were numerous, although only six shovel tests proved positive for artifacts. Five other shovel tests, however, encountered intact mortar flooring and a buried brick wall. Based on these subsurface findings, the site was recommended as potentially eligible for the NRHP, and the LDHP concurred on February 19, 2008. However, the site is listed as ineligible in the LDOA NRHP eligibility database. (CEI 2015)

The Locus Area 03-01 site (16WF180) shown in Figure 3.7-11, and recorded by RCGA in 2008, is likely associated with a mid-20th century structure that fronted LA-965. Eleven shovel tests were excavated within the site's vicinity; however, these shovel tests failed to produce any cultural material. Site 16WF180, due to its limited research potential, was not considered eligible for the NRHP. (CEI 2015)

The Locus Area 03-02 site (16WF181), also recorded by RCGA in 2008, is composed of a medium density surface and subsurface historic-artifact scatter and likely represents the remains of an early-to-mid-19th century occupation. This site is located on a ridge top near the Mississippi River (Figure 3.7-11). Seventeen shovel tests excavated at the site yielded 55 historic-period artifacts. Based upon their findings, RCGA recommended that the site be avoided or tested to see if it was eligible for the NRHP. (CEI 2015)

The Locus Tran-Line 1-01 site (16WF182), the last of the three sites newly recorded by RCGA in 2008, is composed of a low-density surface and subsurface historic artifact scatter and one sherd of Baytown Plain. The site is located on a ridge top overlooking the Mississippi River (Figure 3.7-11). Thirty-three shovel tests were excavated at the site, of which only three proved positive for artifacts. Site 16WF182, due to its limited research potential, was not considered eligible for the NRHP. (CEI 2015)

#### 3.7.4.2 Phase 1A Sensitivity Assessment

The brief historical overview and the results of previous investigations conducted on the property and in similar settings indicate that the ridge tops across the property possess a high potential for containing archaeological resources. Twelve prehistoric and historic period sites have already been identified on and along the property's ridges. Those portions of the bluffs overlooking the Mississippi River especially provided an ideal place for prehistoric peoples to settle, as they offered protection from floodwaters as well as easy access to transportation, fresh water, and a variety of ecosystems to exploit. The inland ridges above the area's streams, particularly those along Grants Bayou, were similarly attractive to prehistoric settlers. In addition, archival cartographic resources indicate that there were numerous late-18th-, 19th-, and 20th-century occupations scattered about the property. There is also a potential for early 18th-century European occupation on the property. Like their prehistoric predecessors, most of these occupations were sited along elevated ridge tops. However, there was also at least some historic-period settlement along the margins of the Mississippi River, and early roads would have had fords, and later bridges, along area streams. (CEI 2015)

Cemeteries were undoubtedly associated with these various occupations, both prehistoric and historic. Although one previously recorded historic-period cemetery (16WF51) purported to be on RBS property was determined to have been mislocated, the field visit and walkover visited an unrecorded turn-of-the-20th-century cemetery on RBS's property near LA-965. Site visits were limited to those portions of the RBS property considered to have a high potential for containing archaeological remains, and to previously recorded archaeological sites. The walkovers made during these visits were limited to visual inspection. (CEI 2015)

In addition to the field visit, background information was gathered specific to the RBS property, and databases at the LDHP were consulted in an effort to identify previously recorded historic properties and archaeological sites within a 6-mile radius of the RBS reactor center point. These archaeological sites and historic properties are listed in Tables 3.7-1 and 3.7-2, respectively. Twelve previously recorded archaeological sites have been identified within the limits of the RBS property (Table 3.7-1). Although none have been identified as being eligible for inclusion on the NRHP, nine require additional investigation to determine their significance in terms of NRHP eligibility (16WF19, 16WF36, 16WF54, 16WF55, 16WF56, 16WF61, 16WF84, 16WF111, and 16WF181). No standing structures have previously been recorded on the RBS property. (CEI 2015)

### 3.7.5 Procedures and Integrated Cultural Resources Management Plans

Entergy has administrative controls in place for management of cultural resources ahead of any future ground-disturbing activities at the plant, although no license-renewal related ground-disturbing activities have been identified. These controls consist of the following:

- Fleet cultural resources protection plan that requires reviews, investigations, and consultations as needed, and provides instructions to workers when performing ground-disturbing activities in undisturbed or cultural resource sensitive areas (Entergy 2015n). Although there is no required training associated with this program, all employees are required to adhere to the instructions contained in the procedure.

- Environmental reviews and evaluations procedure that requires reviews prior to engaging in additional construction or operational activities that may result in an environmental impact, and implementation of BMPs to minimize impacts (Entergy 2013d).

These administrative controls ensure that existing, or potentially existing, cultural resources are adequately protected, and assist RBS in meeting state and federal expectations.

**Table 3.7-1**
**Archaeological Sites, 6-Mile Radius of RBS**

| Site Number | Parish | Quadrangle | NRHP Status |
|---|---|---|---|
| *Listed/Eligible (11)* | | | |
| 16EBR42 | East Baton Rouge | Port Hudson | Eligible |
| 16EF7 | East Feliciana | Port Hudson | Listed |
| 16EF68 | East Feliciana | Port Hudson | Eligible |
| 16PC62 | Pointe Coupee | New Roads | Eligible/Partially Mitigated[a] |
| 16WF34 | West Feliciana | Elm Park | Listed |
| 16WF39 | West Feliciana | Elm Park | Eligible/Partially Mitigated[a] |
| 16WF89 | West Feliciana | Saint Francisville | Eligible/Partially Mitigated[a] |
| 16WF101 | West Feliciana | Elm Park | Eligible |
| 16WF156 | West Feliciana | Elm Park | Listed |
| 16WF175 | West Feliciana | Saint Francisville | Eligible |
| Bayou Sara-Baton Rouge Road | West Feliciana | Elm Park | Eligible |
| *Partially Ineligible/Unknown (9)* | | | |
| 16EF57 | East Feliciana | Port Hudson | Partially Ineligible/Unknown[b] |
| 16PC31 | Pointe Coupee | Port Hudson | Partially Ineligible/Unknown[b] |
| 16WF87 | West Feliciana | Saint Francisville | Partially Ineligible/Unknown[b] |
| 16WF90 | West Feliciana | Saint Francisville | Partially Ineligible/Unknown[b] |
| 16WF96 | West Feliciana | Port Hudson | Partially Ineligible/Unknown[b] |
| 16WF97 | West Feliciana | Port Hudson | Partially Ineligible/Unknown[b] |
| 16WF99 | West Feliciana | Elm Park | Partially Ineligible/Unknown[b] |
| 16WF102 | West Feliciana | Elm Park | Partially Ineligible/Unknown[b] |
| 16WF104 | West Feliciana | Elm Park | Partially Ineligible/Unknown[b] |
| *Ineligible (69)* | | | |
| 16EF56 | East Feliciana | Jackson | Ineligible |
| 16PC33 | Pointe Coupee | New Roads | Ineligible |
| 16EF137 | East Feliciana | Port Hudson | Ineligible |
| 16EF139 | East Feliciana | Port Hudson | Ineligible |
| 16EF140 | East Feliciana | Port Hudson | Ineligible |
| 16PC56 | Pointe Coupee | New Roads | Ineligible |

**Table 3.7-1 (Continued)
Archaeological Sites, 6-Mile Radius of RBS**

| Site Number | Parish | Quadrangle | NRHP Status |
|---|---|---|---|
| 16PC58 | Pointe Coupee | New Roads | Ineligible |
| 16PC59 | Pointe Coupee | New Roads | Ineligible |
| 16PC60 | Pointe Coupee | New Roads | Ineligible |
| 16PC73 | Pointe Coupee | New Roads | Ineligible |
| 16PC75 | Pointe Coupee | New Roads | Ineligible |
| 16PC109 | Pointe Coupee | Port Hudson | Ineligible |
| 16PC111 | Pointe Coupee | New Roads | Ineligible |
| 16PC112 | Pointe Coupee | New Roads | Ineligible |
| 16PC113 | Pointe Coupee | New Roads | Ineligible |
| 16PC114 | Pointe Coupee | New Roads | Ineligible |
| 16PC115 | Pointe Coupee | New Roads | Ineligible |
| 16PC116 | Pointe Coupee | New Roads | Ineligible |
| 16PC123 | Pointe Coupee | New Roads | Ineligible |
| 16PC125 | Pointe Coupee | Port Hudson | Ineligible |
| 16PC126 | Pointe Coupee | New Roads | Ineligible |
| 16WF5 | West Feliciana | Port Hudson | Ineligible |
| 16WF41 | West Feliciana | Port Hudson | Ineligible |
| 16WF42 | West Feliciana | Port Hudson | Ineligible |
| 16WF43 | West Feliciana | Port Hudson | Ineligible |
| 16WF44 | West Feliciana | Port Hudson | Ineligible |
| 16WF45 | West Feliciana | Port Hudson | Ineligible |
| 16WF46 | West Feliciana | Port Hudson | Ineligible |
| 16WF47 | West Feliciana | Port Hudson | Ineligible |
| 16WF58 | West Feliciana | Saint Francisville | Ineligible |
| 16WF59 | West Feliciana | Saint Francisville | Ineligible |
| 16WF62 | West Feliciana | Elm Park | Ineligible |
| 16WF64 | West Feliciana | Port Hudson | Ineligible |
| 16WF65 | West Feliciana | Elm Park | Ineligible |
| 16WF67 | West Feliciana | Elm Park | Ineligible |

**Table 3.7-1 (Continued)**
**Archaeological Sites, 6-Mile Radius of RBS**

| Site Number | Parish | Quadrangle | NRHP Status |
|---|---|---|---|
| 16WF68 | West Feliciana | Elm Park | Ineligible |
| 16WF69 | West Feliciana | Elm Park | Ineligible |
| 16WF72 | West Feliciana | Elm Park | Ineligible |
| 16WF73 | West Feliciana | Elm Park | Ineligible |
| 16WF74 | West Feliciana | Elm Park | Ineligible |
| 16WF75 | West Feliciana | Elm Park | Ineligible |
| 16WF76 | West Feliciana | Elm Park | Ineligible |
| 16WF78 | West Feliciana | Elm Park | Ineligible |
| 16WF79 | West Feliciana | Elm Park | Ineligible |
| 16WF85 | West Feliciana | Port Hudson | Ineligible |
| 16WF88 | West Feliciana | Saint Francisville | Ineligible |
| 16WF91 | West Feliciana | Elm Park | Ineligible |
| 16WF92 | West Feliciana | Elm Park | Ineligible |
| 16WF93 | West Feliciana | Elm Park | Ineligible |
| 16WF94 | West Feliciana | Elm Park | Ineligible |
| 16WF95 | West Feliciana | Elm Park | Ineligible |
| 16WF98 | West Feliciana | Port Hudson | Ineligible |
| 16WF100 | West Feliciana | Elm Park | Ineligible |
| 16WF103 | West Feliciana | Elm Park | Ineligible |
| 16WF105 | West Feliciana | Elm Park | Ineligible |
| 16WF113 | West Feliciana | Elm Park | Ineligible |
| 16WF114 | West Feliciana | Port Hudson | Ineligible |
| 16WF148 | West Feliciana | Saint Francisville | Ineligible |
| 16WF149 | West Feliciana | Port Hudson | Ineligible |
| 16WF150 | West Feliciana | Port Hudson | Ineligible |
| 16WF151 | West Feliciana | Port Hudson | Ineligible |
| 16WF152 | West Feliciana | Port Hudson | Ineligible |
| 16WF153 | West Feliciana | Port Hudson | Ineligible |
| 16WF154 | West Feliciana | Port Hudson | Ineligible |

**Table 3.7-1 (Continued)**
**Archaeological Sites, 6-Mile Radius of RBS**

| Site Number | Parish | Quadrangle | NRHP Status |
|---|---|---|---|
| 16WF155 | West Feliciana | Port Hudson | Ineligible |
| 16WF180 | West Feliciana | Elm Park | Ineligible[c] |
| 16WF182 | West Feliciana | Port Hudson | Ineligible[c] |
| 16WF187 | West Feliciana | Elm Park | Ineligible |
| 16WF188 | West Feliciana | Elm Park | Ineligible |
| *Unknown (37)* | | | |
| 16EF16 | East Feliciana | Port Hudson | Unknown |
| 16EF17 | East Feliciana | Port Hudson | Unknown |
| 16EF18 | East Feliciana | Port Hudson | Unknown |
| 16EF19 | East Feliciana | Port Hudson | Unknown |
| 16PC27 | Pointe Coupee | Port Hudson | Unknown |
| 16PC54 | Pointe Coupee | New Roads | Unknown |
| 16PC110 | Pointe Coupee | New Roads | Unknown |
| 16PC117 | Pointe Coupee | New Roads | Unknown |
| 16PC118 | Pointe Coupee | New Roads | Unknown |
| 16PC119 | Pointe Coupee | New Roads | Unknown |
| 16PC120 | Pointe Coupee | Port Hudson | Unknown |
| 16PC124 | Pointe Coupee | Port Hudson | Unknown |
| 16WF4 | West Feliciana | Port Hudson | Unknown |
| 16WF15 | West Feliciana | Saint Francisville | Unknown |
| 16WF19 | West Feliciana | Port Hudson | Unknown[c] |
| 16WF31 | West Feliciana | Port Hudson | Unknown |
| 16WF35 | West Feliciana | Elm Park | Unknown |
| 16WF36 | West Feliciana | Elm Park | Unknown[c] |
| 16WF37 | West Feliciana | Saint Francisville | Unknown |
| 16WF51 | West Feliciana | Port Hudson | Unknown |
| 16WF52 | West Feliciana | Port Hudson | Unknown |
| 16WF53 | West Feliciana | Port Hudson | Unknown |
| 16WF54 | West Feliciana | Port Hudson | Unknown[c] |

## Table 3.7-1 (Continued)
## Archaeological Sites, 6-Mile Radius of RBS

| Site Number | Parish | Quadrangle | NRHP Status |
|---|---|---|---|
| 16WF55 | West Feliciana | Port Hudson | Unknown[(c)] |
| 16WF56 | West Feliciana | Port Hudson | Unknown[(c)] |
| 16WF57 | West Feliciana | Saint Francisville | Unknown |
| 16WF60 | West Feliciana | Elm Park | Unknown |
| 16WF61 | West Feliciana | Port Hudson | Unknown[(c)] |
| 16WF66 | West Feliciana | Elm Park | Unknown |
| 16WF70 | West Feliciana | Elm Park | Unknown |
| 16WF77 | West Feliciana | Elm Park | Unknown |
| 16WF84 | West Feliciana | Port Hudson | Unknown[(c)] |
| 16WF110 | West Feliciana | Elm Park | Unknown |
| 16WF111 | West Feliciana | Port Hudson | Unknown[(c)] |
| 16WF147 | West Feliciana | Elm Park | Unknown |
| 16WF157 | West Feliciana | Saint Francisville | Unknown |
| 16WF181 | West Feliciana | Elm Park | Unknown[(c)] |
| *Destroyed (1)* | | | |
| 16WF112 | West Feliciana | Elm Park | Destroyed[(c)] |

(CEI 2015)

a. The entire site is determined eligible for inclusion on the NRHP; portions of the site were excavated as part of a Phase III Data Recovery.

b. Only a portion of site is determined not eligible for inclusion on the NRHP; the eligibility of the rest of the site is unknown.

c. Located on RBS property.

**Table 3.7-2**
**NRHP-Listed Properties, 6-Mile Radius of RBS**

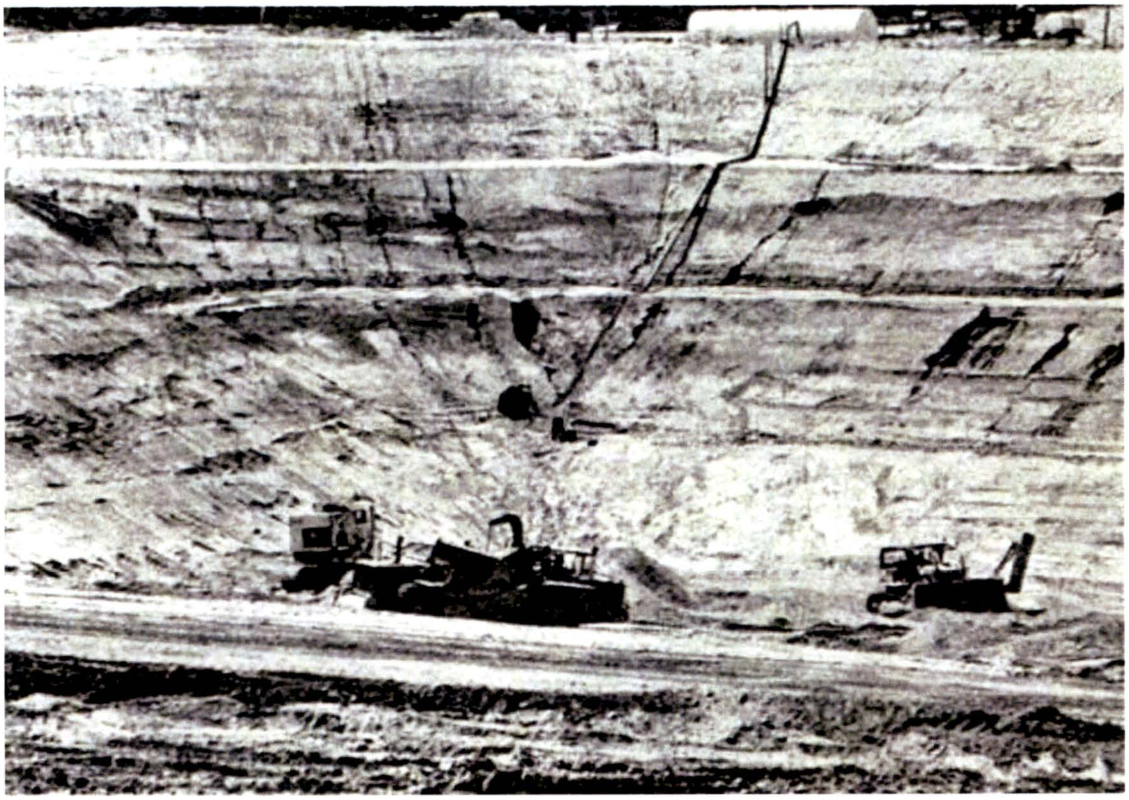
| Resource Name | Parish | Quadrangle | NRHP Listed | Distance from RBS (miles) |
|---|---|---|---|---|
| Wildwood Plantation House | East Feliciana | Port Hudson | 1988 | 5.7 |
| Port Hudson Battlefield (16EF7/16EBR42) | East Feliciana | Port Hudson | 1974[a] | 5.8 |
| 3V Tourist Court | West Feliciana | St. Francisville | 1993 | 3.0 |
| Butler-Greenwood, Greenwood Plantation | West Feliciana | St. Francisville | 1979 | 5.5 |
| Grace Episcopal Church, Grace Church | West Feliciana | St. Francisville | 1979 | 3.5 |
| Myrtles Plantation | West Feliciana | St. Francisville | 1978 | 4.6 |
| Oakley Plantation House<br>Audubon Memorial State Park (16WF34) | West Feliciana | Elm Park | 1973 | 3.2 |
| Propinquity House | West Feliciana | St. Francisville | 1973 | 3.5 |
| Rosedown Plantation<br>Rosedown Plantation State Historic Site (16WF156) | West Feliciana | Elm Park | 2001[a] | 3.8 |
| St. Francisville Historic District | West Feliciana | St. Francisville | 1980 | 3.3 |
| Star Hill Post Office and Store | West Feliciana | Elm Park | 2000 | 1.5 |
| Star Hill Plantation Dependency, Star Hill Billiard Hall | West Feliciana | Elm Park | 2003 | 1.0 |
| The Oaks Plantation | West Feliciana | St. Francisville | 1979 | 4.9 |
| Wickliffe House | Pointe Coupee | New Roads | 1991 | 5.9 |

(CEI 2015)

a. Also listed as a National Historic Landmark.

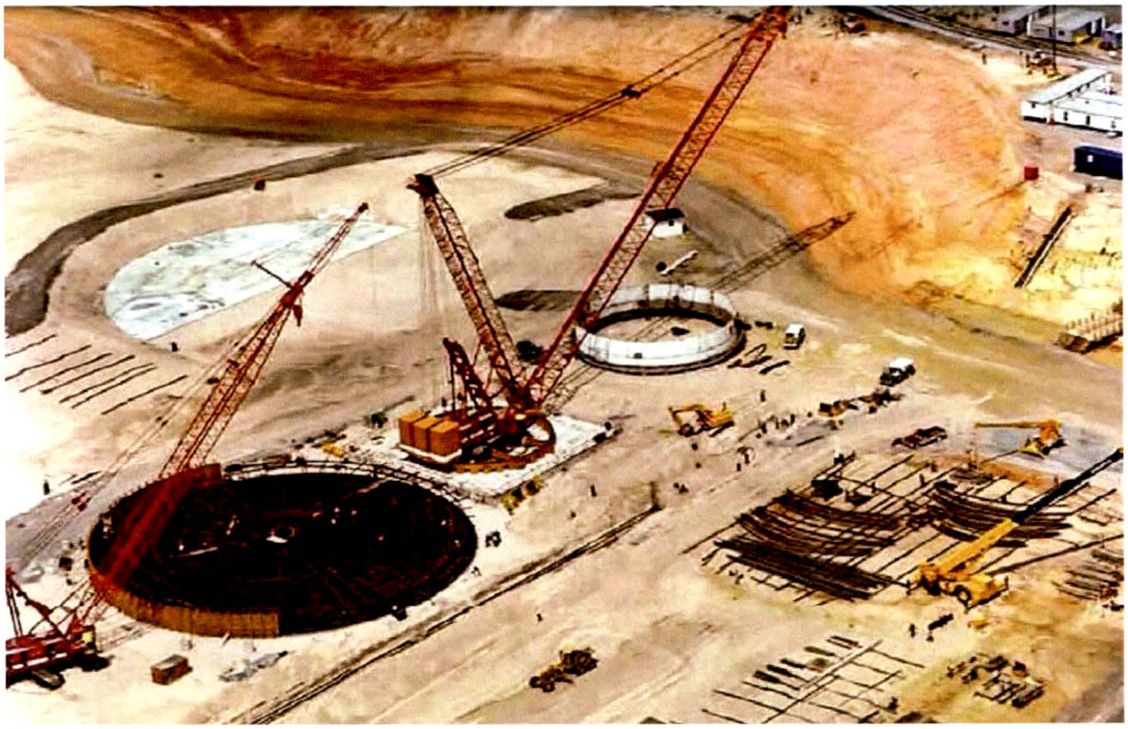
(CEI 2015, Photo 1)

**Figure 3.7-1**
**RBS Construction, 1976**



(CEI 2015, Photo 2)

**Figure 3.7-2**
**RBS Construction, Late 1976**



(CEI 2015, Photo 3)

**Figure 3.7-3**
**RBS Construction circa 1980**

(CEI 2015, Photo 4)

**Figure 3.7-4**
**RBS Construction, January 1982**

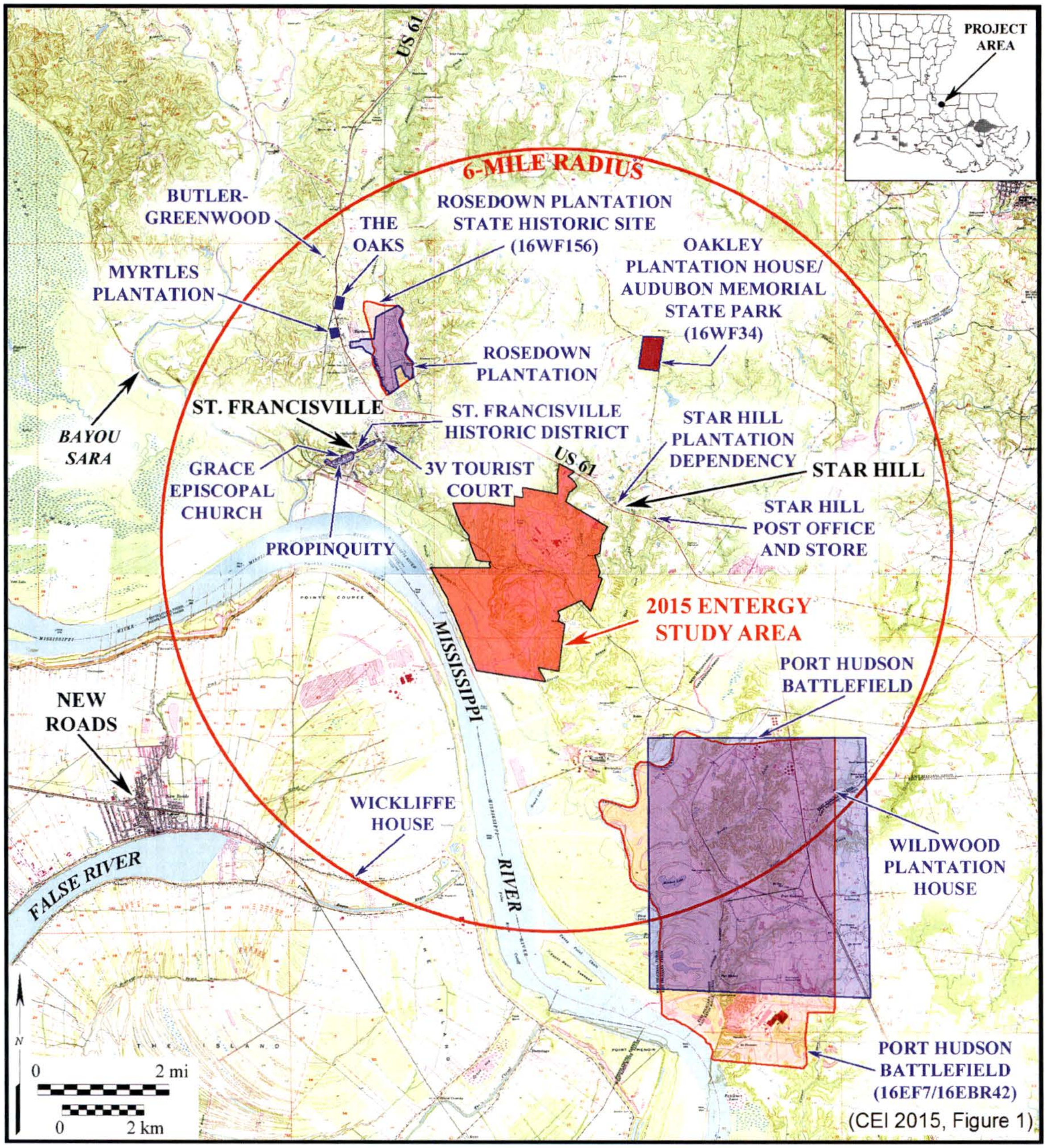



**Figure 3.7-5**
**NRHP-Listed Cultural Resources, 6-Mile Radius of RBS**

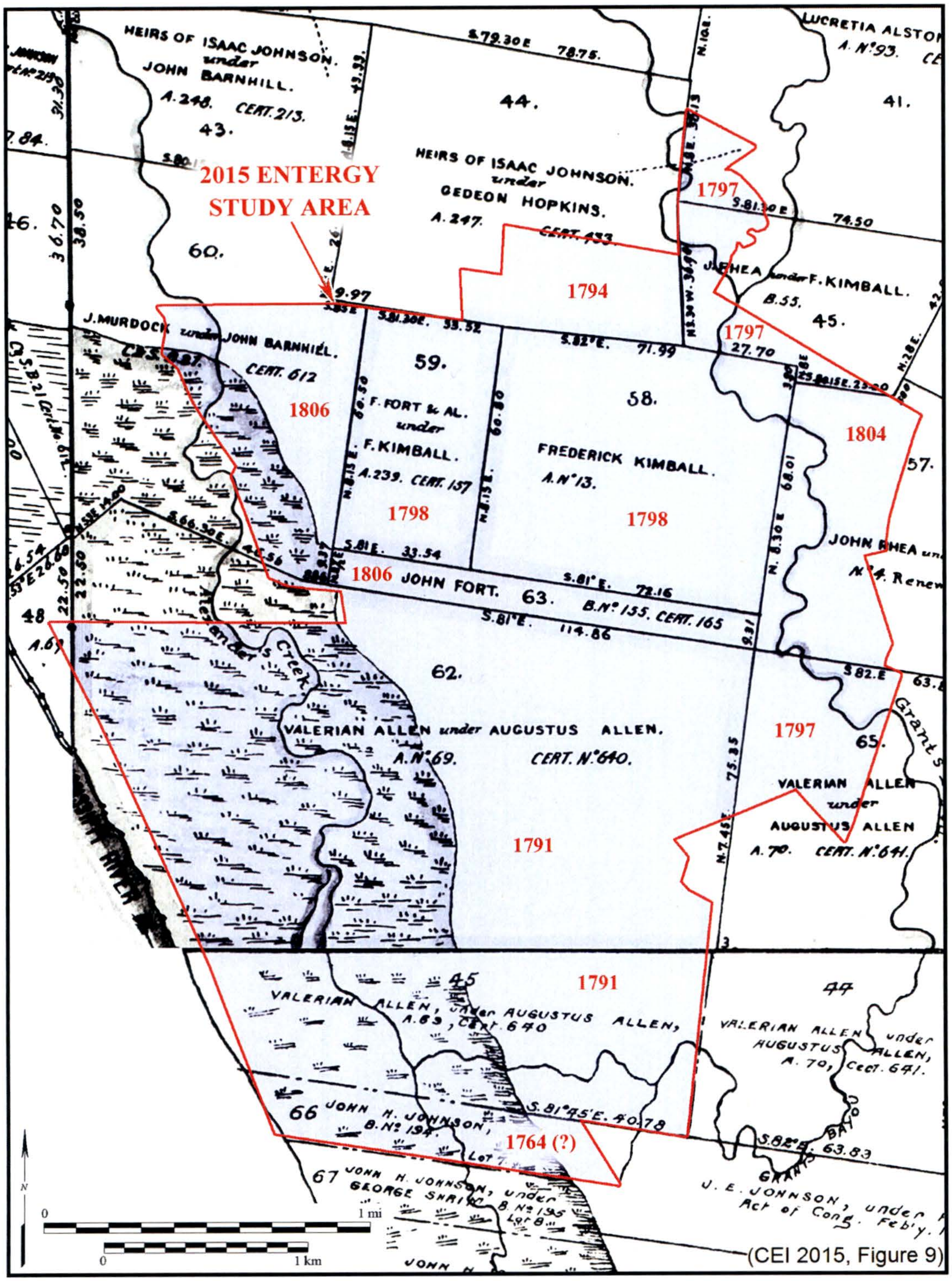



**Figure 3.7-6**
**Spanish and Early American Period Landowners, RBS Property**

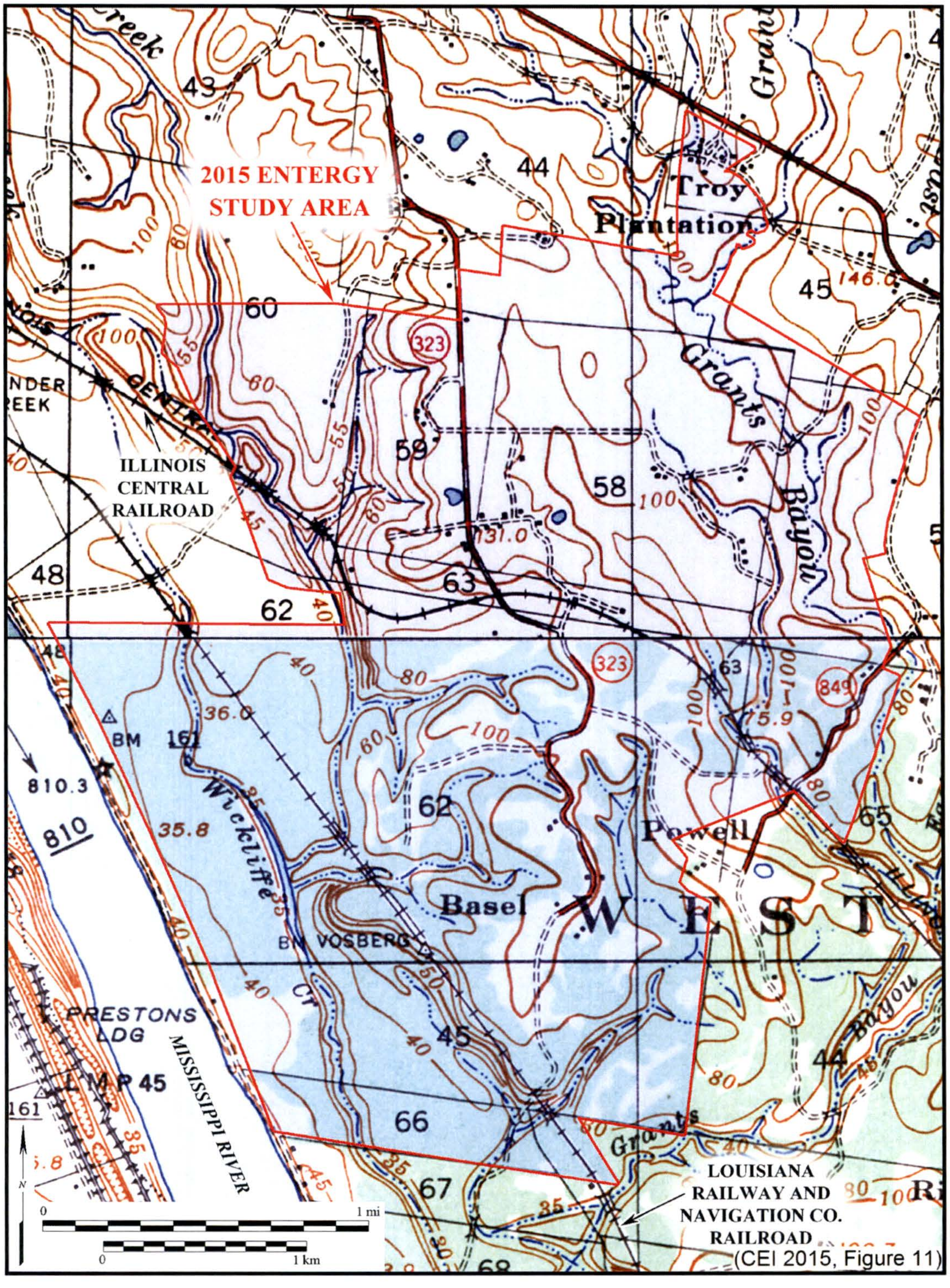



**Figure 3.7-7**
**RBS Project Area, Late 1930s**

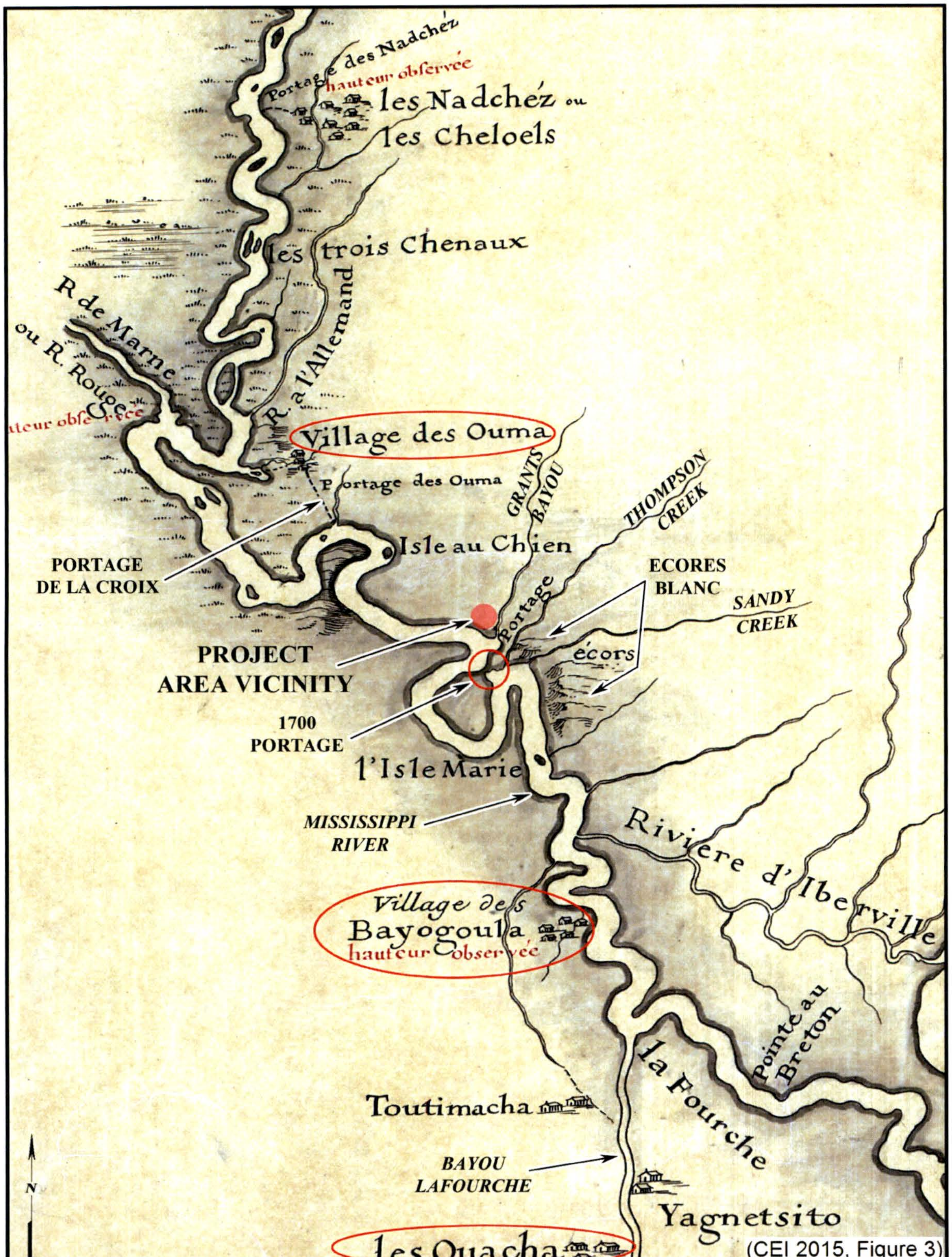



**Figure 3.7-8**
**RBS Area and Vicinity, 1702**

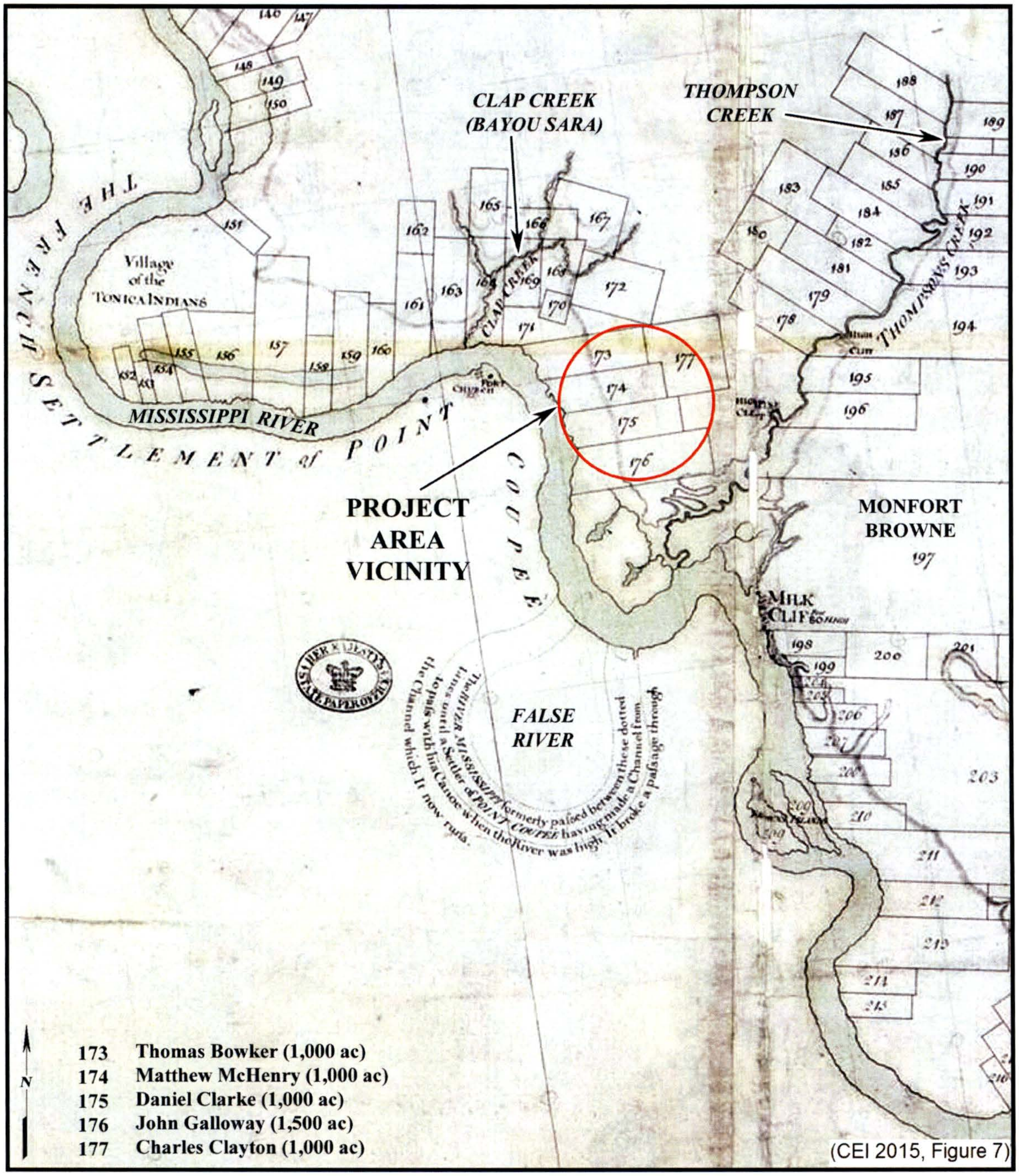



**Figure 3.7-9**
**English Land Grants in RBS Area and Vicinity circa 1772**

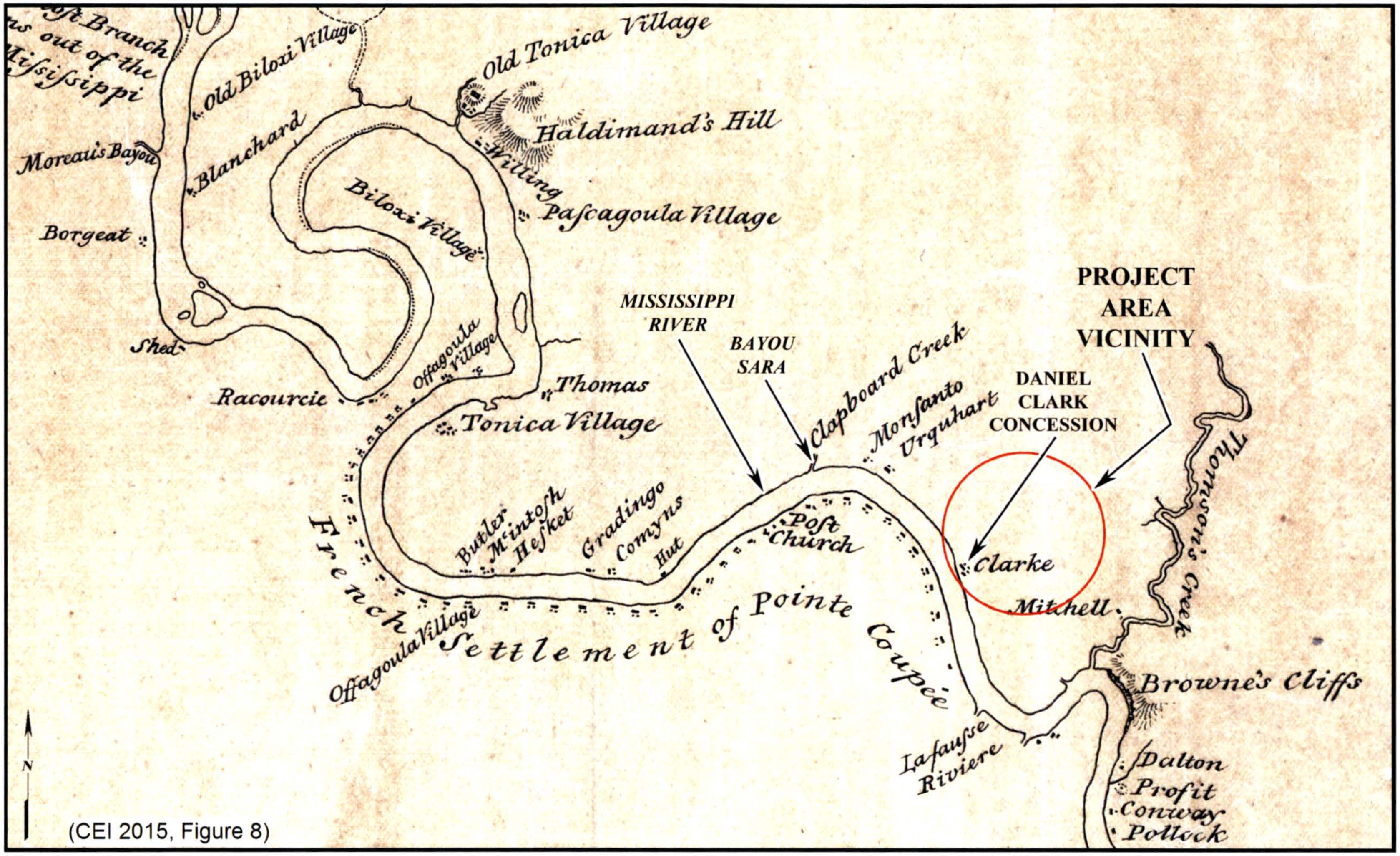



**Figure 3.7-10**
**RBS Area and Vicinity, 1778**

Confidential Information - Withold from public disclosure under 10 CFR 2.390(a)(3)

**Figure 3.7-11**
**Known Archaeological Sites, RBS Property**

Confidential Information - Withold from public disclosure under 10 CFR 2.390(a)(3)

**Figure 3.7-12**
**Cultural Resource Sensitivity Zones, RBS Property**

## 3.8 Socioeconomics

Socioeconomic descriptions are focused on East Baton Rouge and West Feliciana parishes in Louisiana because approximately 69 percent of RBS employees reside in these two parishes, while the remaining work force resides in 14 surrounding Louisiana parishes and nine other states, as presented in Table 2.5-1. In addition, RBS is one of Entergy Louisiana, LLC's assets on which property taxes are paid to West Feliciana Parish.

Refueling outages occur at the plant on a 2-year cycle and historically have lasted approximately 25–30 days. As discussed in Section 2.5, there are approximately 700–900 contractor workers at the plant during outages. Along with the local communities of St. Francisville and Zachary, the Baton Rouge metropolitan area is located within a 50-mile radius of the plant and offers numerous motel, campground, and food service options along the US-61 and I-10 transportation corridors during outages.

### 3.8.1 Employment and Income

As discussed in Section 3.10, the populations of both East Baton Rouge Parish and West Feliciana Parish are expected to increase during the license renewal period. Low-income populations and poverty thresholds for these parishes are described in Section 3.10.2.3.

The estimated employed population in West Feliciana Parish in 2014 was 7,098 persons. The leading occupational sector was government and government enterprises with approximately 33.8 percent, or 2,397 persons employed. No other reported occupational sectors showed employment dominance. (BEA 2016) As of 2016, the largest employer in West Feliciana Parish was the Louisiana State Penitentiary. Entergy was the second largest employer in the parish. (BRAC 2016a) The annual payroll in West Feliciana Parish was reported to be approximately $503 million in 2014, and the average wage per job was $49,911 (BEA 2016). In 2014, per capita personal income was $32,651 (BEA 2016), and the annual unemployment rate decreased from 5.7 percent in 2014 to 5.2 percent in 2015 (BLS 2016).

The estimated employed population in East Baton Rouge Parish in 2014 was 317,243 persons. The leading occupational sector was government and government enterprises with approximately 16.2 percent, or 51,315 persons employed. This was followed by the healthcare and social assistance sector with approximately 12.8 percent, or 40,543 persons employed; and the construction sector with 12.0 percent, or 37,972 persons employed. (BEA 2016) The largest employer in East Baton Rouge Parish in 2016 was Turner Industries Group, followed by Louisiana State University (BRAC 2016a). The annual payroll in East Baton Rouge Parish was approximately 19.2 billion in 2014, and the average wage per job was $48,669 (BEA 2016). In 2014, per capita personal income was $43,106 (BEA 2016), and the annual unemployment rate decreased from 5.8 percent in 2014 to 5.3 percent in 2015 (BLS 2016).

In the aftermath of the 2005 natural disaster Hurricane Katrina, an influx of displaced persons from the Gulf Coast region moved into the Baton Rouge area. Both East Baton Rouge and West Feliciana parishes fall within the nine-parish Baton Rouge MSA. Post-Katrina, the Baton Rouge

MSA experienced an 8.2 percent growth in population between 2005 and 2006. The Baton Rouge MSA's population expansion did not slow immediately following Katrina, but grew from 706,909 residents in 2005 to an estimated 820,159 residents in 2013, a 16-percent increase. With this unique increase in population in such a short time frame, the Baton Rouge area has had to cope with multiple challenges to its economic and public infrastructure. (BRAC 2015a)

Since Katrina, individuals in the MSA area have experienced an overall rise in income. The median individual income as adjusted for inflation has risen from $22,177 in 2005 to $27,059 in 2013, an increase of 21 percent. According to the Louisiana Workforce Commission, total nonfarm employment for the MSA grew from 339,400 in August 2005 to 403,700 for June 2015, a 19-percent increase. The Baton Rouge area has experienced notable growth in the manufacturing, service-providing, professional and business services, and education and health industries. The most notable growth has been in the service-providing industry, where jobs grew from 286,900 in August of 2005 to 320,200 jobs in June of 2015, an increase of 11.6 percent. Although there were initial challenges and uncertainty after Katrina, the Baton Rouge area has been resilient, which has ultimately led to increased economic prosperity. (BRAC 2015a)

### 3.8.2 Housing

Between 2000 and 2010, the total population for West Feliciana Parish grew by approximately 3.4 percent (Table 3.10-2). As seen in Table 3.8-1, total available housing within West Feliciana parish followed the population growth trend with 13.6-percent growth in total housing units and a vacancy rate that increased by 3.4 percent. This indicates enough housing was available to keep up with the increase in parish population.

East Baton Rouge Parish experienced an increase in population between 2000 and 2010, as seen in Table 3.10-2. The total population in the parish grew by approximately 6.6 percent. As seen in Table 3.8-1, total available housing with East Baton Rouge Parish followed the population growth trend, with a 10.8 percent growth in total housing units. As indicated by the vacancy rate increase of less than 1 percent, enough housing units were available for the population growth the parish experienced.

Between 2000 and 2010, median home values in West Feliciana Parish grew by 82.6 percent, and home values grew by 68.0 percent in East Baton Rouge Parish (Table 3.8-1). In the same time period, monthly rental rates grew by 82.0 percent in West Feliciana Parish and by 60.2 percent in East Baton Rouge Parish (Table 3.8-1).

### 3.8.3 Water Supply and Wastewater

#### 3.8.3.1 <u>Water Supply</u>

West Feliciana Parish Water District 13 is the main public water service provider for parish residents and relies on groundwater as its source. It is also the potable water service provider for RBS. The West Feliciana Parish Water District 13 serves approximately 8,000 residents from five wells. (ENERCON 2015a) The Town of St. Francisville has a separate public water system consisting of three groundwater wells serving a population of 1,763 (ENERCON 2015b). As reported in Table 3.8-2, the demand on the West Feliciana Parish Water District 13 is approximately at 35.0 percent capacity and the Town of St. Francisville is at approximately 2.5 percent of capacity. West Feliciana Parish has sufficient water service capabilities to meet the needs of the public.

Baton Rouge Water Company is the main public water provider in East Baton Rouge Parish and relies on groundwater as its source, with 98 wells serving a population of approximately 500,000. The system is at approximately 67.6 percent capacity. Baton Rouge Water Company currently has an additional well that will be put into service and is investigating drilling additional wells. (ENERCON 2015c)

Two municipalities in East Baton Rouge Parish act as the water service providers for their populations: the City of Baker and the City of Zachary. The City of Baker serves a population of approximately 13,800 and relies on groundwater from four wells. The Baker system is currently at approximately 26.6 percent capacity. (ENERCON 2015d) The City of Zachary serves a population of approximately 18,000 and relies on groundwater from five wells. The Zachary system is currently at 27.8 percent capacity. (ENERCON 2015e)

#### 3.8.3.2 Wastewater

Along with RBS, the majority of West Feliciana parish residents and businesses have their own individual sewer treatment processing. Four individual sewer districts in the West Feliciana Parish (Hardwood, Turner, Solitude, and Independence) combined serve approximately 500 customers. These are at 20.0 percent capacity. (ENERCON 2015a) The Town of St. Francisville has public wastewater treatment services and, as shown in Table 3.8-3, it is currently at 27.8 percent capacity. (ENERCON 2015b)

As shown in Table 3.8-3, East Baton Rouge Parish has three wastewater treatment plants. Based on 2013 permitting, the North Wastewater Treatment Plant is at 31.5 percent capacity, the Central Wastewater Treatment Plant is at 37.5 percent capacity, and the South Wastewater Treatment Plant is at 70.4 percent capacity. (ENERCON 2015f)

Because of federal government mandates set forth due to occasional overflow of the East Baton Rouge Parish sewerage system during heavy rains, a sanitary sewer overflow program is in the process of being implemented in the parish. Through the sanitary sewer overflow program, an ongoing $1.3 billion renovation of the City-Parish's aging sewer system is underway. The South Wastewater Treatment Plant underwent a $250 million dollar upgrade that was completed and increased capacity to 200 MGD (peak, wet weather). The Central Wastewater Treatment Plant is expected to close with flows diverted to the South Wastewater Treatment Plant. Improvements will also take place at the North Wastewater Treatment Plant. All elements of the improved sewer system are expected to be completed by the end of 2018. (EBRP 2015)

The City of Baker and the City of Zachary sewer lines transfer sewerage to the East Baton Rouge Parish wastewater system for treatment and disposal (COB 2015; ENERCON 2015d; ENERCON 2015e).

### 3.8.4 Community Services and Education

West Feliciana Parish has one public school district. Based on the 2013–2014 school year, there were four public schools (pre-kindergarten through grade 12) in the parish with 2,151 students. The student/teacher ratio was 12.42. The State of Louisiana has a statewide special school district educational program in place for social services and correctional facilities. In West Feliciana Parish, 16 students (grade 12) participated in the program at the Louisiana State Penitentiary. There are no private schools in the parish. (NCES 2016) One of the most dramatic education gains in the Capital Region in 2015 was in the district of West Feliciana Parish. West Feliciana Parish School District rose seven slots in the school district rankings in 2015, coming in at number three (out of 75) in the state, based on performance scores. The state of Louisiana Department of Education also assigns letter grades to school districts based on district performance, where A is the highest and F is the lowest score. The West Feliciana Parish school district earned an A score for both 2014 and 2015. (BRAC 2016b)

East Baton Rouge Parish has 11 public school districts. Based on the 2013–2014 school year, there were 114 public schools in the parish with 59,523 students. East Baton Rouge Parish School District has the largest enrollment with 41,937 students and 87 schools with a student/teacher ratio of 15.05. The East Baton Rouge Parish School District makes up approximately 70 percent of the entire parish's student enrollment. The second-largest school district is the Zachary Community School District with 5,470 students (approximately 9 percent of the Parish student enrollment) and eight schools with a student/teacher ratio of 15.03. East Baton Rouge Parish also has 47 private schools with an additional 15,469 students. (NCES 2016) Between 2014 and 2015, the East Baton Rouge Parish Public School System, which educates 33 percent of Capital Region public school district students and is the largest school district in the area, retained both its place in the middle of Capital Region rankings and its "C" rating. However, the System lost a spot in the rankings, going from 46 to 47 of 75 districts statewide, due to a drop in performance of 1.8 percent. (BRAC 2016b) Scattered throughout Baton Rouge are five public 2-year or 4-year higher education institutions and 20 private higher education institutions. (NCES 2016)

In West Feliciana Parish, in addition to the West Feliciana Sheriff's Office, the municipality of St. Francisville has the only other police force in the parish (USACOPS 2015). The town of St. Francisville Police Department consists of eight full-time and 11 reserve officers (ENERCON 2015g). The West Feliciana Sheriff's Office has a total of 70 full-time and 45 part-time employees (WFPS 2015). Serving an estimated 2014 population of 15,406 (USCB 2015f), the ratio of parish law enforcement personnel per 1,000 residents was 8.7. RBS maintains its own security force to handle security within the RBS property boundary, and coordinates with the parish sheriff's office if additional resources are needed (EOI 2008a, Section 2.5.2.9.2).

In East Baton Rouge Parish there are multiple municipalities with their own police departments. The East Baton Rouge Parish Sheriff's Office has approximately 720 law enforcement personnel (ENERCON 2015h). The municipalities that have their own law enforcement include Baker, Baton Rouge, and Zachary (USACOPS 2015). Baton Rouge Police Department currently has allotted positions for 886 employees, which includes 789 police personnel (BRPD 2015). Zachary Police Department reported approximately 41 employees on the force, including 32 officers (ZPD 2015). Serving a 2014 estimated population of 446,042 (USCB 2015f), the ratio of East Baton Rouge Parish law enforcement personnel per 1,000 residents would be approximately 3.7.

While the post-Katrina surge in population initially coincided with higher overall crime rates in Baton Rouge, crime has fallen since 2009 despite the population continuing to grow. Total crime has declined by 31 percent in Baton Rouge since 2004, demonstrating that the population growth prompted by Hurricane Katrina did not have a negative effect on public safety in the capital region. (BRAC 2015a)

In 2015, the city of Baton Rouge reported having the largest fire department in East Baton Rouge Parish with 19 stations and a staff of 555 full-time paid fire fighters. In the parish, there were a total of 956 active firefighters (career and volunteer) serving communities from 46 stations. (USFA 2015) Serving a 2014 estimated population of 446,042 (USCB 2015f) in East Baton Rouge Parish, the ratio of firefighters per 1,000 residents was 2.1. In West Feliciana Parish, there were a total of 11 stations with 175 firefighters (career and volunteer) on staff. (USFA 2015) Serving a 2014 estimated population of 15,406 (USCB 2015f), the ratio of firefighters per 1,000 residents in West Feliciana Parish was 11.4.

There is one primary hospital in West Feliciana Parish: West Feliciana Parish Hospital located in St. Francisville. The West Feliciana Parish Hospital has 22 licensed beds (LHA 2015) and an associated staff of 17 primary care and medical specialist professionals (WFPH 2015). Some of the larger medical facilities located in East Baton Rouge Parish include the Baton Rouge General Medical Center (Bluebonnet and Mid-City), Lane Regional Medical Center, Ochsner Medical Center–Baton Rouge, Our Lady of the Lake Regional Medical Center, and the Woman's Hospital. In 2015, there were a total of 2,348 licensed beds reported for East Baton Rouge Parish. (LHA 2015)

### 3.8.5 Local Government Revenues

For property tax purposes, Louisiana calculates a total entity or unit value for regulated utilities in the state, including Entergy Louisiana, LLC, and does not value RBS on a standalone basis. All Entergy Louisiana, LLC-owned property in Louisiana was assessed at approximately $524 million in 2015 (LTC 2015, page 9). Based on most recent data available, the 2013 taxable assessed value of Entergy Louisiana, LLC property allocated to West Feliciana Parish was approximately $179 million dollars (WFP 2015c). Entergy Louisiana, LLC does not receive separate tax invoices from West Feliciana Parish for power plants. In 2015, Entergy Louisiana, LLC paid approximately $14.4 million in total property taxes to West Feliciana Parish. (Entergy 2016o)

Total property tax revenues for West Feliciana Parish, including parish and local taxes, were approximately $21.8 million in 2015. The largest program receiving parish funds was schools, which received a total of approximately $9.9 million in revenues. This was followed by a total allocation of approximately $3.9 million to law enforcement, and about $2.4 million to parish improvement funds. (LTC 2015, page 90) In 2015, Entergy Louisiana, LLC payments to West Feliciana Parish in property taxes represented roughly 66 percent of the total parish property tax revenues (Table 3.8-4).

RBS currently employs 680 full-time employees (Table 2.5-1). Additionally, typically 700–900 contractor workers participate in regularly scheduled refueling outages that occur on a 2-year cycle. Therefore, current employees and contractor workers at RBS benefit local and regional economies as employee salaries flow through the communities with the purchase of goods and services, in addition to contributing income, sales, and personal property taxes.

State general sales and use taxes are levied on the sale of tangible personal property at retail; the use, consumption, distribution, or storage of any tangible personal property; the lease or rental within Louisiana of any item or article of tangible personal property; and the sale of services as defined in the statues under R.S. 47:301(14) (LDR 2015). The state sales tax rate is 5 percent, and the combined local rate in West Feliciana Parish is 5 percent (LATA 2016). In 2013, a total of approximately $9 million in sales tax was distributed to the following entities: West Feliciana Parish school board ($5,442,357), the town of St. Francisville ($680,163), and West Feliciana Parish ($2,957,297) (WFP 2015c).

### 3.8.6 Transportation

Transportation in the RBS region includes a rural and urbanized road network, railroads, airports, and barge transportation on the Mississippi River. The primary highway network in the area, as shown on Figures 3.0-3 and 3.0-4, include US-61, which generally runs north to south, connecting Mississippi with St. Francisville and Baton Rouge. Other major routes in the region include I-10, which runs through Baton Rouge; and US-190, which extends from Baton Rouge to just south of New Roads.

The Baton Rouge roadways were put under severe strain by the post-Katrina population surge. The increase of more than 58,000 residents in 2005 represented more than 7 years of normal population growth condensed into one, which the capital region was unable to plan for or effectively adapt to. According to the Texas Transportation Institute's 2012 Urban Mobility Report, the population change in 1 year translated to the addition of more than 43,000 daily rush-hour travelers; 295,000 vehicle-miles of travel on highways and arterial roads, and nearly one million hours of additional delay. The report also shows that between 2004 and 2011 (the most recent year for which data were available), the Baton Rouge area ranked as the second worst mid-size city in the country for traffic congestion. Although the Baton Rouge area has successfully overcome many obstacles in the wake of Hurricane Katrina, traffic persists as a critical issue in the region. (BRAC 2015a)

The Baton Rouge Area Chamber has helped identify several initiatives to achieve improved performance of transit operations in the capital region. Along with local road improvements and funding, these initiatives would include improving access to a high-quality mass transit system to reduce the number of cars on the road; the development of inter-city passenger rail between the Baton Rouge area and the greater New Orleans region; the Baton Rouge bypass and other toll road projects to enhance regional mobility; and the development of an airport strategic plan for air access, land use, and economic development, etc. (BRAC 2015b)

US-61 is a north-south highway in the region that circulates traffic from Baton Rouge past RBS into Mississippi, and was recently the focus of a major transportation improvement project. Primary access to RBS is from US-61 via the North Access Road (Figure 3.0-1). The LADOTD average annual daily traffic (AADT) volumes for state roads in the 6-mile radius that link to the RBS plant are listed in Table 3.8-5. The 2013 AADT count taken on US-61 in West Feliciana Parish northwest of RBS (13,800) and 2012 AADT count taken on US-61 in East Feliciana Parish southeast of RBS (14,088), were the highest traffic volumes recorded to date at these locations as part of the LADOTD biennial transportation studies. Subsequently, a 2015 AADT count taken on US-61 in East Feliciana Parish (13,236) indicates that volumes have dropped on the road southeast of RBS (LADOTD 2016).

To accommodate traffic demand, in 2011 the expansion of US-61 from a two-lane to a four-lane divided highway with a center median and paved shoulders was completed. At the North Access Road plant entrance, a dedicated turn lane was included in construction of the north-bound portion of US-61, along with the installation of traffic lights for controlling traffic flow. A second road with access to the plant from US-61 is the two-lane paved highway LA-965, located northwest of RBS in West Feliciana Parish. Transportation studies show that use of this road is minimal in comparison to US-61, and traffic volume has fluctuated very little over the years. The most recent traffic volume recorded for LA-965 west of US-61 was an AADT count of 545. Southwest of the RBS property boundary, the recently completed LA-10 Audubon Bridge crosses the Mississippi River and links Pointe Coupee Parish with West Feliciana Parish. No roads within RBS directly access LA-10. An AADT count of 3,066 was taken in 2012 on LA-10 east of the bridge. No AADT counts of a later date were available for West Feliciana Parish recorded mile-point locations.

The U.S. Transportation Research Board has developed a commonly used indicator called level of service (LOS) to measure how well a highway accommodates traffic flow. LOS is a qualitative assessment of traffic flow and how much delay the average vehicle might encounter during peak hours. LOS categories are defined in the Highway Capacity Manual (HCM) (TRB 2010) and listed in Table 3.8-6.

No LOS assignments were available for local road segments. To evaluate LOS for US-61, the known AADT traffic volumes were compared to the estimated capacity of a multilane highway, as presented in the HCM. No US-61 field-observed travel time studies nor peak commuter traffic counts are available for the roads near RBS. The HCM notes that the capacity of a multilane highway under base conditions varies with the free flow speed (FFS). For 60 mph FFS, the capacity is 2,200 passenger cars per hour per lane (pc/h/ln). For lower FFSs, capacity diminishes (e.g., for 45-mph FFS, capacity is 1,900 pc/h/ln). The HCM also notes that speeds remain constant until they reach 1,400 pc/h/ln, after which speeds decline with further increases in flow rate. (TRB 2010) Based on 2013 AADT recorded volumes, the US-61 AADT count location northwest of RBS has a reported flow rate of 144 pc/h/ln on average. Based on 2012 AADT volumes, the US-61 AADT count location southeast of RBS had a reported flow rate of 147 pc/h/ln on average, and subsequently dropped to 138 pc/h/ln in 2015. Because FFSs should not be affected by the current average traffic flow rate reported for US-61, there should be ample traffic capacity on US-61 in the road area associated with plant access. Given the recent expansion of US-61 from a two-lane to four-lane and applying the LOS traffic conditions defined in Table 3.8-6, US-61 should fall within a LOS "A" range of conditions.

Primary railway lines in the state connect New Orleans and Baton Rouge with other locations within Louisiana and beyond. There is a 1.2-mile abandoned rail line spur that traverses the RBS site, with no plans to reestablish use. (EOI 2008a, Section 2.5.2.10)

A significant amount of barge traffic on the Mississippi River passes by RBS. The closest important regional shipping port is the Port of Greater Baton Rouge, approximately 32 river miles downstream from RBS, as described in Section 3.0.2. The port handles a diverse range of cargo and provides access to all types of intermodal transportation including ship, barge, truck, and rail. (EOI 2008a, Section 2.5.2.10)

The region contains a number of airports; the largest commercial airport is the Baton Rouge Metropolitan Airport (EOI 2008a, Section 2.5.2.10), located approximately 19 miles from RBS, as discussed in Section 3.0.2. Passenger flights can be scheduled through major airline companies, and the airport has car rental and other services available. (EOI 2008a, Section 2.5.2.10)

### 3.8.7 Recreational Facilities

As shown in Figure 3.0-5 and described in Section 3.0.4, there are a number of recreational areas within the vicinity of RBS. These include a federal national wildlife refuge, several state historic sites, and a number of local parks.

West of RBS, a portion of the Cat Island National Wildlife Refuge is located within a 6-mile radius of RBS. Cat Island is one of the largest recreational facilities in West Feliciana Parish, consisting of 10,473 acres. It was established as a national wildlife refuge in 2000 to conserve, restore, and manage native forested wetland habitats for migratory birds, aquatic resources, and endangered and threatened plants and animals. Recreational activities include permitted hunting and fishing, wildlife viewing, interpretive programs and environmental education, photography, hiking, and canoeing/kayaking. (USFWS 2015f) The USFWS reported that Cat Island receives approximately 4,000 visitors a year (ENERCON 2015i).

Notable state-managed sites within the vicinity include Audubon State Historic Site, Rosedown Plantation State Historic Site, Port Hudson State Historic Site, and Locust Grove State Historic Site. The main visitor activities common to Audubon, Rosedown Plantation, and Port Hudson, include daily tours, museum facilities, historic/nature programs, and walking trails. Locust Grove is a local historic cemetery with special events and programs scheduled several times a year. (LADCRT 2015a) During fiscal year (FY) 2015 (July 1, 2014–June 30, 2015), Audubon State Historic Site reported 14,861 visitors. The Locust Grove site visitor count is included with the reported Audubon site visitor count. Port Hudson State Historic Site reported 15,487 visitors, and Rosedown Plantation State Historic Site reported 29,433 visitors. Approximately 1.9 million people were reported to have visited a Louisiana state park or historic site during FY 2015. (ENERCON 2015j)

The US-61 Louisiana Tourism welcome center, located in the town of St. Francisville, reported assisting 12,875 visitors in 2014; and 8,420 visitors as of September 2015 (ENERCON 2015k). Approximately 1.1 million people were reported to have visited a welcome center in Louisiana in FY 2015 (LADCRT 2015b).

The local St. Francisville and West Feliciana Parish parks support a variety of community activities. Recreation facilities include public gardens, picnic amenities, playgrounds, and athletic playing fields. (SFWF 2015)

**Table 3.8-1**
**Housing Statistics, East Baton Rouge and West Feliciana Parishes, 2000–2010**

| Parish | 2000 | 2010 | 2000 to 2010 Change |
|---|---|---|---|
| **East Baton Rouge** | | | |
| Total housing units | 169,073 | 187,353 | 10.8% increase |
| Occupied units | 156,365 | 172,057 | 10.0% increase |
| Vacant units | 12,708 | 15,296 | 20.4% increase |
| Vacancy rate (percent) | 7.5% | 8.2% | 0.7% increase |
| Median house value ($) | $98,800 | $166,000[a] | 68.0% increase |
| Median rent ($/month) | $510 | $817[a] | 60.2% increase |
| **West Feliciana** | | | |
| Total housing units | 4,485 | 5,097 | 13.6% increase |
| Occupied units | 3,645 | 3,971 | 8.9% increase |
| Vacant units | 840 | 1,126 | 34.0% increase |
| Vacancy rate (percent) | 18.7% | 22.1% | 3.4% increase |
| Median house value ($) | $107,500 | $196,300[a] | 82.6% increase |
| Median rent ($/month) | $411 | $748[a] | 82.0% increase |

(USCB 2015g)

a. 2009–2013 American Community Survey 5-Year Estimates.

**Table 3.8-2**
**Public Water Systems, East Baton Rouge and West Feliciana Parishes**

| Water Providers | Parish | Water Source | Number of Plants/Facilities | Population Served (approx.) | Design Capacity (MGD) | Average Productions (MGD) | Demand (% Design Capacity) |
|---|---|---|---|---|---|---|---|
| West Feliciana Parish (Water District 13) | West Feliciana | Groundwater | 5 wells, 4 storage tanks | 8,000 | 3.25 | 1.14 | 35.0 |
| Town of St. Francisville | West Feliciana | Groundwater | 3 wells | 1,763 | 4.00 | 0.10 | 2.5 |
| Baton Rouge Water Company | East Baton Rouge | Groundwater | 98 wells (14 MG elevated/ ground storage) | 500,000 | 98.38 | 66.54 | 67.6 |
| City of Baker | East Baton Rouge | Groundwater | 4 wells | 13,800 | 5.80 | 1.54 | 26.6 |
| City of Zachary | East Baton Rouge | Groundwater | 5 wells, (2 storage tanks, 500,000 gal. each) | 18,000 | 9.00 | 2.50 | 27.8 |
| (ENERCON 2015a; ENERCON 2015b; ENERCON 2015c; ENERCON 2015d; ENERCON 2015e) | | | | | | | |

**Table 3.8-3**
**Public Wastewater Systems, East Baton Rouge and West Feliciana Parishes**

| Sewer Providers | Parish | Treatment Plants/ Facilities | Design Capacity (MGD) | Average Production (MGD) | Demand (% Design Capacity) |
|---|---|---|---|---|---|
| Town of St. Francisville | West Feliciana[a] | Treatment pond | 0.36 | 0.10 | 27.80 |
| Four Sewer Districts: Hardwood, Turner, Solitude, and Independence (500 customers combined) | West Feliciana[a] | Package plants or treatment ponds | 0.30 | 0.06 | 20.00 |
| East Baton Rouge Parish Wastewater: North Wastewater Treatment Plant | East Baton Rouge | Plant | 54.00 | 17.00 | 31.50 |
| East Baton Rouge Parish Wastewater: Central Wastewater Treatment Plant | East Baton Rouge | Plant | 32.00 | 12.00 | 37.50 |
| East Baton Rouge Parish Wastewater: South Wastewater Treatment Plant | East Baton Rouge | Plant | 54.00 | 38.00 | 70.40 |

(ENERCON 2015a; ENERCON 2015b; ENERCON 2015f)

a. The majority of West Feliciana Parish rural residents have individual sewer treatment.

**Table 3.8-4**
**Entergy Louisiana, LLC Property Tax Payments, 2011–2015**

| Year | Entergy Louisiana, LLC Property Taxes | West Feliciana Parish Revenues | Percent of Parish Revenue |
|---|---|---|---|
| 2011 | $15,632,000 | $21,532,096 | 73 |
| 2012 | $15,444,000 | $21,704,008 | 71 |
| 2013 | $14,331,000 | $21,407,045 | 67 |
| 2014 | $14,561,000 | $21,641,059 | 67 |
| 2015 | $14,420,000 | $21,831,975 | 66 |

(Entergy 2016o; LTC 2011; LLTC 2012; LTC 2013; LTC 2014; LTC 2015)

**Table 3.8-5**
**Total Average Annual Daily Traffic Counts on Routes near RBS**

| Route | Location | Mile Marker | 2000 | 2001 | 2003 | 2004 | 2006 | 2007 | 2009 | 2010 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| US-61 | Northwest of RBS (West Feliciana) | 105.72 | NC | 11,299 | NC | 9,846 | NC | 10,479 | NC | 11,989 | NC | 13,800 |
| LA-965 | Northwest of RBS (West Feliciana) | 2.06 | NC | 661 | NC | 459 | NC | 500 | NC | 618 | NC | 545 |
| LA-10 | Southwest of RBS (West Feliciana) | 140.15 | NC | NC | NC | NC | NC | NC | NC | NC | 3,066[a] | NC |
| US-61 | Southeast of RBS (East Feliciana) | 99.08 | 9,630 | NC | 9,995 | NC | 11,172 | NC | 9,679 | NC | 14,088 | NC |

(LADOTD 2015)

a. LA-10 Audubon Bridge linking West Feliciana Parish and Point Coupe Parish southwest of RBS was completed in 2011. The 2012 AADT count is the first year available.

NC: no count.

## Table 3.8-6
## Level of Service Definitions

| Level of Service | Conditions |
|---|---|
| A | Free flow of the traffic stream; users are mostly unaffected by the presence of other vehicles. |
| B | Free flow of the traffic stream, although the presence of other vehicles becomes noticeable. Drivers have slightly less freedom to maneuver. |
| C | The influence of the traffic density on operations becomes marked and queues may be expected to form. The ability to maneuver with the traffic stream is clearly affected by other vehicles. |
| D | The ability to maneuver is severely restricted due to traffic congestion. Travel speed is reduced by the increasing volume. Only minor disruptions can be absorbed without extensive queues forming and the service deteriorating. |
| E | Operations at or near capacity, an unstable level. The densities vary, depending on the free-flow speed. Vehicles are operating with the minimum spacing (or gaps) for maintaining uniform flow. Disruptions cannot be dissipated readily, often causing queues to form and service to deteriorate to LOS F. |
| F | Forced or breakdown of flow. It occurs either when vehicles arrive at a rate greater than the rate at which they are discharged or when the forecast demand exceeds the computed capacity. Queues form behind these breakdowns. Operations within queues are highly unstable, with vehicles experiencing brief periods of movement followed by stoppages. |

(TRB 2010)

## 3.9 Human Health

### 3.9.1 Radiological Hazards

As discussed in Section 2.3, no license-renewal-related refurbishment activities have been identified.

#### 3.9.1.1 Liquid and Gaseous Effluent Releases

A description of the RBS liquid and gaseous radwaste system is presented in Section 2.2.3 of this ER. All normal liquid and gaseous release pathways to the environment are continuously monitored to ensure that potential doses to the general public would be well within the allowable limits of 10 CFR Part 20, 10 CFR Part 50, Appendix I, and 40 CFR Part 190. The controls for limiting the release of radiological liquid and gaseous effluents are described in the RBS ODCM (RBS 2013b).

Regulation 10 CFR 50.36(a) requires nuclear power plants to submit an annual report to the NRC that lists the types and quantities of radioactive effluents released into the environment. Based on review of the RBS annual radioactive effluent release reports for 2011 through 2015 (Entergy 2012c; Entergy 2013c; Entergy 2014a; Entergy 2015m; Entergy 2016g), doses to members of the public complied with the radiation protection standards contained in Appendix I to 10 CFR Part 50, 10 CFR Part 20, and 40 CFR Part 190.

Dose estimates for members of the public are calculated based on radioactive gaseous and liquid effluent release data, and atmospheric and aquatic transport models. The 2015 annual radioactive effluent release report contains a detailed presentation of the radioactive discharges and the resultant calculated doses. The following summarizes the calculated dose to a member of the public from radioactive gaseous and liquid effluents released during 2015 (Entergy 2016g):

- The maximum whole body dose to an offsite member of the public from radioactive liquid effluents is 5.34E-05 millirem (mrem), which is below the 3-mrem dose criterion in Appendix I to 10 CFR Part 50.
- The maximum organ dose to an offsite member of the public from radioactive liquid effluents is 3.52E-04 mrem, which is below the 10-mrem dose criterion in Appendix I to 10 CFR Part 50.
- The maximum air dose at the site boundary from gamma radiation in gaseous effluents is 4.51E-01 milliradiation absorbed dose (mrad), which is below the 10-mrad dose criterion in Appendix I to 10 CFR Part 50.
- The maximum air dose at the site boundary from beta radiation in gaseous effluents is 2.14E-01 mrad, which is below the 20-mrad dose criterion in Appendix I to 10 CFR Part 50.

- The maximum organ (child thyroid) dose to an offsite member of the public from radioactive iodine and radioactive material in particulate form with half-lives greater than 8-days was 9.12E-02 mrem, which is well below the 15 mrem dose criterion in Appendix I to 10 CFR Part 50.

- The maximum organ (child bone) dose to an offsite member of the public from carbon-14, radioactive iodine, tritium, and radioactive material in particulate form with half-lives greater than 8-days was 4.70 mrem, which is well below the 15 mrem dose criterion in Appendix I to 10 CFR Part 50.

#### 3.9.1.2 Radiological Environmental Monitoring Program

The REMP is conducted to assess the radiological impact, if any, to its employees, the public, and the environment from operations. The REMP measures aquatic, terrestrial, and atmospheric radioactivity, as well as ambient radiation. The REMP also measures background radiation (i.e., cosmic sources, global fallout, and naturally occurring radioactive material, including radon). The REMP supplements the radioactive effluent monitoring program by verifying that any measurable concentrations of radioactive materials and levels of radiation in the environment are not higher than those calculated using the radioactive effluent release measurements and transport models. (NRC 2014b, Section 4.9.2.1)

RBS established its REMP prior to the station becoming operational to provide data on background radiation and radioactivity normally present in the area, and to ensure that plant operating controls properly function to minimize any associated radiation endangerment to human health or the environment. The REMP is designed for the following (Entergy 2016d, Section 1.1):

- 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 RBS.

- Correlating levels of radiation and radioactivity in the environment with radioactive releases from station operation.

RBS has continued to monitor the environment; its REMP includes sampling indicator and control locations. 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. RBS compares indicator results with control, preoperational, and previous years of operational results to assess any impact RBS might have on the surrounding environment. (Entergy 2016d)

The RBS REMP is based on four exposure pathways to the public: airborne, direct radiation, waterborne, and ingestion. The airborne samples taken around RBS are airborne radioiodine and particulates. Direct radiation is measured at locations around the plant site using thermoluminescent dosimeters. The waterborne pathway samples are taken from surface water and groundwater, and shoreline sediment samples also are taken for this pathway. The ingestion pathway samples include milk (when available), fish and invertebrates, and broadleaf vegetation. (Entergy 2016d)

RBS prepares an annual radiological environmental operating report, which contains a discussion of the results of the monitoring program performed for the previous year, and submits it to the NRC. These annual reports provide a data set that covers a broad range of activities that would occur at a nuclear power plant, including refueling outages, non-refueling outage years, routine operation, and years where there may be significant maintenance activities (NRC 2014b, Section 4.9.2.1). Based on submitted annual radiological environmental operating reports for 2011 through 2015 (Entergy 2012d; Entergy 2013e; Entergy 2014d; Entergy 2015o; Entergy 2016d), RBS observed no adverse trends (i.e., steadily increasing build-up of radioactivity levels), and the 5 years of data show no measurable impact to the environment from RBS operations.

#### 3.9.1.3 Occupational Exposure

Some workers at RBS are classified as radiological workers and, depending on their work assignments, receive occupational radiation exposure. NRC regulations at 10 CFR Part 20 limit the annual total effective dose equivalent (TEDE) for individual radiation workers to 0.05 Sieverts (5 roentgen equivalent man [rem]) per year; however, RBS procedures administratively limit the exposure below NRC's regulatory limit.

Based on NUREG-0713, the 3-year average (2012–2014) collective TEDE (sum of dose for all exposed workers) for RBS was approximately 80 person-rem per reactor as compared to the national average collective dose for all boiling water reactors (BWRs) of approximately 119 person-rem for the same 3-year period. The average TEDE per RBS worker over this period (2012–2014) was 0.082 rem as compared to the national average of 0.114 rem for all BWRs. The average TEDE per megawatt generated per year was 0.09 rem for RBS as compared to the national average of 0.13 rem for BWRs. (NRC 2016a, Table 4.5)

As discussed in Section 3.9.1, no license-renewal-related refurbishment activities have been identified. In addition, there are no expected increases in either occupational or public radiation exposure during the license renewal term. Based on NRC historical data for the period 1993-2005 (NRC 2013b, Table 3.9-8), RBS's occupation radiation exposures fall within the range of those for other operating BWRs. Although the NRC requires nuclear plants to keep collective doses as low as reasonably achievable (ALARA), there is no regulatory limit on collective dose.

### 3.9.2 Microbiological Hazards

The GEIS (NRC 2013b, Section 3.9.3) discusses microbiological hazards around nuclear power plants, including background information, results of studies of microbiological hazards in cooling towers, hazards to plant workers, and hazards to members of the public. The discussion of specific hazards focuses on the thermophilic microorganisms *Legionella* spp., which can be a hazard in cooling towers, and *Naegleria fowleri*, which can be a hazard in cooling water discharge. There have been no Entergy or state studies conducted to determine the presence of these microorganisms in waters influenced by RBS.

Exposure to *Legionella* spp. from power plant operations is a potential problem for a subset of the workforce. Plant personnel most likely to come in contact with *Legionella* aerosols would be workers who dislodge biofilms, where *Legionella* are often concentrated, such as during the cleaning of condenser tubes and cooling towers. (NRC 2013b, Section 3.9.3.3) RBS plant workers involved in cleaning the cooling towers or condenser tubes are protected by a fleet procedure that provides a standard methodology for identifying industrial hazards prior to performance of jobs. Under this procedure, possible factors that may influence safe execution of the job, including chemical and biological hazards, would be considered and appropriate worker protection measures would be designated for use during performance of the work. (Entergy 2013f) Exposure of members of the public to *Legionella* from RBS operations would not be expected, because there is no opportunity for these pathogens to be sufficiently concentrated at expected exposure points.

*Naegleria fowleri* in heated plant effluent can be a hazard to recreational water users. *Naegleria* infection is the cause of primary amebic meningoencephalitis, an extremely rare disease that is usually fatal. *Naegleria* spp. is ubiquitous in nature and can be enhanced in heated water bodies at temperatures ranging from 95°F to 106°F or higher. *Naegleria* is rarely found in water cooler than 95°F, and infection rarely occurs in water temperatures of 95°F or less. (NRC 2013b, Section 3.9.3.1)

As discussed in the environmental report of the RBS3 COL application, it was determined that the combined heated effluent from RBS and RBS3 would result in a limited thermal discharge plume into the Mississippi River within a small mixing zone. This limited size would limit the area of conditions necessary for optimal growth of these etiological agents. Even during worst-case scenario operational conditions (i.e., discharge into the Mississippi River during the summertime with extremely elevated water temperatures and low river flow), the area of the thermal plume with temperatures elevated above 90°F is only approximately 54 feet by 5 feet. Therefore when considering only RBS, it can be concluded that the area of the thermal plume with temperatures elevated above 90°F would be smaller. Additionally, the discharge flow rate would be minor when compared with river flows exhibited by the Mississippi River. (EOI 2008a, Section 5.3.4.1)

Diseases caused by thermophilic microorganisms associated with warm waters are typically contracted via nasal passageway contact with contaminated water (NRC 2013b, Section 3.9.3.3). The point of discharge of heated effluent from the RBS site is not typically utilized for primary contact recreation, because it is limited by strong, swift currents. Therefore, it is highly unlikely that a disease caused by an etiological agent would be contracted as a result of human interaction with the thermal plume. (EOI 2008a, Section 5.3.4.1)

Based on conversation with the Louisiana State Epidemiologist (LDHH), there have been only three cases of primary amebic meningoencephalitis reported during the period 2004–2014: two cases in 2011 and one case in 2013, none of which were related to recreational surface water use, and none of which occurred in the vicinity of RBS. Instead, the contributing cause in all three cases was related to tap water. In addition, the Louisiana State Epidemiologist also stated that no studies have been conducted in the Mississippi River for the *Naegleria* ameba because no cases of primary amebic meningoencephalitis have been attributed to the Mississippi River. Studies are only carried out for reported cases of primary amebic meningoencephalitis. (Entergy 2015p)

### 3.9.3 Electric Shock Hazards

As discussed in Section 2.2.5.4, it was determined that the transmission lines meet the applicable shock prevention provisions of the NESC. In addition, operational requirements associated with OSHA are incorporated into RBS's occupational health and safety program. Specifically, as it relates to transmission lines and acute shock hazards, RBS has processes in place which limit the potential for plant workers to receive an "induced" current from an object becoming capacitively charged. Also as discussed in Section 2.2.5.4, because all in-scope transmission lines are located completely within Entergy Louisiana, LLC-owned property, the public does not have access to this area and, as a result, no induced shock hazards would exist for the public.

## 3.10 Environmental Justice

### 3.10.1 Regional Population

The GEIS presents a population characterization method based on two factors: "sparseness" and "proximity" (NRC 1996, Section C.1.4). Sparseness measures population density and city size within 20 miles of a site and categorizes the demographic information as follows.

**Demographic Categories Based on Sparseness**

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

(NRC 1996, Section C.1.4)

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

**Demographic Categories Based on Proximity**

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

(NRC 1996, Section C.1.4)

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

**GEIS Sparseness and Proximity Matrix**

| | | Proximity | | | |
|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** |
| **Sparseness** | **1** | 1.1 | 1.2 | 1.3 | 1.4 |
| | **2** | 2.1 | 2.2 | 2.3 | 2.4 |
| | **3** | 3.1 | 3.2 | 3.3 | 3.4 |
| | **4** | 4.1 | 4.2 | 4.3 | 4.4 |

| Low Population Area | Medium Population Area | High Population Area |
|---|---|---|

(NRC 1996, Figure C.1)

The 2010 census population and TIGER/Line® data from the USCB were used to determine demographic characteristics in the vicinity of the site. The data were processed at the state, county, and census block levels using ArcGIS® (USCB 2015d; USCB 2015h; USCB 2015i). Census data include people living in group quarters such as institutionalized and non-institutionalized populations. Examples of institutional populations living in group quarters are correctional institutions (i.e., prisons, jails, and detention centers); nursing homes; mental (psychiatric) hospitals; hospitals or wards for the chronically ill; and juvenile institutions. Examples of non-institutional populations living in group quarters are group homes; college dormitories; military quarters; soup kitchens; shelters for abused women (shelters against domestic violence or family crisis centers); and shelters for children who are runaways, neglected, or without conventional housing.

The 2010 census data indicate that approximately 126,900 people live within a 20-mile radius of the RBS site, which equates to a population density of 101 persons per square mile (USCB 2015d; USCB 2015h; USCB 2015i). Based on the GEIS sparseness index, the site is classified as Category 3 with 60 to 120 persons per square mile within 20 miles.

The 2010 census data indicate that approximately 953,086 people live within a 50-mile radius of the site, which equates to a population density of 121 persons per square mile (USCB 2015d; USCB 2015h; USCB 2015i).

Based on the U.S. Census-derived urban area estimates, two communities within a 50-mile radius have a population greater than 100,000 residents (Table 3.10-1). Based on the GEIS proximity index, the site is classified as Category 3 (i.e., one or more cities with 100,000 or more persons within 50 miles).

As illustrated in the GEIS sparseness and proximity matrix, the combination of "sparseness" Category 3 and "proximity" Category 3 results in the conclusion that the RBS site is located in a "medium" population area.

The area within a 50-mile radius of the RBS site totally or partially includes 18 parishes and five counties within the states of Louisiana and Mississippi (Table 3.10-2). Evangeline Parish has a small portion that is included in the 50-mile region; however, according to the 2010 census data, it is unpopulated. Therefore, it is not included. According to the 2010 census, the permanent population (not including transient populations) of the entire 18 parishes and five counties were approximately 1,450,666 and 103,828, respectively (Table 3.10-2). By 2045, the end of the proposed license renewal period, the permanent population (not including transient populations) of the entire 18 parishes is projected to be approximately 2,229,978 and approximately 105,636 for the entire five counties. Based on 2010–2045 population projections, an annual growth rate of approximately 1.17 percent is anticipated for the permanent population in the 23 parishes and counties wholly or partially within a 50-mile radius (OPRP 2012; WPEI 2014a; WPEI 2014b).

As shown in Table 3.10-2, the total population (including transient populations) of the entire 23 counties and parishes, which are totally or partially included within a 50-mile radius, is projected to be approximately 2,371,688 in 2045. The total population (including transient populations) within a 50-mile radius is projected to be 1,475,906 in 2045. (OPRP 2012; TNS 2014; UNO 2014; USCB 2015b; VMS 2014; WPEI 2014a; WPEI 2014b)

The permanent population projections for Louisiana were obtained from Woods & Poole Economics, Inc. (WPEI 2014a; WPEI 2014b). The latest permanent population projections for Mississippi were obtained from the Office of Policy Research and Planning, Mississippi Institution of Higher Learning (OPRP 2012). Parish and county-level permanent population values for the counties and parishes within a 50-mile radius are shown in Table 3.10-2. Transient data for the state of Louisiana were obtained from the Louisiana Tourism Forecast 2014-2017 (UNO 2014). Transient data for the state of Mississippi were obtained from the Travel and Tourism Economic Contribution Report 2014 (VMS 2014).

RBS is located in West Feliciana Parish. As shown in Table 3.10-2, the population of West Feliciana Parish, Louisiana, as reported in the 2010 census was 15,625. Based on Louisiana's projected data set (Table 3.10-3), West Feliciana Parish projected population for 2045 is expected to be 19,143. The average projected annual growth rate for this period is 0.58 percent (WPEI 2014a; WPEI 2014b). Estimated projected populations and average annual growth rates for East Baton Rouge and West Feliciana Parishes are shown in Table 3.10-3.

Cities, towns, villages, and census designated places with centers falling within a 50-mile radius are listed in Table 3.10-1. The town nearest to RBS with a census-reported population is St.

Francisville. As shown in Table 3.10-1, its 2010 population was reported at 1,765 residents. St. Francisville, Louisiana, is the only city in West Feliciana Parish. Based on U.S. Census-derived urban area estimates, two communities within a 50-mile radius have a population greater than 100,000: Baton Rouge, Louisiana (approximately 24 miles); and Lafayette, Louisiana (approximately 55 miles). These communities have a 2010 population of 229,493 and 120,623 residents, respectively. A total of two additional communities (Central and Prairieville) within a 50-mile radius have a population greater than 25,000 (Table 3.10-1).

#### 3.10.1.1 Migrant Labor

Migrant labor, or migrant worker, is defined by the USDA as "a farm worker whose employment required travel that prevented the migrant worker from returning to his/her permanent place of residence the same day." In 2012, West Feliciana Parish reported that 60 out of 163 total farms employed farm labor. East Baton Rouge Parish reported 101 out of 432 total farms employed farm labor. The 2012 Census of Agriculture reported that three West Feliciana parish farms employed an estimated 27 migrant farm workers. Farms in East Baton Rouge Parish did not employ migrant workers. For West Feliciana Parish, an estimated total of 162 farm laborers were hired, of which 103 were estimated to work fewer than 150 days per year. For East Baton Rouge Parish, an estimated total of 236 farm laborers were hired, of which 167 were estimated to work fewer than 150 days per year. (USDA 2012)

#### 3.10.1.2 Subsistence Consumption

Subsistence refers to the use of natural resources as food for consumption and for ceremonial and traditional cultural purposes, usually by low-income or minority populations. Specific examples of subsistence uses include gathering plants for direct consumption (rather than produced for sale from farming operations), for use as medicine, or in ritual practices. Fishing or hunting activities associated with direct consumption or use in ceremonies, rather than for sport, are other examples.

Determining the presence of subsistence use can be difficult, as data at the county or block group level is aggregated and not usually structured to identify such uses on or near the site, where any potential impacts arising from the continued operation of RBS would arise. Frequently, the best means of investigating the presence of subsistence use is through dialogue with the local population who are most likely to know of such activity. This may include county officials as well as land owners in the immediate vicinity who would have knowledge of subsistence activity.

During the development of the RBS3 COL application, through a series of phone calls and emails, contact was made with a number of individuals associated with local government, social services, and economic development organizations. No populations involved in subsistence use activities (as described above) were identified on or near the site. (EOI 2008a, Section 2.5.4.4) During the development of this RBS ER, no new information was discovered that would invalidate these findings.

## 3.10.2 Minority and Low-Income Populations

### 3.10.2.1 Background

The NRC performs environmental justice analyses utilizing a 50-mile radius around the plant as the environmental "impact area." LIC-203 Revision 3 (NRC 2013c, page D-4) defines a geographic area for comparison as a 50-mile radius (also referred to as "the region" in this discussion) centered on the nuclear plant. An alternative approach is also addressed that uses an individual state that encompasses the 50-mile radius individually for comparative analysis as the "geographic area." Both approaches were used to assess the minority and low-income population criteria for RBS.

LIC-203 guidance suggests using the most recent USCB decennial census data. However, low-income data are collected separately from the decennial census and are available in 5-year averages. The 2010 low-income and minority census population data and TIGER/Line data for Louisiana were obtained from the USCB website and processed using ArcGIS software. Census population data were used to identify the minority and low-income populations within a 50-mile radius of RBS. Environmental justice evaluations for minority and low-income populations are based on the use of USCB block groups for minority and low-income populations.

### 3.10.2.2 Minority Populations

NRC procedural guidance defines a "minority" population as Black or African American, American Indian or Alaska Native, Asian, Native Hawaiian/other Pacific Islander, some other race, two or more races, the aggregate of all minority races, Hispanic or Latino ethnicity, and the aggregate of all minority races and Hispanic ethnicity (NRC 2013c, pages D-4 and D-5). The guidance indicates that a minority population is considered present if either of the following conditions exists:

1. The minority population in the census block group exceeds 50 percent; or
2. The minority population percentage is more than 20 percentage points greater in the census block group than the minority percentage of the geographic area chosen for the comparative analysis.

To establish minimum thresholds for each minority category, the non-white minority population total for each state was divided by the total population in the state. This process was repeated with a 50-mile radius total minority population and 50-mile radius total population. As described in the second criterion, 20 percent was added to the minority percentage values for each geographic area. The lower of the two NRC conditions for a minority population was selected as defining a minority area (i.e., census block group minority population exceeds 50 percent, or minority population is more than 20 percent greater than the minority population of the geographic area). Any census block group with a percentage exceeding this value was considered a minority population. Minority percentages for Louisiana, Mississippi, and a 50-mile radius, along with corresponding thresholds, are shown in Table 3.10-4.

A minority category of "Aggregate of All Races" is created when the populations of all the 2010 U.S. Census minority categories are summed. As shown in Table 3.10-4, the 2010 "Aggregate of All Races" category, when compared to the total population, indicates 40.6 percent of the population in a 50-mile radius are minorities. The minority population percentages for Louisiana and Mississippi is 37.4 percent and 40.9 percent, respectively. Using the second criterion listed above for identification of a minority population, when a 50-mile radius is used as the geographic area, any census block group with a combined minority population equal to or greater than 60.6 percent would be considered a minority population. Because 60.6 percent exceeds the criterion of 50 percent, the first criterion (50 percent) would be used. The states are evaluated in a similar manner. When the two states are used as the geographic area, any census block group with an "Aggregate of All Races" population exceeding 50 percent in Louisiana or Mississippi would be considered a minority population.

Because Hispanic is not considered a race by the USCB, Hispanics are already represented in the census-defined race categories. However, because Hispanics can be represented in any race category, some white Hispanics not otherwise considered minorities become classified as a minority when categorized in the "Aggregate and Hispanic" category. Also, Hispanics of non white racial background are included in both the racial group and the Hispanic group, and thereby counted twice. The "Aggregate and Hispanic" category, however, results in the greatest chance of consideration of populations within a block group to be classified as minority.

The number of census block groups contributing to the minority population count was evaluated using the criteria shown in Table 3.10-4 and summarized in Table 3.10-5. The results of the evaluation are census block groups flagged as having a minority population(s). The resulting maps (Figures 3.10-1, 3.10-2, 3.10-3, 3.10-4, 3.10-5, 3.10-6, 3.10-7, 3.10-8, 3.10-9, and 3.10-10) depict the location of minority population census block groups flagged accordingly for each race or aggregate category. Because no block group met the criteria for the American Indian, Native Hawaiian/Other Pacific Islander, Other, or Two or More Races race categories, no figures illustrating those race categories were produced. As discussed in Section 3.0.4, the Tunica-Biloxi Indian reservation, located in Avoyelles Parish, is approximately 49 miles west-northwest of RBS.

The percentage of census block groups exceeding the "Aggregate of All Races" minority population criterion was 41.6 percent when a 50-mile radius was used and 41.6 percent when the individual state was used as the geographic area (Table 3.10-5). For the "Aggregate and Hispanic" category, 43.6 percent of the census block groups contained a minority population when the region was used, and 43.6 percent of the block groups contained minority populations when the individual state was used (Table 3.10-5). The minority population values of the block groups were significantly reduced when races were analyzed individually.

The identified minority population closest to the RBS center point is located 3.8 miles southwest of the site: Block Group 221259517012. This census block group contained a total of 6,891 people, with 4,940 "Black or African American," 4 "American Indian," 1 "Asian," 38 "Two or More Races," and 15 "Hispanic or Latino" individuals. Using either the individual state criteria or the regional criteria, the block group contains a "Black or African American" population, an

"Aggregate of All Races" population, and an "Aggregate and Hispanic" population. (USCB 2015d; USCB 2015j)

One block group within a 6-mile radius meets the criteria for a minority population. There are 268 identified minority population block groups located in, partially within, or adjacent to cities, municipalities, or USCB-defined urban areas. This leaves several block groups that do not fall within or are not immediately adjacent to cities, municipalities, or USCB-defined urban areas (USCB 2015d).

### 3.10.2.3 Low-Income Populations

NRC guidance defines "low-income" using USCB statistical poverty thresholds for individuals or families (NRC 2013c, pages D-5 and D-6). As addressed above with minority populations, two alternative geographic areas (Louisiana and Mississippi individually and the region) were used as the geographic areas for comparison in this analysis. The guidance indicates that a low-income population is considered present if either of the two following conditions exists:

1. The low-income population in the census block group exceeds 50 percent; or
2. The percentage of households below the poverty level in a block group is significantly greater (typically at least 20 percentage points) than the low-income population percentage of the geographic area chosen for the comparative analysis (i.e., individual state and region's combined average).

To establish minimum thresholds for the individual low-income category, the population with an income below the poverty level for the state was divided by the total population for whom poverty status is determined in the state. To establish minimum thresholds for the family low-income category, the family population count with an income below the poverty level for the state was divided by the total family population count in the state. This process was repeated for the regional population with an income below the poverty level and regional total population for whom poverty status is determined. As described in the second criterion, 20 percent was added to the low-income values for individuals and families and each geographic area. None of the geographic areas described in the first criterion exceeded 50 percent.

As shown in Table 3.10-6, when the 2006–2010 census data category "income in the past 12 months below poverty level" (individual) is compared to "total population for whom poverty status is determined," 18.1 percent of the population in the region has an individual income below poverty level. In the states of Louisiana and Mississippi, the percentage of individuals with an income below poverty level is 18.1 percent and 21.2 percent, respectively.

As shown in Table 3.10-6, Louisiana has an estimated 285,360 families and Mississippi has an estimated 219,519 families living below poverty level. When the 2006–2010 census data family category "income in the past 12 months below poverty level" is compared to "total family count", 17.3 percent of the families within the region have an income below poverty level. In the states of

Louisiana and Mississippi, the percentage of the family population with an income below poverty level is 17.4 percent and 17.3 percent, respectively.

As an example, when Louisiana is used as the geographic area, any census block group within the region with a low-income population equal to or greater than 38.1 percent of the total block group, the population would be considered a "low-income population" (individual) (Table 3.10-6). Using the appropriate criteria for the individual state (Mississippi and Louisiana), 97 of the total 635 census block groups (15.3 percent) have low-income individual population percentages which meet or exceed the percentages in Table 3.10-5. These census block groups are illustrated in Figure 3.10-11.

When the region is used as the geographic area, any census block group within a 50-mile radius with populations of low-income individuals equal to or greater than 38.1 percent of the total block group population would be considered a "low-income population." Using these criteria, 99 of the 635 census block groups (15.6 percent) were identified within a 50-mile radius of the RBS site, as shown in Figure 3.10-12. (USCB 2015k) Similarly, these criteria are found using both geographies and family census counts (Table 3.10-5). Using the family individual state and regional criteria, 85 census block groups were identified as having low-income families in each criteria (Table 3.10-5). These census block groups are illustrated in Figures 3.10-13 and 3.10-14. (USCB 2015k)

The closest low-income block group that meets the guidance criteria for individuals or families is located approximately 6.2 miles west-southwest of the RBS center point, inside the New Roads Urban Area. It is Block Group 220779519004. (USCB 2015k)

As an indicator of diverse income growth, a post-Katrina analysis in the Baton Rouge MSA indicated that the median individual income of African Americans has grown by 32 percent. This growth rate outpaced the MSA's overall growth rate of 21 percent and the national income growth rate for African Americans of 13 percent. (BRAC 2015a)

**Table 3.10-1**
**Cities or Towns Located Totally or Partially within a 50-Mile Radius of RBS**

| Name | U.S. Census Designation | Parish/County | State | 2000 Census Population[a] | 2010 Census Population[a] | Distance to RBS (miles)[b][c] | Direction |
|---|---|---|---|---|---|---|---|
| Addis | Town | West Baton Rouge | LA | 2,238 | 3,593 | 28 | S |
| Albany | Village | Livingston | LA | 865 | 1,088 | 48 | ESE |
| Amite | Town | Tangipahoa | LA | 4,110 | 4,141 | 49 | E |
| Arnaudville | Town | Saint Landry | LA | 1,398 | 1,057 | 43 | SW |
| Baker | City | East Baton Rouge | LA | 13,793 | 13,895 | 15 | SE |
| Baton Rouge | City | East Baton Rouge | LA | 227,818 | 229,493 | 24 | SSE |
| Bayou Goula | CDP | Iberville | LA | Null | 612 | 39 | SSE |
| Bordelonville | CDP | Avoyelles | LA | Null | 525 | 42 | NW |
| Breaux Bridge | City | Saint Martin | LA | 7,281 | 8,139 | 47 | SW |
| Brownfields | CDP | East Baton Rouge | LA | 5,222 | 5,401 | 19 | SE |
| Brusly | Town | West Baton Rouge | LA | 2,020 | 2,589 | 25 | SSE |
| Carencro | City | Lafayette | LA | 6,120 | 7,526 | 52 | SW |
| Catahoula | CDP | Saint Martin | LA | Null | 1,094 | 44 | SSW |
| Cecilia | CDP | Saint Martin | LA | 1,505 | 1,980 | 42 | SW |
| Central | City | East Baton Rouge | LA | Null | 26,864 | 22 | SE |
| Clinton | Town | East Feliciana | LA | 1,998 | 1,653 | 20 | ENE |
| Cottonport | Town | Avoyelles | LA | 2,316 | 2,006 | 46 | WNW |
| Crescent | CDP | Iberville | LA | Null | 959 | 35 | S |
| Denham Springs | City | Livingston | LA | 8,757 | 10,215 | 29 | SE |

**Table 3.10-1 (Continued)**
**Cities or Towns Located Totally or Partially within a 50-Mile Radius of RBS**

| Name | U.S. Census Designation | Parish/County | State | 2000 Census Population[a] | 2010 Census Population[a] | Distance to RBS (miles)[b][c] | Direction |
|---|---|---|---|---|---|---|---|
| Donaldsonville | City | Ascension | LA | 7,605 | 7,436 | 50 | SSE |
| Erwinville | CDP | West Baton Rouge | LA | Null | 2,192 | 16 | SSW |
| Evergreen | Town | Avoyelles | LA | 314 | 310 | 48 | WNW |
| Fordoche | Town | Pointe Coupee | LA | 933 | 928 | 20 | SW |
| French Settlement | Village | Livingston | LA | 945 | 1,116 | 45 | SE |
| Gardere | CDP | East Baton Rouge | LA | 8,992 | 10,580 | 31 | SSE |
| Gonzales | City | Ascension | LA | 8,156 | 9,781 | 43 | SE |
| Grand Coteau | Town | Saint Landry | LA | 1,040 | 947 | 49 | WSW |
| Greensburg | Town | Saint Helena | LA | 631 | 718 | 40 | E |
| Grosse Tete | Village | Iberville | LA | 670 | 647 | 25 | SSW |
| Henderson | Town | Saint Martin | LA | 1,531 | 1,674 | 41 | SW |
| Independence | Town | Tangipahoa | LA | 1,724 | 1,665 | 50 | E |
| Inniswold | CDP | East Baton Rouge | LA | 4,944 | 6,180 | 29 | SSE |
| Jackson | Town | East Feliciana | LA | 4,130 | 3,842 | 9 | NE |
| Kentwood | Town | Tangipahoa | LA | 2,205 | 2,198 | 50 | ENE |
| Krotz Springs | Town | Saint Landry | LA | 1,219 | 1,198 | 29 | WSW |
| Lafayette | City | Lafayette | LA | 110,257 | 120,623 | 55 | SW |
| Leonville | Town | Saint Landry | LA | 1,007 | 1,084 | 43 | WSW |
| Livingston | Town | Livingston | LA | 1,342 | 1,769 | 39 | ESE |

**Table 3.10-1 (Continued)**
**Cities or Towns Located Totally or Partially within a 50-Mile Radius of RBS**

| Name | U.S. Census Designation | Parish/County | State | 2000 Census Population[(a)] | 2010 Census Population[(a)] | Distance to RBS (miles)[(b)(c)] | Direction |
|---|---|---|---|---|---|---|---|
| Livonia | Town | Pointe Coupee | LA | 1,339 | 1,442 | 19 | SW |
| Mansura | Town | Avoyelles | LA | 1,573 | 1,419 | 47 | WNW |
| Maringouin | Town | Iberville | LA | 1,262 | 1,098 | 21 | SSW |
| Marksville | City | Avoyelles | LA | 5,537 | 5,702 | 51 | WNW |
| Melville | Town | Saint Landry | LA | 1,376 | 1,041 | 25 | W |
| Merrydale | CDP | East Baton Rouge | LA | 10,427 | 9,772 | 22 | SE |
| Monticello | CDP | East Baton Rouge | LA | 4,763 | 5,172 | 25 | SE |
| Montpelier | Village | Saint Helena | LA | 214 | 266 | 41 | E |
| Moreauville | Village | Avoyelles | LA | 922 | 929 | 43 | WNW |
| Morganza | Village | Pointe Coupee | LA | 659 | 610 | 16 | W |
| New Roads | City | Pointe Coupee | LA | 4,966 | 4,831 | 7 | WSW |
| Norwood | Village | East Feliciana | LA | 337 | 322 | 20 | NE |
| Oak Hills Place | CDP | East Baton Rouge | LA | 7,996 | 8,195 | 30 | SSE |
| Old Jefferson | CDP | East Baton Rouge | LA | 5,631 | 6,980 | 33 | SE |
| Opelousas | City | Saint Landry | LA | 22,860 | 16,634 | 47 | WSW |
| Palmetto | Village | Saint Landry | LA | 188 | 164 | 34 | W |
| Parks | Village | Saint Martin | LA | 533 | 653 | 48 | SW |
| Plaquemine | City | Iberville | LA | 7,064 | 7,119 | 33 | S |
| Plaucheville | Village | Avoyelles | LA | 281 | 248 | 41 | WNW |

**Table 3.10-1 (Continued)**
**Cities or Towns Located Totally or Partially within a 50-Mile Radius of RBS**

| Name | U.S. Census Designation | Parish/County | State | 2000 Census Population[a] | 2010 Census Population[a] | Distance to RBS (miles)[b][c] | Direction |
|---|---|---|---|---|---|---|---|
| Port Allen | City | West Baton Rouge | LA | 5,278 | 5,180 | 22 | SSE |
| Port Barre | Town | Saint Landry | LA | 2,287 | 2,055 | 39 | WSW |
| Port Vincent | Village | Livingston | LA | 463 | 741 | 41 | SE |
| Prairieville | CDP | Ascension | LA | Null | 26,895 | 38 | SE |
| Rosedale | Village | Iberville | LA | 753 | 793 | 23 | SSW |
| Roseland | Town | Tangipahoa | LA | 1,162 | 1,123 | 49 | E |
| St. Francisville | Town | West Feliciana | LA | 1,712 | 1,765 | 3 | WNW |
| St. Gabriel | Town | Iberville | LA | 5,514 | 6,677 | 37 | SSE |
| Shenandoah | CDP | East Baton Rouge | LA | 17,070 | 18,399 | 31 | SE |
| Simmesport | Town | Avoyelles | LA | 2,239 | 2,161 | 32 | WNW |
| Slaughter | Village | East Feliciana | LA | 1,011 | 997 | 12 | ESE |
| Sorrento | Town | Ascension | LA | 1,227 | 1,401 | 49 | SE |
| Sunset | Town | Saint Landry | LA | 2,352 | 2,897 | 50 | WSW |
| Tangipahoa | Village | Tangipahoa | LA | 747 | 748 | 49 | E |
| Ventress | CDP | Pointe Coupee | LA | Null | 890 | 7 | SW |
| Village St. George | CDP | East Baton Rouge | LA | 6,993 | 7,104 | 32 | SSE |
| Walker | Town | Livingston | LA | 4,801 | 6,138 | 34 | ESE |
| Washington | Town | Saint Landry | LA | 1,082 | 964 | 44 | WSW |
| Watson | CDP | Livingston | LA | Null | 1,047 | 26 | ESE |

**Table 3.10-1 (Continued)**
**Cities or Towns Located Totally or Partially within a 50-Mile Radius of RBS**

| Name | U.S. Census Designation | Parish/County | State | 2000 Census Population[(a)] | 2010 Census Population[(a)] | Distance to RBS (miles)[(b)(c)] | Direction |
|---|---|---|---|---|---|---|---|
| Westminster | CDP | East Baton Rouge | LA | 2,515 | 3,008 | 28 | SSE |
| White Castle | Town | Iberville | LA | 1,946 | 1,883 | 42 | SSE |
| Wilson | Village | East Feliciana | LA | 668 | 595 | 17 | NE |
| Zachary | City | East Baton Rouge | LA | 11,275 | 14,960 | 13 | SE |
| Centreville | Town | Wilkinson | MS | 1,680 | 1,684 | 28 | NNE |
| Crosby | Town | Amite | MS | 360 | 318 | 40 | NNE |
| Gloster | Town | Amite | MS | 1,073 | 960 | 35 | NNE |
| Liberty | Town | Amite | MS | 633 | 728 | 41 | NE |
| Woodville | Town | Wilkinson | MS | 1,192 | 1,096 | 24 | N |
| CDP: Census designated place. | | | | | | | |
| Null: No available data. | | | | | | | |

a. (USCB 2015c)

b. (USDOT 2015)

c. Distances reported were measured from the RBS center point to the city center.

CDP: Census designated place.
Null: No available data.

## Table 3.10-2
## Parish/County Populations Totally or Partially Included within a 50-Mile Radius of RBS

| State and County | 2000 Population[a] | 2010 Population[a] | 2045 Projected Permanent Population[b] | 2045 Projected Total Population[b] |
|---|---|---|---|---|
| **Louisiana** (18 parishes) | 1,302,649 | 1,450,666 | 2,229,978 | 2,263,926 |
| Ascension | 76,627 | 107,215 | 201,994 | 205,069 |
| Assumption | 23,388 | 23,421 | 25,649 | 26,040 |
| Avoyelles | 41,481 | 42,073 | 49,589 | 50,344 |
| Catahoula | 10,920 | 10,407 | 10,407 | 10,565 |
| Concordia | 20,247 | 20,822 | 20,983 | 21,302 |
| East Baton Rouge | 412,852 | 440,171 | 570,315 | 578,997 |
| East Feliciana | 21,360 | 20,267 | 21,528 | 21,856 |
| Iberia | 73,266 | 73,240 | 96,776 | 98,249 |
| Iberville | 33,320 | 33,387 | 34,810 | 35,340 |
| Lafayette | 190,503 | 221,578 | 410,613 | 416,864 |
| Livingston | 91,814 | 128,026 | 338,058 | 343,204 |
| Pointe Coupee | 22,763 | 22,802 | 23,290 | 23,645 |
| St. Helena | 10,525 | 11,203 | 11,631 | 11,808 |
| St. Landry | 87,700 | 83,384 | 94,357 | 95,793 |
| St. Martin | 48,583 | 52,160 | 83,126 | 84,392 |
| Tangipahoa | 100,588 | 121,097 | 186,893 | 189,738 |
| West Baton Rouge | 21,601 | 23,788 | 30,816 | 31,285 |
| West Feliciana | 15,111 | 15,625 | 19,143 | 19,435 |

**Table 3.10-2 (Continued)**
**Parish/County Populations Totally or Partially Included within a 50-Mile Radius of RBS**

| State and County | 2000 Population[a] | 2010 Population[a] | 2045 Projected Permanent Population[b] | 2045 Projected Total Population[b] |
|---|---|---|---|---|
| **Mississippi** (5 counties) | 105,639 | 103,828 | 105,636 | 107,762 |
| Adams | 34,340 | 32,297 | 32,297 | 32,947 |
| Amite | 13,599 | 13,131 | 13,131 | 13,395 |
| Franklin | 8,448 | 8,118 | 8,118 | 8,281 |
| Pike | 38,940 | 40,404 | 41,617 | 42,455 |
| Wilkinson | 10,312 | 9,878 | 10,473 | 10,684 |
| U.S. Regional Parish/County Total | 1,408,288 | 1,554,494 | 2,335,614 | 2,371,688 |

a. (USCB 2015b)
b. (OPRP 2012; VMS 2014; WPEI 2014a; WPEI 2014b)

**Table 3.10-3**
**Parish/County Population Growth, 2010–2045**

| | | | 2010 | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 |
|---|---|---|---|---|---|---|---|---|---|---|
| Louisiana | East Baton Rouge Parish | Population | 440,879 | 459,251 | 481,349 | 502,474 | 521,934 | 539,457 | 555,175 | 570,315 |
| | | Average Annual Growth % | | 0.82 | 0.94 | 0.86 | 0.76 | 0.66 | 0.58 | 0.54 |
| | West Feliciana Parish | Population | 15,633 | 16,004 | 16,671 | 17,295 | 17,854 | 18,339 | 18,757 | 19,143 |
| | | Average Annual Growth % | | 0.47 | 0.82 | 0.74 | 0.64 | 0.54 | 0.45 | 0.41 |

(WPEI 2014a; WPEI 2014b)

Note: The reported 2010 population values represent the U.S. Census Annual Estimates of the Resident Population: July 1, 2010. Projected population values, including the 2015 value, are based on the population projection growth trend for the years reported.

**Table 3.10-4**
**Minority Populations Evaluated Against Criterion**

| Geographic Area | Louisiana | | | Mississippi | | | 50-Mile Radius (Region)[a] | | |
|---|---|---|---|---|---|---|---|---|---|
| Total Population[b] | 4,533,372 | | | 2,967,297 | | | 1,019,794 | | |
| Census Categories | State Population by Census Category[b] | Percent[c] | Criteria | State Population by Census Category[b] | Percent[c] | Criteria | State Population by Census Category[d] | Percent[c] | Criteria |
| Black | 1,452,396 | 32.0 | 50.0 | 1,098,385 | 37.0 | 50.0 | 370,787 | 36.4 | 50.0 |
| American Indian | 30,579 | 0.7 | 20.7 | 15,030 | 0.5 | 20.5 | 3,161 | 0.3 | 20.3 |
| Asian | 70,132 | 1.5 | 21.5 | 25,742 | 0.9 | 20.9 | 15,281 | 1.5 | 21.5 |
| Native Hawaiian\other Pacific Islander | 1,963 | 0.04 | 20.04 | 1,187 | 0.04 | 20.04 | 301 | 0.03 | 20.03 |
| Other | 69,227 | 1.5 | 21.5 | 38,162 | 1.3 | 21.3 | 12,266 | 1.2 | 21.2 |
| Two or more Races | 72,883 | 1.6 | 21.6 | 34,107 | 1.1 | 21.1 | 12,553 | 1.2 | 21.2 |
| Aggregate of All Races | 1,697,180 | 37.4 | 50.0 | 1,212,613 | 40.9 | 50.0 | 414,349 | 40.6 | 50.0 |
| Hispanic | 192,560 | 4.2 | 24.2 | 81,481 | 2.7 | 22.7 | 33,078 | 3.2 | 23.2 |
| Aggregate and Hispanic | 1,889,740 | 41.7 | 50.0 | 1,294,094 | 43.6 | 50.0 | 447,427 | 43.9 | 50.0 |

a. Population values reported in this column are from block groups (USCB 2015d, Tiger files; USCB 2015j, SF1 Data). Block groups located on the 50-mile radius boundary were not area weighted for these calculations.

b. (USCB 2015l; USCB 2015m) AFF State Demographic Data 2010 (DP-1).

c. Percent values were calculated by dividing each U.S. Census categories' population by the Louisiana, Mississippi, and 50-mile radius total population values.

d. (USCB 2015d; USCB 2015j) Census 2010 Summary File 1 (SF1) Data.

**Table 3.10-5**
**Minority Census Block Group Counts, 50-Mile Radius of RBS**

| | **Individual State Method** | | **50-Mile Radius** | |
|---|---|---|---|---|
| | Census Block Groups[a] | | Census Block Groups[a] | |
| Total Number of Block Groups with Population within 50-mile radius | 635 | | 635 | |
| Census Categories | Number of Block Groups with Identified Minority and Low Income Category | Percent of Block Groups within 50 miles | Number of Block Groups with Identified Minority and Low Income Category | Percent of Block Groups within 50 miles |
| Black | 247 | 38.9 | 247 | 38.9 |
| American Indian | 0 | 0 | 0 | 0 |
| Asian | 3 | 0.5 | 3 | 0.5 |
| Native Hawaiian\other Pacific Islander | 0 | 0 | 0 | 0 |
| Other | 0 | 0 | 0 | 0 |
| Two or more Races | 0 | 0 | 0 | 0 |
| Aggregate of All Races | 264 | 41.6 | 264 | 41.6 |
| Hispanic | 4 | 0.6 | 4 | 0.6 |
| Aggregate and Hispanic | 277 | 43.6 | 277 | 43.6 |
| Low Income[b] (Individuals) | 97 | 15.3 | 99 | 15.6 |
| Low Income[b] (Families) | 85 | 13.4 | 85 | 13.4 |

a. (USCB 2015d; USCB 2015j) Census 2010 Summary File 1 (SF1) Data.

b. (USCB 2015k) 2006–2010 ACS 5-Year Summary Tiger Files.

**Table 3.10-6**
**Low-Income Population Criteria Using Two Geographic Areas**

| | **Louisiana** | | | **Mississippi** | | | **50-Mile Radius (Region)** | | |
|---|---|---|---|---|---|---|---|---|---|
| (Income) Total Population[a] | 4,302,475 | | | 2,845,365 | | | 967,165 | | |
| (Income) Total Families[a] | 1,641,165 | | | 1,081,052 | | | 365,137 | | |
| Census Category | State Population by Census Category | Percent[b] | Criteria | State Population by Census Category | Percent[b] | Criteria | State Population by Census Category | Percent[b] | Criteria |
| Low Income—Number of Persons Below Poverty Level (DP-3) | 780,359 | 18.1 | 38.1 | 604,272 | 21.2 | 41.2 | 174,645 | 18.1 | 38.1 |
| Low Income—Number of Families Below Poverty Level (DP-3) | 285,360 | 17.4 | 37.4 | 219,519 | 20.3 | 40.3 | 63,203 | 17.3 | 37.3 |

a. (USCB 2015n) 2006–2010 ACS 5-Year Summary File.

b. Percent values were calculated by dividing each U.S. Census categories' population by the Louisiana, Mississippi, and 50-mile radius total population values (USCB 2015k).

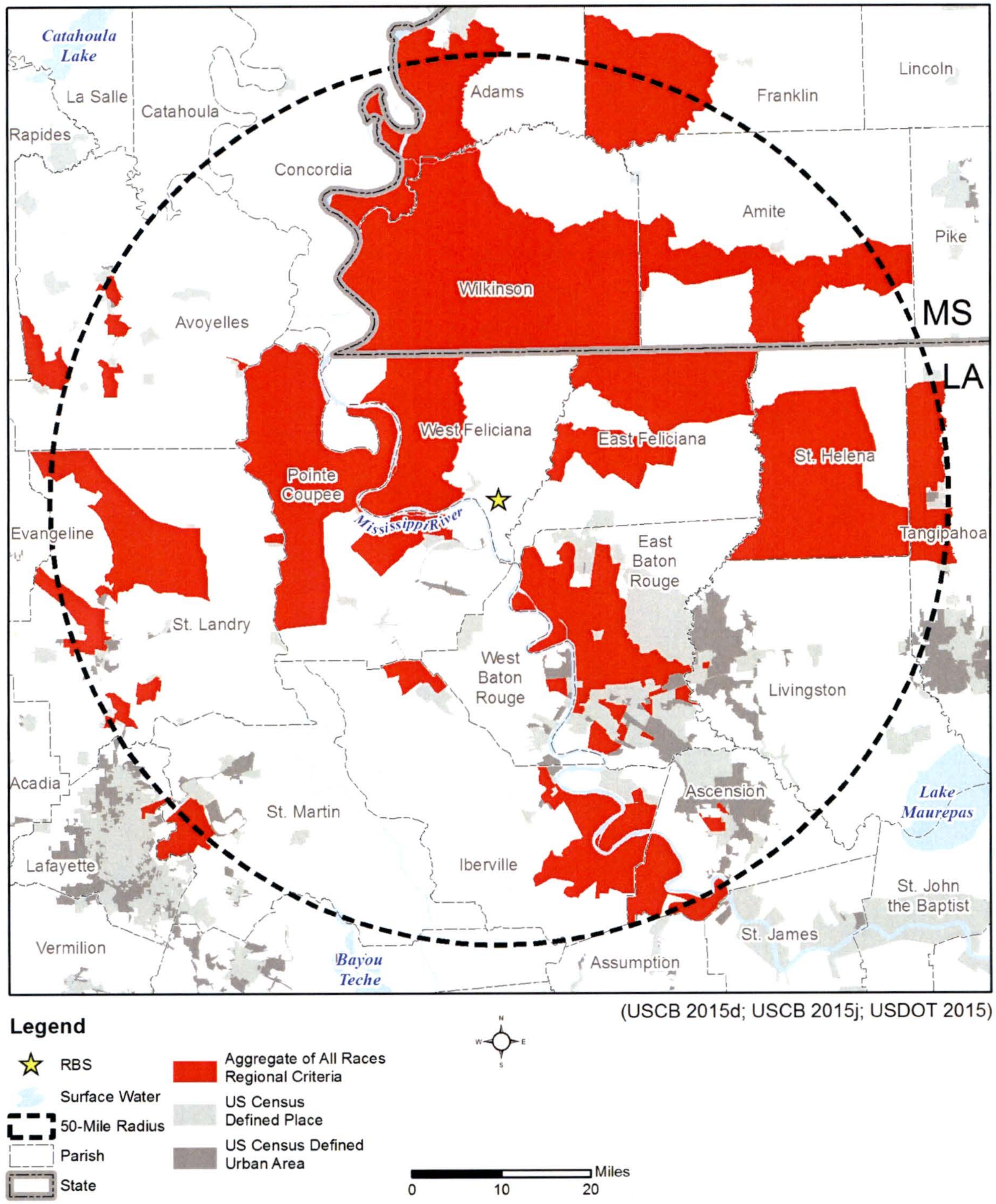
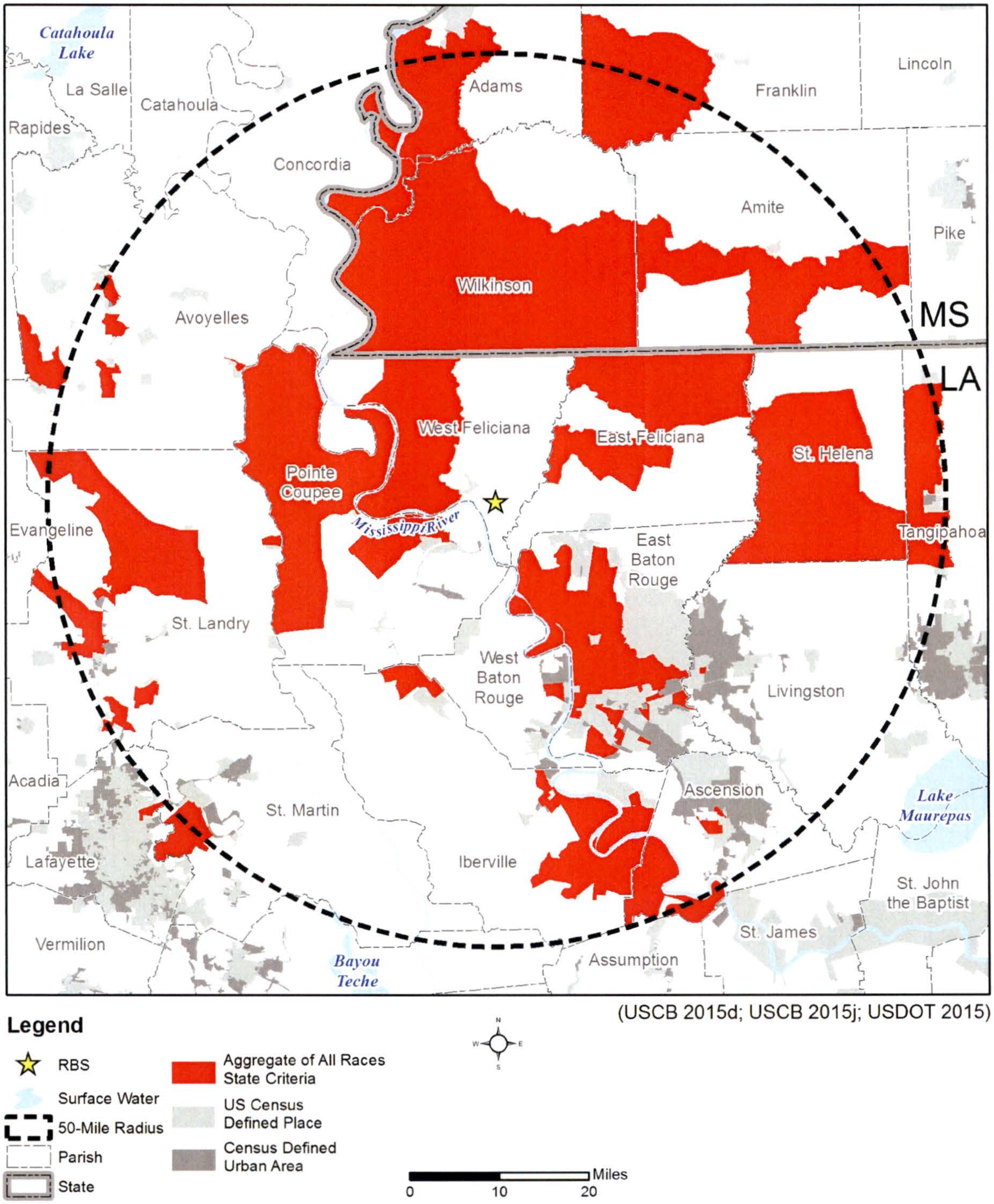



**Figure 3.10-1**
**Census—Aggregate of All Races Populations (Regional)**




(USCB 2015d; USCB 2015j; USDOT 2015)

**Figure 3.10-2**
**Census—Aggregate of All Races Populations (Individual State)**

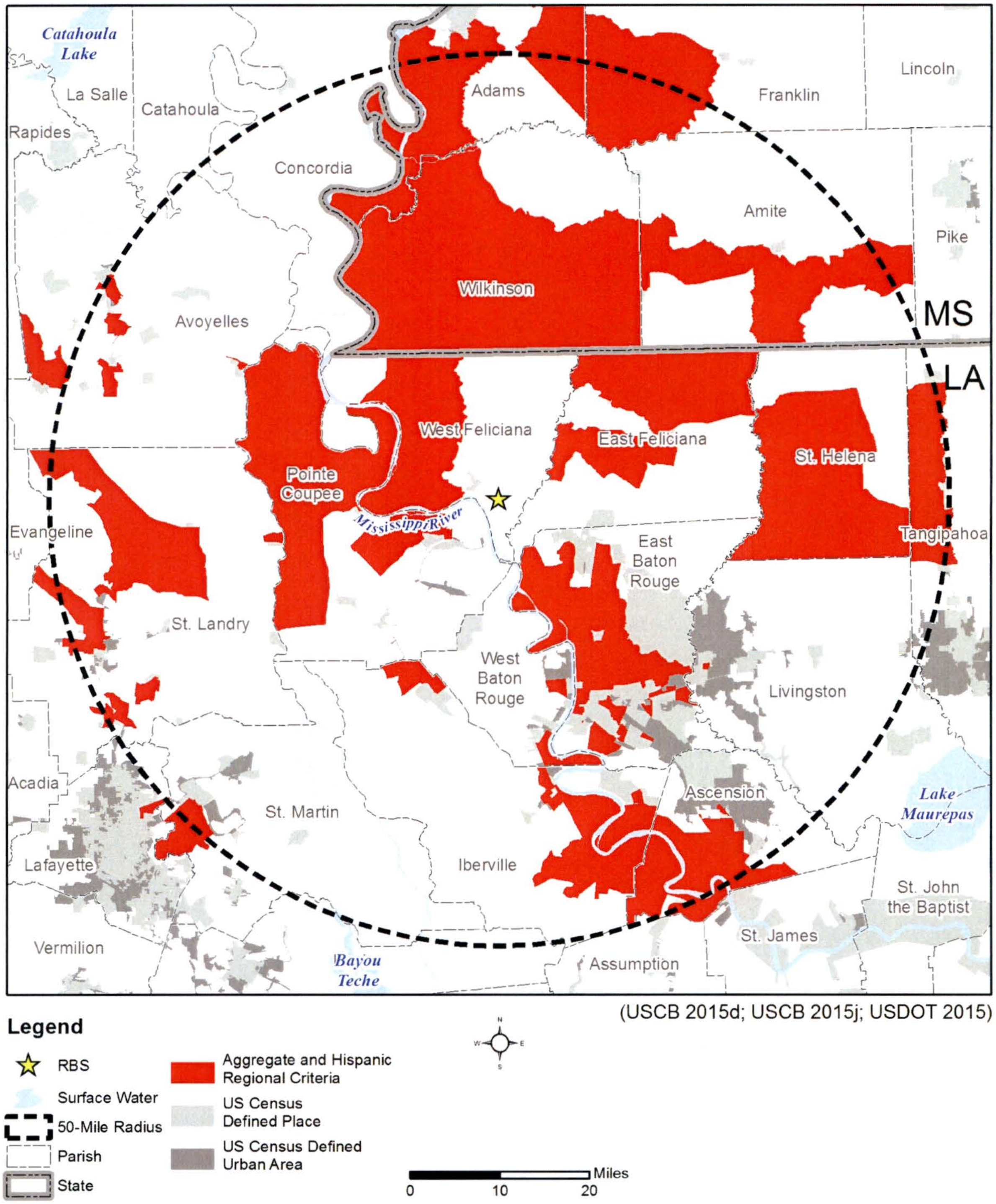
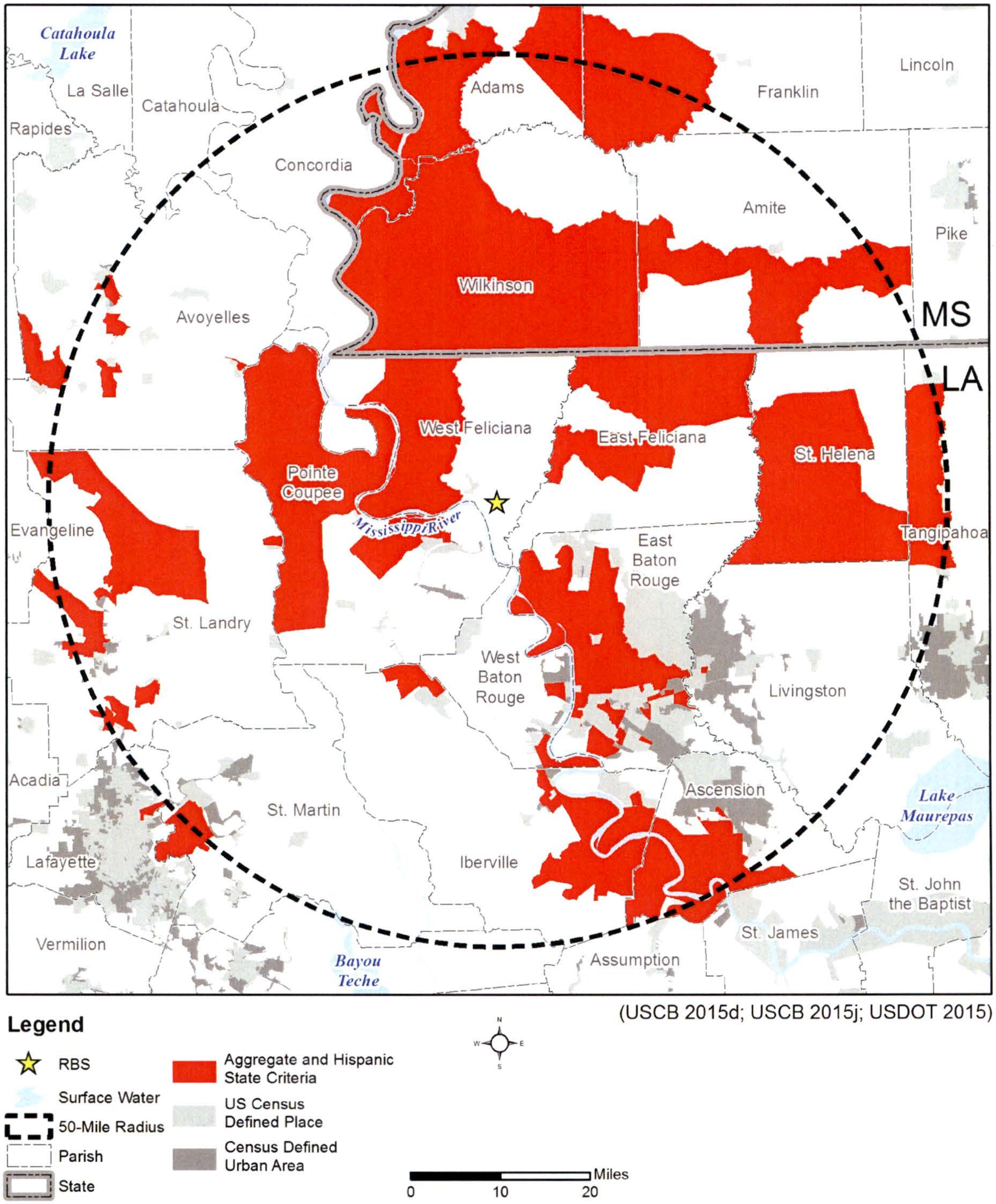



**Figure 3.10-3**
**Census—Aggregate and Hispanic Populations (Regional)**




(USCB 2015d; USCB 2015j; USDOT 2015)

**Figure 3.10-4**
**Census—Aggregate and Hispanic Populations (Individual State)**

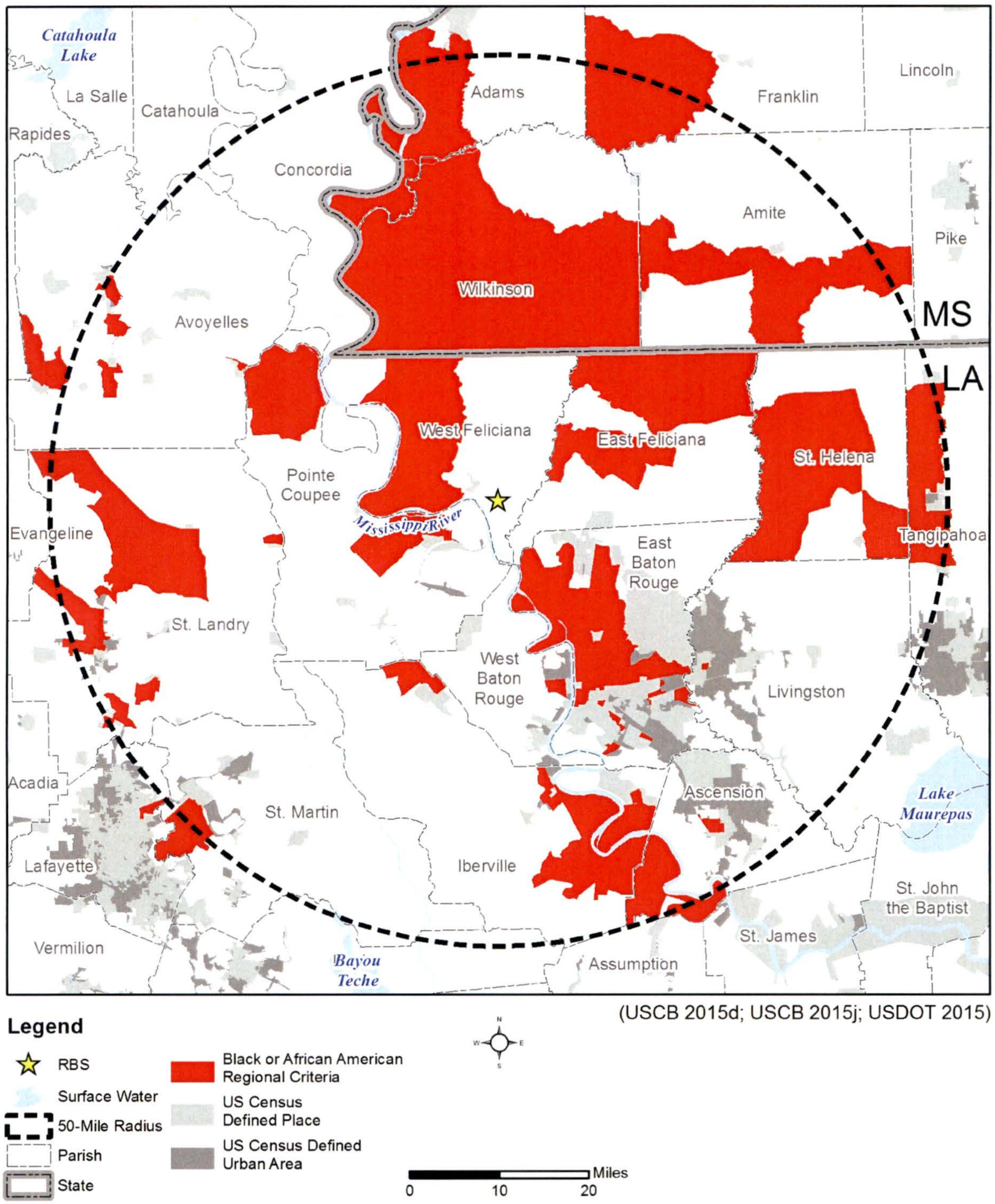



**Figure 3.10-5**
**Census—Black or African American Populations (Regional)**

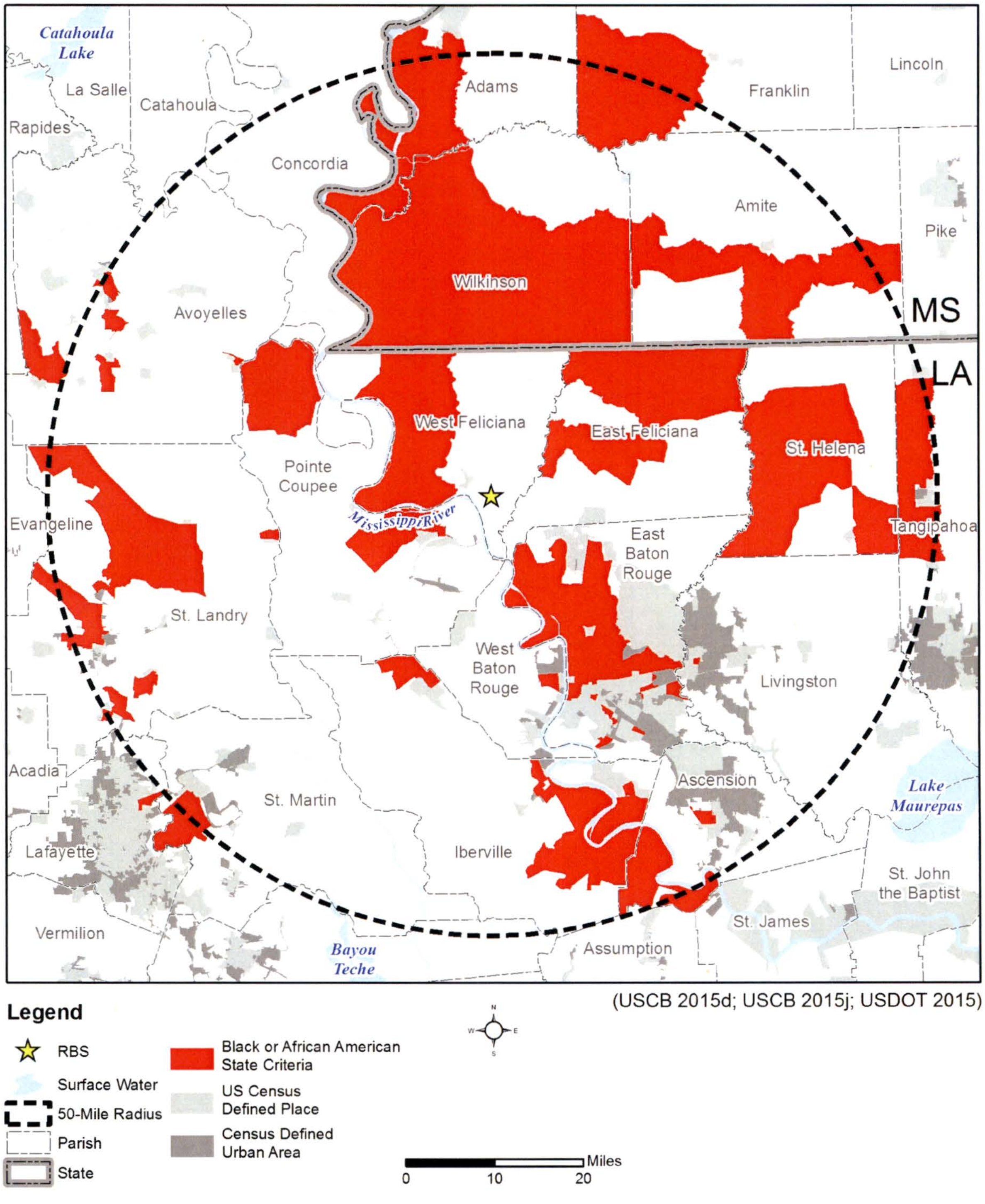



**Figure 3.10-6**
**Census—Black or African American Populations (Individual State)**

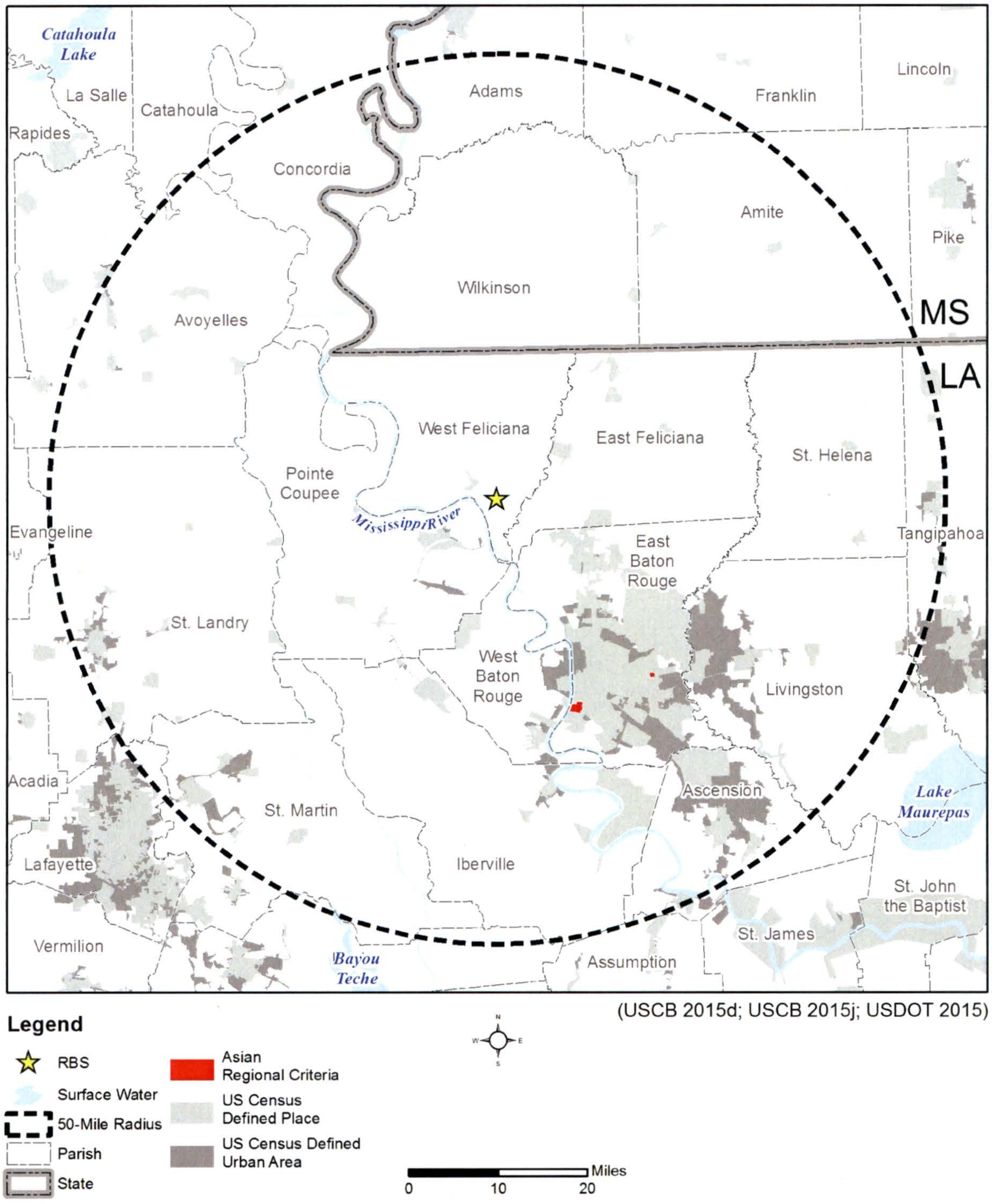



**Figure 3.10-7**
**Census—Asian Populations (Regional)**

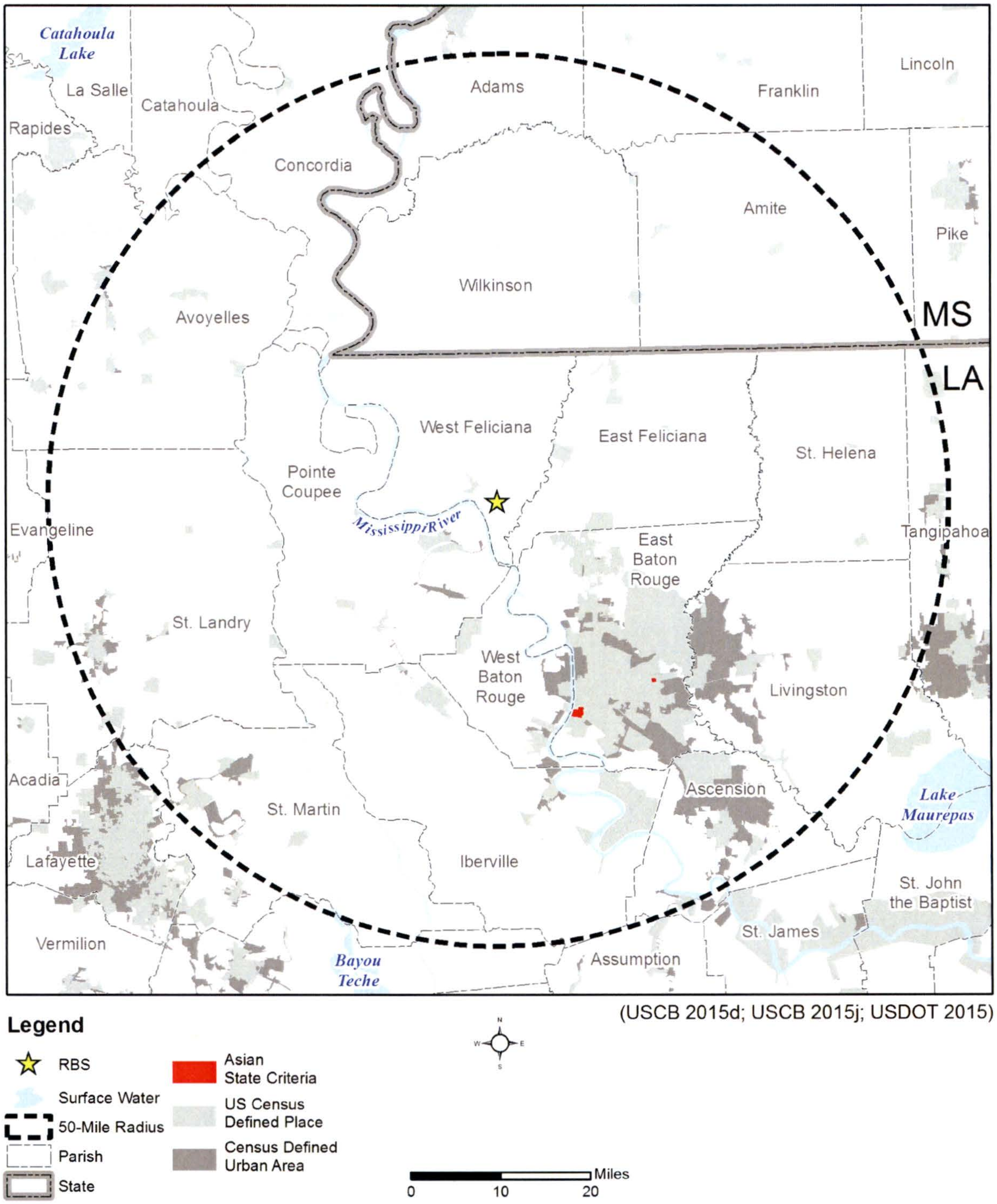



**Figure 3.10-8**
**Census—Asian Populations (Individual State)**

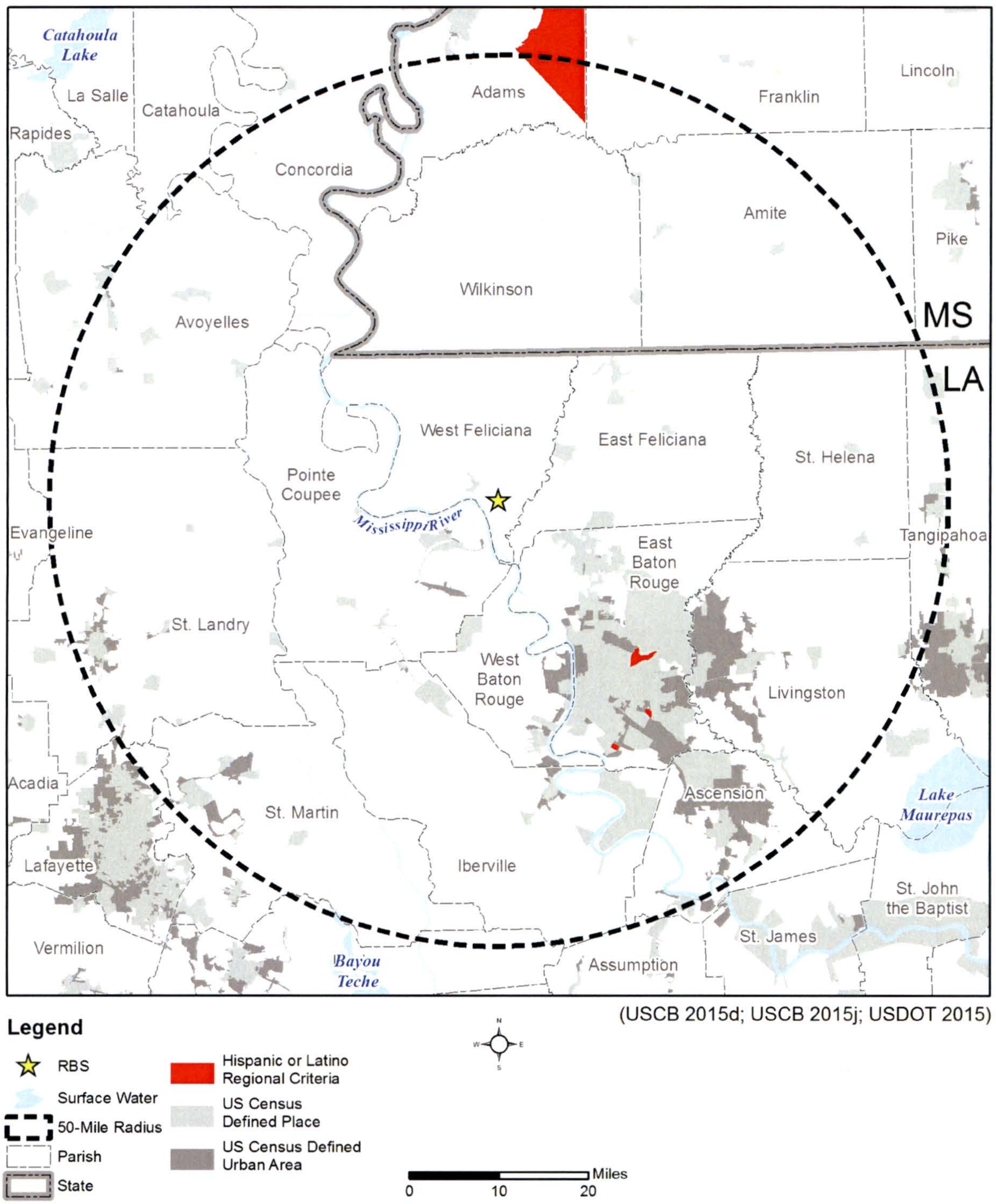



**Figure 3.10-9**
**Census—Hispanic or Latino Populations (Regional)**

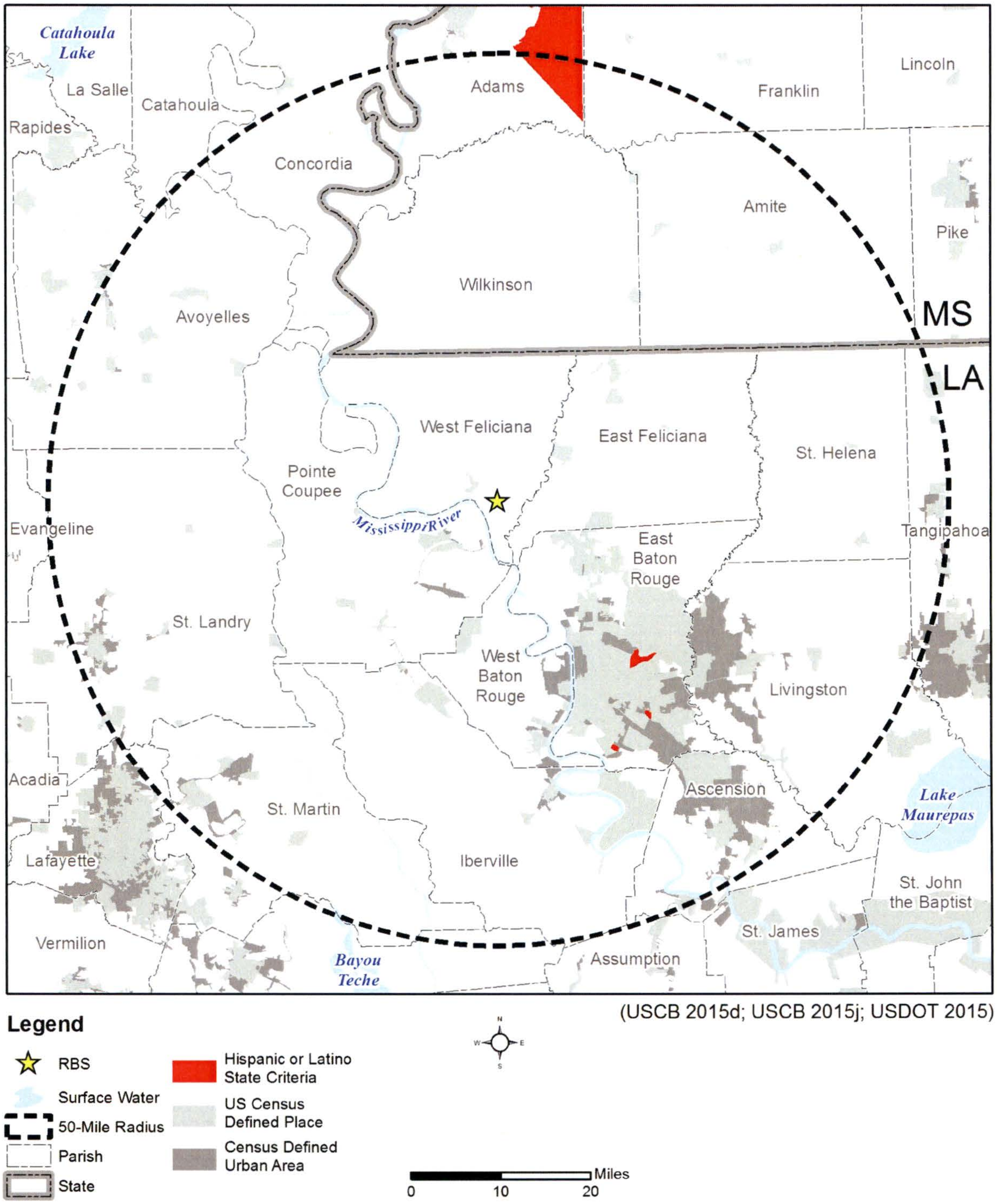



**Figure 3.10-10**
**Census—Hispanic or Latino Populations (Individual State)**

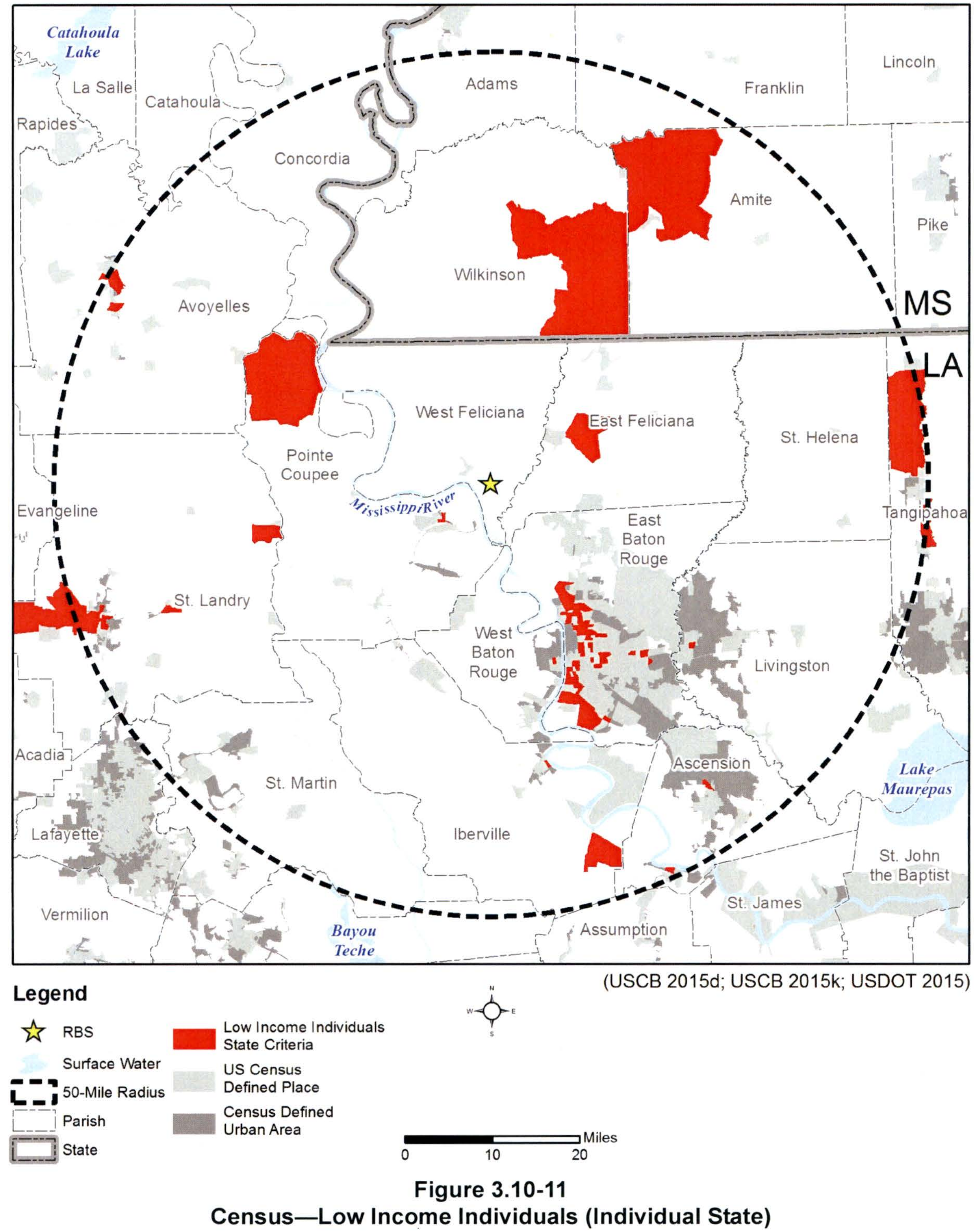



**Figure 3.10-11**
**Census—Low Income Individuals (Individual State)**

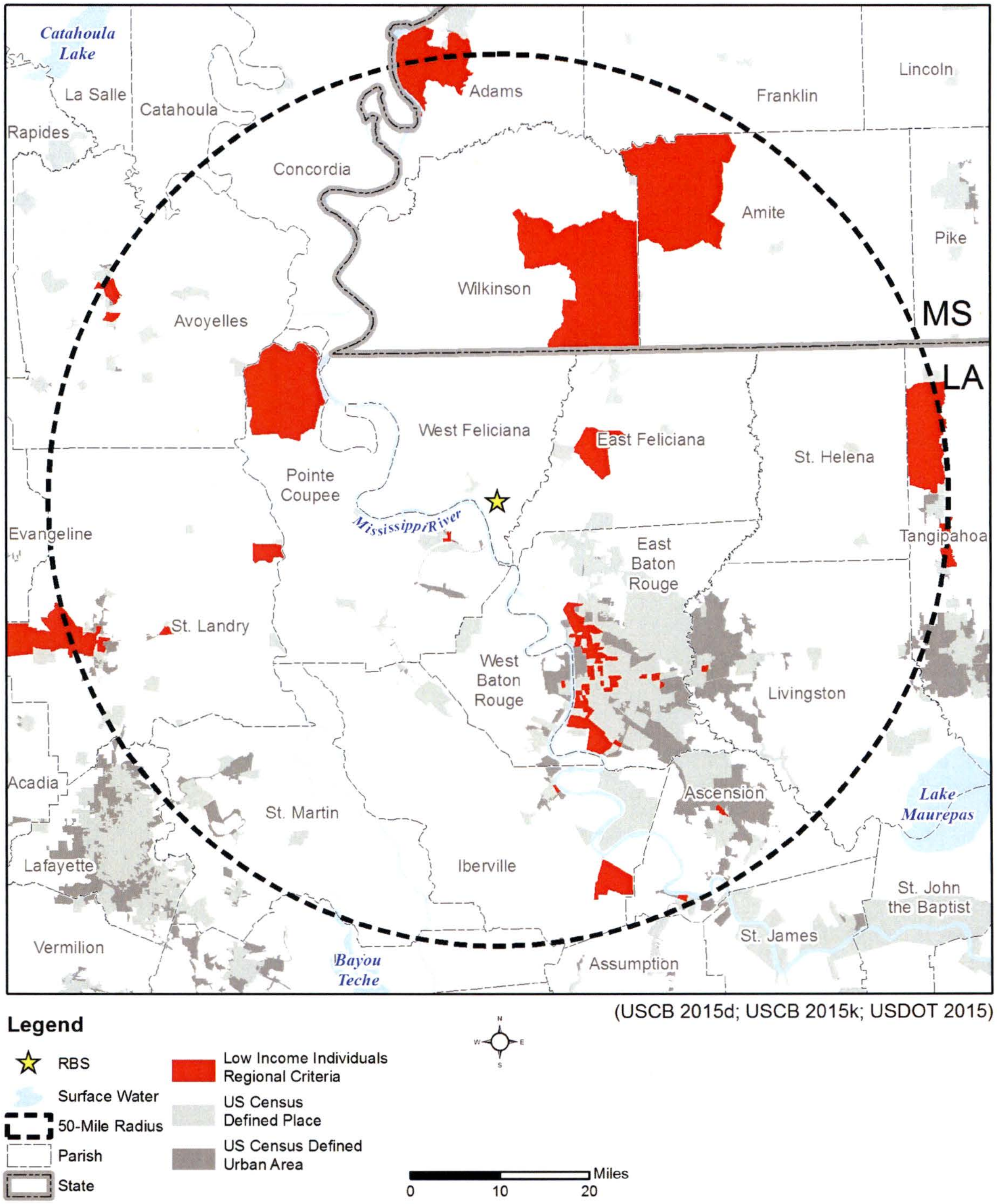



**Figure 3.10-12**
**Census—Low Income Individuals (Regional)**

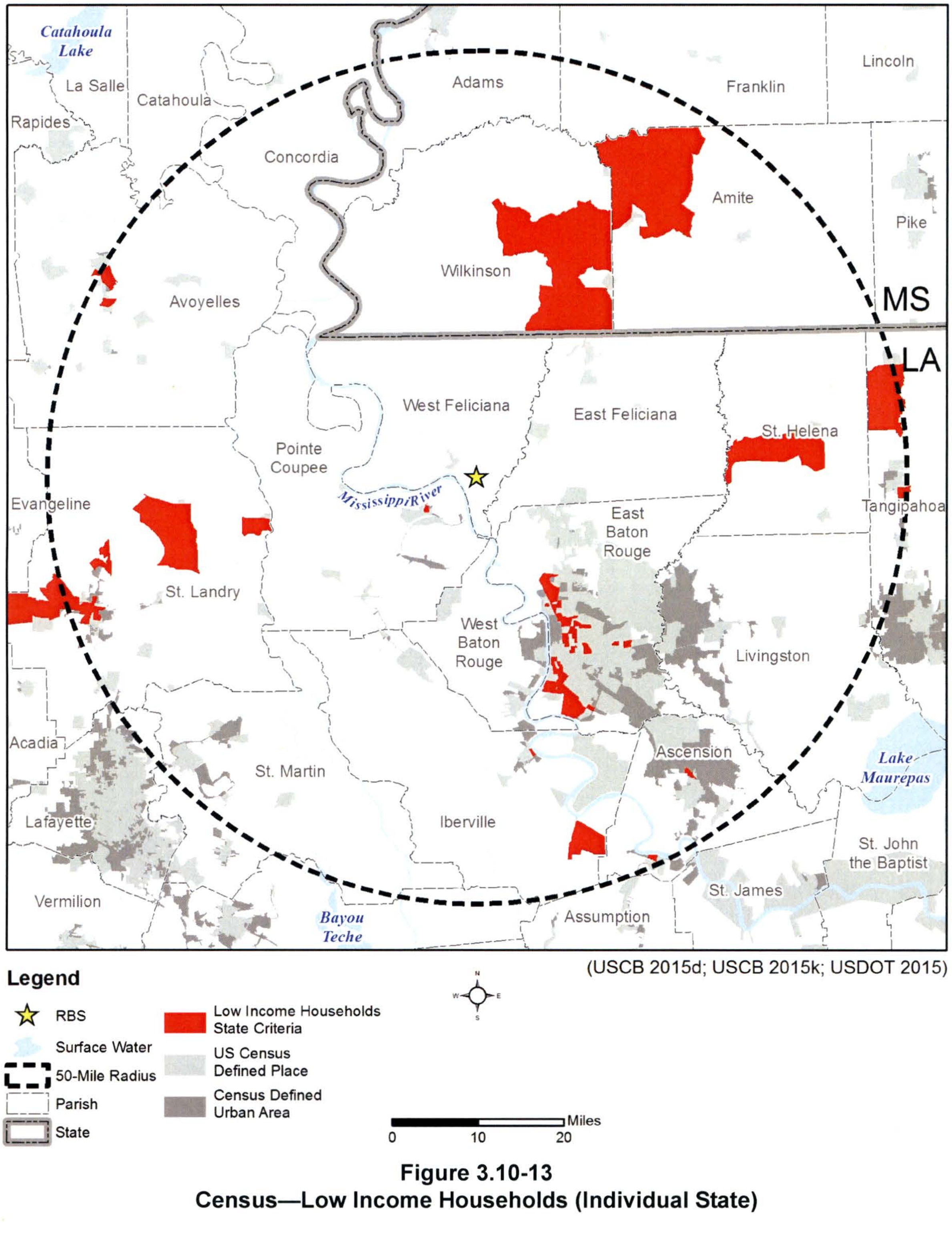
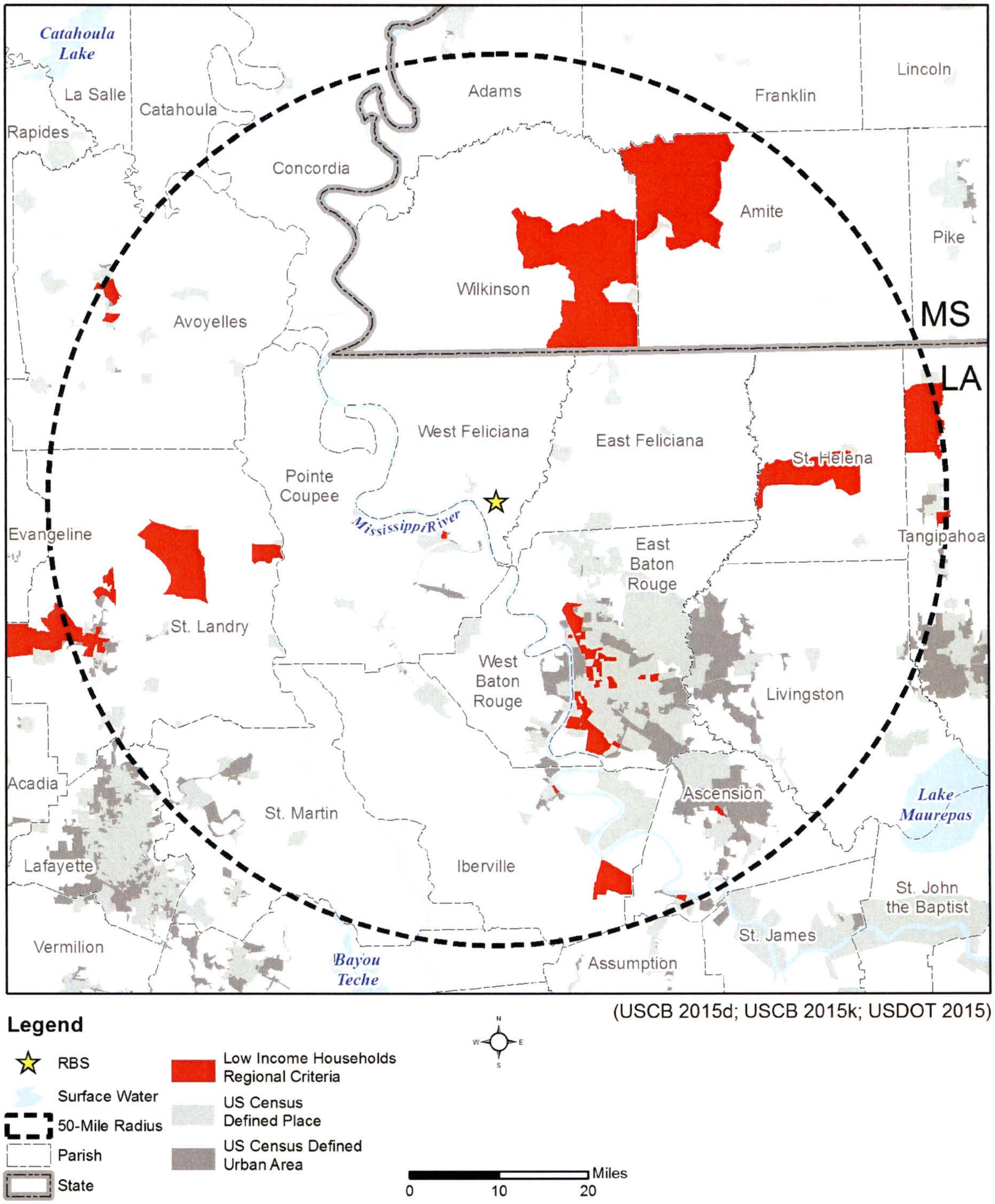



**Figure 3.10-13**
**Census—Low Income Households (Individual State)**




(USCB 2015d; USCB 2015k; USDOT 2015)

**Figure 3.10-14**
**Census—Low Income Households (Regional)**

## 3.11 Waste Management

In addressing the plant's radioactive and nonradioactive waste management systems and programs, NRC Regulatory Guide 4.2, Supplement 1, Revision 1, specifies that the information being requested in this section can be incorporated by reference to Section 2.2 of the ER (NRC 2013a, Section 3.11). Therefore, consistent with NRC Regulatory Guide 4.2, Entergy is providing the information below to address RBS's radioactive and nonradioactive waste management systems and programs.

Section 2.2.3 includes a discussion of Entergy's liquid, gaseous, and solid radwaste systems. The section provides a description of the systems, controls for limiting the releases of radioactive liquid and gaseous effluents, management of LLMW, radwaste storage, spent fuel storage, and permitted facilities currently utilized for offsite processing and disposal of radioactive wastes.

Nonradioactive waste management systems are discussed in the following sections:

- Section 2.2.4—Management of RCRA waste, types of wastes generated and quantities, and minimization programs.
- Section 3.5.1.1—National Pollutant Discharge Elimination System (NPDES) permitted discharges and associated permit requirements, stormwater pollution prevention, and sanitary wastewater discharges.
- Section 3.2.5—Air permitted discharges and associated permit requirements, quantities of emission pollutants, and GHG emissions associated with plant operations.
- Section 3.5.4.2.2—Spill prevention programs for minimizing the potential for a chemical release to the environment.

# 4.0 ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION AND MITIGATING ACTIONS

> The report must contain a consideration of alternatives for reducing adverse impacts . . . for all Category 2 license renewal issues . . . . [10 CFR 51.53(c)(3)(iii)]
>
> The environmental report must include an analysis that considers . . . the environmental effects of the proposed action . . . and alternatives available for reducing or avoiding adverse environmental effects. [10 CFR 51.45(c) as adopted by 10 CFR 51.53(c)(2) and 10 CFR 51.53(c)(3)(iii)]
>
> The environmental report shall . . . discuss . . . the impact of the proposed action on the environment. Impacts shall be discussed in proportion to their significance. [10 CFR 51.45(b)(1) as adopted by 10 CFR 51.53(c)(2)]
>
> The information submitted . . . should not be confined to information supporting the proposed action but should also include adverse information. [10 CFR 51.45(e) as adopted by 10 CFR 51.53(c)(2)]

The NRC has identified and analyzed 78 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). The NRC 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 offsite radiological impacts—collective impacts from other than the disposal of spent fuel and high-level waste).
- 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 NRC concluded that one or more of the Category 1 criteria could not be met, the NRC designated the issue Category 2, which requires plant-specific analysis. The NRC designated one issue as NA, signifying that the categorization and impact definitions do not apply to this issue. NRC rules do not require analyses of Category 1 issues that were resolved using generic findings [10 CFR Part 51, Subpart A, Appendix B, Table B-1] as described in the GEIS. Therefore, an applicant may reference the GEIS findings for Category 1 issues, absent new and significant information.

### 4.0.1 Category 1 License Renewal Issues

> The environmental report for the operating license renewal stage is not required to contain analyses of the environmental impacts of the license renewal issues identified as Category 1 issues in Appendix B to subpart A of this part. [10 CFR 51.53(c)(3)(i)]

> [A]bsent new and significant information, the analyses for certain impacts codified by this rulemaking need only be incorporated by reference in an applicant's environmental report for license renewal . . . . (61 FR 28483)

Entergy has determined that, of the 60 Category 1 issues, seven are not applicable to the RBS site because they apply to design or operational features that do not exist at the facility. Table 4.0-1 lists these seven issues and provides a brief explanation of why they are not applicable to the site. Table 4.0-2 lists the 53 issues applicable to the site. Entergy reviewed the NRC findings on these 53 issues and identified no new and significant information that would invalidate the findings for the site (Chapter 5).

### 4.0.2 Category 2 License Renewal Issues

> The environmental report must contain analyses of the environmental impacts of the proposed action, including the impacts of refurbishment activities, if any, associated with license renewal and the impacts of operation during the renewal term, for those issues identified as Category 2 issues in Appendix B to subpart A of this part. [10 CFR 51.53(c)(3)(ii)]

> 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 . . . . [10 CFR 51.53(c)(3)(iii)]

The NRC designated 17 issues as Category 2. Entergy has determined that, of the 17 issues shown in Table 4.0-3, four are not applicable to the RBS site because they apply to design or operational features that do not exist at the facility. Where the issue does not apply to the site, the section explains the basis.

For the 13 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 RBS OL for the site and, when applicable, discuss potential mitigative alternatives to the extent appropriate. With the exception of threatened and endangered species/EFH, historic and cultural resources, and environmental justice, Entergy has identified the significance of the impacts associated with each issue as SMALL, MODERATE, or LARGE consistent with the criteria that the NRC established in 10 CFR Part 51, Subpart A, 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, important attributes of the resource.

**LARGE:** Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource. For issues where probability is a key consideration (i.e., accident consequences), probability was a factor in determining significance.

Threatened and endangered species/EFH, historic and cultural resources, and environmental justice were not assigned a significance impact of SMALL, MODERATE or LARGE in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. Therefore, consistent with NRC guidance, Entergy identified the significance of the impacts for these three Category 2 issues as follows:

- For threatened and endangered species (ESA): (1) would have no effect, (2) not likely to adversely affect, (3) likely to adversely affect, or (4) likely to jeopardize or adversely modify designated critical habitat. For EFH (Magnuson Stevens Fishery Conservation and Management Act): (1) no adverse impact, (2) minimal adverse impact, or (3) substantial adverse impact to the essential habitat of federally managed fish populations.

- For historic and cultural resources (National Historic Preservation Act [NHPA]): (1) no historic properties are present (no effect); (2) historic properties are present, but not adversely affected (no adverse effect); or (3) historic properties are adversely affected (adverse effect).

- For environmental justice, impacts would be based on disproportionately high and adverse human health and environmental effects on minority and low-income populations.

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).

### 4.0.3 "NA" License Renewal Issues

The NRC determined that its categorization and impact-finding definitions did not apply to chronic effects of electromagnetic fields. Because the categorization and impact finding definitions do not apply as noted in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, Footnote 5, applicants are not currently required to submit information on this issue.

### 4.0.4 Format of Issues Reviewed

The review and analysis of the Category 1 and 2 issues identified in Regulatory Guide 4.2, Supplement 1, Revision 1 (NRC 2013a) are discussed in the following sections. The format for the review of these issues is described below. Although Category 1 issues have been evaluated for new and significant information in Chapter 5, specific issues are also being listed in this chapter for consistency purposes with the recommended Regulatory Guide 4.2 format.

- *Issue:* Title of the issue.
- *Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1:* The findings for the issue from 10 CFR Part 51, Subpart A, Appendix B, Table B-1, Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants.
- *Requirement:* Restatement of the applicable 10 CFR 51.53 requirement.
- *Analysis:* An analysis of the environmental impact, taking into account information provided in the GEIS, 10 CFR Part 51, Subpart A, Appendix B, as well as current site-specific information. If an issue is not applicable, the analysis lists the explanation. The analysis section also provides a summary conclusion of the environmental impacts, and identifies as applicable, either ongoing or additional planned mitigation measures to reduce adverse impacts. For Category 1 issues listed in this chapter, an analysis is not required absent new and significant information.

**Table 4.0-1**
**Category 1 Issues Not Applicable to RBS**

| Resource Issue | Comment |
|---|---|
| ***Land Use*** | |
| Offsite land use in transmission line right-of-ways | All in-scope transmission lines subject to the evaluation of environmental impacts for license renewal are located within the RBS property. |
| ***Surface Water Resources*** | |
| Altered salinity gradients | RBS does not discharge to an estuary. |
| Altered thermal stratification of lakes | RBS is not located on a lake. |
| Surface water use conflicts (plants with once-through cooling systems) | RBS utilizes a closed-cycle cooling system equipped with mechanical draft cooling towers for condenser cooling purposes. |
| ***Groundwater Resources*** | |
| Groundwater quality degradation (plants with cooling ponds in salt marshes) | RBS is located on a freshwater body and does not utilize cooling ponds. |
| Groundwater quality degradation resulting from water withdrawals | RBS does not utilize Ranney wells and is not located on an ocean or estuary. |
| ***Terrestrial Resources*** | |
| Cooling system impacts on terrestrial resources (plants with once-through cooling systems or cooling ponds) | RBS utilizes a closed-cycle cooling system equipped with mechanical draft cooling towers for condenser cooling purposes. |

**Table 4.0-2**
**Category 1 Issues Applicable to RBS**

| Resource Issue | Subcategories |
|---|---|
| Land Use | Onsite land use |
| | Offsite land use |
| Visual Resources | Aesthetic impacts |
| Air Quality | Air quality impacts (all plants) |
| | Air quality effects of transmission lines |
| Noise | Noise impacts |
| Geologic Environment | Geology and soils |
| Surface Water Resources | Surface water use and quality (non-cooling system impacts) |
| | Altered current patterns at intake and discharge structures |
| | Scouring caused by discharged cooling water |
| | Discharge of metals in cooling system effluent |
| | Discharge of biocides, sanitary wastes, and minor chemical spills |
| | Effects of dredging on surface water quality |
| | Temperature effects on sediment transport capacity |
| Groundwater Resources | Groundwater contamination and use (non-cooling system impacts) |
| | Groundwater use conflicts (plants that withdraw less than 100 gpm) |
| Aquatic Resources | Impingement and entrainment of aquatic organisms (plants with cooling towers) |
| | Entrainment of phytoplankton and zooplankton (all plants) |
| | Thermal impacts on aquatic organisms (plants with cooling towers) |
| | Infrequently reported thermal impacts (all plants) |
| | Effects of cooling water discharge on dissolved oxygen, gas supersaturation, and eutrophication |
| | Effects of nonradiological contaminants on aquatic organisms |
| | Exposure of aquatic organisms to radionuclides |
| | Effects of dredging on aquatic organisms |
| | Effects on aquatic resources (non-cooling system impacts) |
| | Impacts of transmission line right-of-way management on aquatic resources |
| | Losses from predation, parasitism, and disease among organisms exposed to sub-lethal stresses |

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

| Resource Issue | Subcategories |
|---|---|
| Terrestrial Resources | Exposure of terrestrial organisms to radionuclides |
| | Cooling tower impacts on vegetation (plants with cooling towers) |
| | Bird collisions with plant structures and transmission lines |
| | Transmission line right-of-way management impacts on terrestrial resources |
| | Electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock) |
| Socioeconomics | Employment and income, recreation and tourism |
| | Tax revenues |
| | Community services and education |
| | Population and housing |
| | Transportation |
| Human Health | Radiation exposures to the public |
| | Radiation exposures to plant workers |
| | Human health impact from chemicals |
| | Microbiological hazards to plant workers |
| | Physical occupational hazards |
| Waste Management | Low-level waste storage and disposal |
| | Onsite storage of spent nuclear fuel |
| | Offsite radiological impacts of spent nuclear fuel and high-level waste disposal |
| | Mixed-waste storage and disposal |
| | Nonradioactive waste storage and disposal |
| Uranium Fuel Cycle | Offsite radiological impacts—individual impacts from other than the disposal of spent fuel and high-level waste |
| | Offsite radiological impacts—collective impacts from other than the disposal of spent fuel and high-level waste |
| | Nonradiological impacts of the uranium fuel cycle |
| | Transportation |
| Termination of Nuclear Power Plant Operations and Decommissioning | Termination of plant operations and decommissioning |
| Postulated Accidents | Design-basis accidents |

**Table 4.0-3**
**Category 2 Issues Applicability to RBS**

| Resource Issue | Applicability | Section |
|---|---|---|
| ***Surface Water Resources*** | | |
| Surface water use conflicts (plants with cooling ponds or cooling towers using makeup water from a river) | Applicable | 4.5.1.1 |
| ***Groundwater Resources*** | | |
| Groundwater use conflicts (plants that withdraw more than 100 gallons per minute) | Not Applicable | 4.5.2.1 |
| Groundwater use conflicts (plants with closed-cycle cooling systems that withdraw makeup water from a river) | Applicable | 4.5.2.2 |
| Groundwater quality degradation (plants with cooling ponds at inland sites) | Not Applicable | 4.5.2.3 |
| Radionuclides released to groundwater | Applicable | 4.5.2.4 |
| ***Aquatic Resources*** | | |
| Impingement and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds) | Not Applicable | 4.6.1.1 |
| Thermal impacts on aquatic organisms (plants with once-through cooling systems or cooling ponds) | Not Applicable | 4.6.1.2 |
| Water use conflicts with aquatic resources (plants with cooling ponds or cooling towers using makeup water from a river) | Applicable | 4.6.1.3 |
| ***Terrestrial Resources*** | | |
| Effects on terrestrial resources (non-cooling system impacts) | Applicable | 4.6.2.1 |
| Water use conflicts with terrestrial resources (plants with cooling ponds or cooling towers using makeup water from a river) | Applicable | 4.6.2.2 |
| ***Special Status Species and Habitats*** | | |
| Threatened, endangered, and protected species, and essential fish habitat | Applicable | 4.6.3.1 |
| ***Historic and Cultural Resources*** | | |
| Historic and cultural resources | Applicable | 4.7 |
| ***Human Health*** | | |
| Microbiological hazards to the public (plants with cooling ponds or canals or cooling towers that discharge to a river) | Applicable | 4.9.1 |
| Electric shock hazards | Applicable | 4.9.2 |
| ***Environmental Justice*** | | |
| Minority and low-income populations | Applicable | 4.10.1 |
| ***Cumulative Impacts*** | | |
| Cumulative impacts | Applicable | 4.12 |
| ***Postulated Accidents*** | | |
| Severe accidents | Applicable | 4.15.1 |

## 4.1 Land Use and Visual Resources

### 4.1.1 Onsite Land Use

#### 4.1.1.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. Changes in onsite land use from continued operations and refurbishment associated with license renewal would be a small fraction of the nuclear power plant site and would involve only land that is controlled by the licensee.

#### 4.1.1.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

#### 4.1.1.3 Analysis

Onsite land use information is presented in Section 3.1.1 of this ER. No license-renewal-related refurbishment activities have been identified as discussed in Section 2.3. In addition, no license-renewal-related construction activities have been identified. Therefore, no changes in onsite land use during the license renewal period are anticipated.

In the GEIS, the NRC determined that onsite land use impacts from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.2.1.1). Based on Entergy's review, no new and significant information was identified as it relates to onsite land use, and further analysis is not required.

### 4.1.2 Offsite Land Use

#### 4.1.2.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. Offsite land use would not be affected by continued operations and refurbishment associated with license renewal.

#### 4.1.2.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

#### 4.1.2.3 Analysis

Offsite land use information is presented in Section 3.1.2 of this ER. As discussed in Section 2.5, there are no plans to add workers to support plant operations during the extended license renewal period and, as discussed in Section 2.3, no license-renewal-related refurbishment activities have been identified. Therefore, no changes in offsite land use during the license renewal period are anticipated.

In the GEIS, the NRC determined that offsite land use impacts from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.2.1.1). Based on Entergy's review, no new and significant information was identified as it relates to offsite land use, and further analysis is not required.

### 4.1.3 Visual Resources

#### 4.1.3.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. No important changes to the visual appearance of plant structures or transmission lines are expected from continued operations and refurbishment associated with license renewal.

#### 4.1.3.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

#### 4.1.3.3 Analysis

The visual appearance of the plant and in-scope transmission lines is presented in Section 3.1.3 of this ER. As discussed in Section 3.1.3, none of the RBS plant structures are visible from US-61 because of the presence of a significant tree buffer around the site. From the highway entrance, only the RBS training center building is visible, and it has the appearance of an office building. The only visible effect from RBS would be the plume from the mechanical draft cooling towers. No license-renewal-related refurbishment or construction activities have been identified that would change the aesthetics of the RBS facility during the license renewal term. Therefore, no changes in visual resources during the license renewal period are anticipated.

In the GEIS, the NRC determined that aesthetic impacts from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.2.1.2). Based on Entergy's review, no new and significant information was identified as it relates to visual resources, and further analysis is not required.

## 4.2 Air Quality

### 4.2.1 Air Quality Impacts (all plants)

#### 4.2.1.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. Air quality impacts from continued operations and refurbishment associated with license renewal are expected to be small at all plants. Emissions resulting from refurbishment activities at locations in or near air quality nonattainment or maintenance areas would be short-lived and would cease after these refurbishment activities are completed. Operating experience has shown that the scale of refurbishment activities has not resulted in exceedance of the *de minimis* thresholds for criteria pollutants, and best management practices including fugitive dust controls and the imposition of permit conditions in State and local air emissions permits would ensure conformance with applicable State or Tribal Implementation plans.

Emissions from emergency diesel generators and fire pumps and routine operations of boilers used for space heating would not be a concern, even for plants located in or adjacent to nonattainment areas. Impacts from cooling tower particulate emissions even under the worst-case situations have been small.

#### 4.2.1.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

#### 4.2.1.3 Analysis

Air quality information is presented in Section 3.2.4 of this ER. No license-renewal-related refurbishment activities have been identified as discussed in Section 2.3. As discussed in Section 3.2.4, West Feliciana Parish is in attainment with the NAAQS for all criteria air pollutants. As discussed in Section 3.2.5, no future upgrade or replacement activities (e.g., diesel generators, diesel pumps) that would increase or decrease air emissions over the license renewal period were identified as necessary for plant operations.

As discussed in Section 3.2.5, the RBS air permit contains conditions established by the LDEQ to protect Louisiana's ambient air quality and ensure impacts are maintained at acceptable levels. These same conditions would regulate any future RBS activities that may increase air pollutants or threaten the attainment status of West Feliciana Parish.

In the GEIS, the NRC determined that air quality impacts from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.3.1.1). Based on Entergy's review, no new and significant information was identified as it relates to air quality, and further analysis is not required.

### 4.2.2 Air Quality Effects of Transmission Lines

#### 4.2.2.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. Production of ozone and oxides of nitrogen is insignificant and does not contribute measurably to ambient levels of these gases.

4.2.2.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

4.2.2.3 Analysis

Based on the GEIS, it was determined through several studies that the amount of ozone generated by even the largest lines in operation (765 kV) would be insignificant (NRC 2013b, Section 4.3.1.1). As discussed in Section 2.2.5.1, RBS's in-scope transmission lines are 230 kV. Therefore, the production of ozone and oxides of nitrogen would be *de minimus*.

In the GEIS, the NRC determined that air quality effects of transmission lines from continued plant operations over the license renewal term would be SMALL for all nuclear plants and designated this as a Category 1 issue (NRC 2013b, Section 4.3.1.1). Based on Entergy's review, no new and significant information was identified as it relates to air quality effects of transmission lines, and further analysis is not required.

## 4.3 Noise

### 4.3.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. Noise levels would remain below regulatory guidelines for offsite receptors during continued operations and refurbishment associated with license renewal.

### 4.3.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

### 4.3.3 Analysis

Noise impacts associated with plant operations are presented in Section 3.3 of this ER. No license-renewal-related refurbishment activities have been identified, as discussed in Section 2.3. As discussed in Section 3.3, the predicted noise emissions from normal station operation are not expected to exceed the St. Francisville nighttime sound level limit of 65 dBA at the nearest noise-sensitive receptors.

As discussed in Section 3.3, over a 5-year period (2011–2015), there have been no noise complaints related to actual plant operations. However, Entergy did previously receive a complaint from a local resident regarding activities associated with the firing range. Based on meetings with the local resident, it was determined that nighttime activities at the firing range were not occurring during the time period specified by the local resident. Therefore, Entergy concluded that the source of noise which produced the complaint was unrelated to nighttime firing range activities.

In the GEIS, the NRC determined that noise impacts from continued plant operations over the license renewal term would be SMALL for all nuclear plants and designated this as a Category 1 issue (NRC 2013b, Section 4.3.1.2). Based on Entergy's review, no new and significant information was identified as it relates to noise, and further analysis is not required.

## 4.4 Geology and Soils

### 4.4.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. The effect of geologic and soil conditions on plant operations and the impact of continued operations and refurbishment activities on geology and soils would be small for all nuclear power plants and would not change appreciably during the license renewal term.

### 4.4.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

### 4.4.3 Analysis

Geology and soils information is presented in Section 3.4 of this ER. Routine infrastructure, renovation, and maintenance projects would be expected during continued operation. As discussed in Sections 3.4.2.2 and 3.5.1.1.2, RBS maintains and implements a SWPPP that identifies potential sources of pollution that would reasonably be expected to affect the quality of stormwater, such as erosion, and identifies the practices that are used to prevent or reduce the pollutants in stormwater discharges.

In the GEIS, the NRC determined that geology and soil impacts from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.4.1). Based on Entergy's review, no new and significant information was identified as it relates to geology and soils, and further analysis is not required.

## 4.5 Water Resources

### 4.5.1 Surface Water Resources

#### 4.5.1.1 Surface Water Use Conflicts (Plants with Cooling Ponds or Cooling Towers Using Makeup Water from a River)

##### 4.5.1.1.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL or MODERATE. Impacts could be of small or moderate significance, depending on makeup water requirements, water availability, and competing water demands.

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

If the applicant's plant utilizes cooling towers or cooling ponds and withdraws makeup water from a river, an assessment of the impact of the proposed action on water availability and competing water demands, the flow of the river . . . must be provided.

4.5.1.1.3 Analysis

As discussed in Section 3.5.1, the Mississippi River and its tributaries drain a total of 1,245,000 square miles, which is 41 percent of the 48 contiguous states of the United States. With an average discharge of 593,000 cfs, the Mississippi River is the largest river in the United States. As discussed in Section 3.5.1, during the period 1965–2015, the minimum and maximum flows recorded near the RBS site were 111,000 cfs (May 2011) and 1,619,000 cfs (July 1988), respectively. The mean flow rate during this same period was 514,080 cfs. The probable minimum flow rate of the Mississippi River at RBS during the operating life of the station is not anticipated to be less than 100,000 cfs. As discussed in Section 3.5.1, the 7-day, 10-year low flow for the segment of the Mississippi River basin, on which RBS is located, is 141,955 cfs.

As discussed in Section 3.5.3.1, RBS withdraws cooling water from the Mississippi River through two intake screens at a design flow rate of 23.0 MGD (35.6 cfs), which represents approximately 0.04 percent of the flow in the Mississippi River at its lowest anticipated flow rate of 100,000 cfs. As shown in Figure 2.2-1, the drift/evaporation rate from the CWS and SWCS cooling towers is 17.7 MGD (27.4 cfs) and 0.38 MGD (0.6 cfs), respectively, based on design maximum. Therefore, of the volume of water withdrawn, 4.9 MGD (7.6 cfs) would be returned to the Mississippi River, and 18.1 MGD (28.0 cfs) would be lost to the atmosphere from drift and evaporation. Conservatively using the lowest anticipated flow of 100,000 cfs during the operating life of the station, the 28.0 cfs would represent only approximately 0.03 percent of the Mississippi River flow at the RBS intake structure.

Based on 2013 surface water withdrawals from the Mississippi River for parishes within a 6-mile radius of RBS that withdraw from the river (East Baton Rouge, Pointe Coupee, and West Feliciana) as shown in Table 3.5-6, approximately 374.6 MGD (579.5 cfs) of surface water was withdrawn. Based on the lowest anticipated flow rate (100,000 cfs), this volume would represent only approximately 0.6 percent of the Mississippi River flow. As discussed in Section 3.5.3.1, the state of Louisiana does not currently restrict the quantity of water that can be withdrawn from the Mississippi River.

During the license renewal term, RBS is expected to consume water from the Mississippi River at current rates; therefore, there would be no increase in consumptive water use. As discussed above, the amount of water withdrawn by RBS and lost through cooling tower drift and evaporation when conservatively using the lowest anticipated flow rate (100,000 cfs) would be a very small fraction of the Mississippi River flow at the RBS intake structure. Therefore, Entergy concludes that the potential impacts on surface water resources and downstream water availability from RBS's consumptive water use during the license renewal term would be SMALL and do not warrant additional mitigation measures.

### 4.5.2 Groundwater Resources

4.5.2.1 Groundwater Use Conflicts (Plants that Withdraw more than 100 GPM)

4.5.2.1.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL, MODERATE, or LARGE. Plants that withdraw more than 100 gpm could cause groundwater use conflicts with nearby groundwater users.

4.5.2.1.2 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 must be provided.

4.5.2.1.3 Analysis

As discussed in Section 3.5.3.2, there are five wells that withdraw groundwater at the RBS site: four for industrial purposes and one for remediation of tritium-contaminated groundwater. Two wells are screened within the tertiary Zone 3 aquifer (2,800-foot sand), one well screened within the tertiary Zone 1 aquifer (1,200-foot sand), and two wells screened within the UTA. Based on the previous 5 years (2011–2015), annual average water withdrawals from the five wells have ranged from 7 to 42 gpm in the tertiary Zone 3 aquifer (2,800-foot sand), 0.3 to 2.0 gpm in the tertiary Zone 1 aquifer (1,200-foot sand), and 1 to 4 gpm in the UTA, as shown in Table 3.5-9.

There is no active operational groundwater dewatering occurring at the RBS site. Because total onsite groundwater withdrawals are less than 100 gpm, this issue is not applicable, and further analysis is not required.

4.5.2.2 Groundwater Use Conflicts (Plants with Closed-Cycle Cooling Systems that Withdraw Makeup Water from a River)

4.5.2.2.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL, MODERATE, or LARGE. Water use conflicts could result from water withdrawals from rivers during low-flow conditions, which may affect aquifer recharge. The significance of impacts would depend on makeup water requirements, water availability, and competing water demands.

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

If the applicant's plant utilizes cooling towers or cooling ponds and withdraws makeup water from a river, an assessment of the impact of the proposed action on water availability and competing water demands . . . must be provided. The applicant shall also provide an assessment of the impacts of the withdrawal of water from the river on alluvial aquifers during low flow.

#### 4.5.2.2.3 Analysis

As discussed in Section 4.5.1.1.3, during the period 1965–2015, the minimum and maximum flows recorded near the RBS site were 111,000 cfs and 1,619,000 cfs, respectively. The mean flow rate during this same period was 514,080 cfs. The probable minimum flow rate of the Mississippi River at RBS during the operating life of the station is not anticipated to be less than 100,000 cfs.

As discussed in Section 3.5.2.1, the lower terrace alluvial deposits of the Mississippi floodplain and Port Hickey Terrace together form the MRAA. Within Louisiana, the MRAA encompasses approximately 9,947 square miles (LDEQ 2003, Figure 8-1). Recharge of the MRAA is accomplished by direct infiltration of rainfall in the river valley, lateral and upward movement of water from adjacent and underlying aquifers, and overbank stream flooding (LDEQ 2003, page 3). The MRAA is primarily used for irrigation and aquaculture (LADOTD 2009).

The MRAA is in direct hydraulic connection with the Mississippi River as well as underlying deposits, such as the tertiary aquifer (GZA 2007, Section 4.1.2). In addition, the western part of the UTA at the RBS site responds to changes in the Mississippi River stage, which indicates that a hydraulic connection exists between these deposits and the river. However, effects of the river on the UTA dissipate with distance and appear to have no significant effect in water level fluctuations on the eastern part of the RBS site or at the plant area. (GZA 2007, Section 4.2.1)

The maximum depths of occurrence of fresh water in the MRAA range from 20 feet below sea level to 500 feet below sea level. The range of thickness of the freshwater interval in the MRAA is 50 to 500 feet. (LDEQ 2003, page 3) The average thickness of the MRAA is approximately 200 feet in West Feliciana Parish. Reported values of hydraulic conductivity and storage coefficient for the MRAA are 200 feet/day and $1.0 \times 10^{-2}$ to $9.0 \times 10^{-4}$, respectively. Locally, the MRAA terminates east of the Mississippi River against the natural levee wall of the Mississippi River valley and lies unconformably above older Quaternary and Tertiary deposits (EOI 2008a, Section 2.3.1.2.2).

As discussed in Section 4.5.1.1.3, RBS would withdraw approximately 0.04 percent of the flow in the Mississippi River when conservatively using the lowest anticipated flow rate of 100,000 cfs. The state of Louisiana does not currently restrict the quantity of water that can be withdrawn from the Mississippi River.

As also discussed in Section 4.5.1.1.3, RBS withdraws cooling water from the Mississippi River through two intake screens at a design flow rate of 23.0 MGD (35.6 cfs), with a drift/evaporation rate from the CWS and SWCS cooling towers at 17.7 MGD (27.4 cfs) and 0.38 MGD (0.6 cfs), respectively, based on design maximum. Of the volume of water withdrawn, 4.9 MGD (7.6 cfs) would be returned to the Mississippi River, and 18.1 MGD (28.0 cfs) would be lost to the atmosphere from drift and evaporation. Conservatively using the lowest anticipated flow of 100,000 cfs, the 28.0 cfs would represent only approximately 0.03 percent of the Mississippi River flow at the RBS intake structure. During the license renewal term, RBS is expected to consume water from the Mississippi River at current rates; therefore, there would be no increase in consumptive water use.

Based on the above information, Entergy has concluded that withdrawal of surface water during the license renewal period would have a SMALL impact on recharge to the alluvial aquifer and would not warrant mitigation based on the following:

- RBS's surface water withdrawal rate of 23.0 MGD (35.6 cfs) conservatively using the lowest anticipated flow rate (100,000 cfs) represents only approximately 0.04 percent of the flow in the Mississippi River.
- Water lost to the atmosphere from cooling tower drift and evaporation (28.0 cfs), conservatively using the lowest anticipated flow of 100,000 cfs, would represent only approximately 0.03 percent of the Mississippi River flow at the RBS intake structure.
- Because the plant's water withdrawals and consumptive water use during the license renewal term will not increase beyond current rates, continued operation of the plant would cause no increased effects on Mississippi River flow during the license renewal term.

#### 4.5.2.3 Groundwater Quality Degradation (Plants with Cooling Ponds at Inland Sites)

##### 4.5.2.3.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL, MODERATE, or LARGE. Inland sites with closed-cycle cooling ponds could degrade groundwater quality. The significance of the impact would depend on cooling pond water quality, site hydrogeologic conditions (including the interaction of surface water and groundwater), and the location, depth, and pump rate of water wells.

##### 4.5.2.3.2 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.

##### 4.5.2.3.3 Analysis

As discussed in Section 2.2.2 of this ER, RBS utilizes a closed-cycle cooling heat dissipation system equipped with mechanical draft cooling towers and does not utilize cooling ponds. Therefore, this issue is not applicable, and further analysis is not required.

### 4.5.2.4 Radionuclides Released to Groundwater

#### 4.5.2.4.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL or MODERATE. Leaks of radioactive liquids from plant components and pipes have occurred at numerous plants. Groundwater protection programs have been established at all operating nuclear power plants to minimize the potential impact from any inadvertent releases. The magnitude of impacts would depend on site-specific characteristics.

#### 4.5.2.4.2 Requirement [10 CFR 51.53(c)(3)(ii)(P)]

An applicant shall assess the impact of any documented inadvertent releases of radionuclides into groundwater. The applicant shall include in its assessment a description of any groundwater protection program used for the surveillance of piping and components containing radioactive liquids for which a pathway to groundwater may exist. The assessment must also include a description of any past inadvertent releases and the projected impact to the environment (e.g., aquifers, rivers, lakes, ponds, ocean) during the license renewal term.

#### 4.5.2.4.3 Analysis

A description of the RBS groundwater protection program established in accordance with NEI 07-07 is discussed in Section 3.5.2.4. The hydrogeological characteristics of the groundwater resources on and near the RBS site are described in Sections 3.4 and 3.5. Table 3.5-5 presents well construction details for the RBS groundwater monitoring wells, while Figure 3.5-6 shows the location of the wells. Table 3.5-8 presents information on registered water wells within a 2-mile band around RBS, while Figure 3.5-8 shows the location of these registered wells.

Historic radionuclide releases are discussed in Section 3.5.4.2.1. The only historic release where tritium is being detected in groundwater is associated with the December 2011 event involving the detection of tritium (48,245 pCi/l) in the PZ-01 groundwater monitoring well near the field administration building. The source affecting groundwater is currently believed to be from water containing tritium seeping through degraded turbine building and heater bay floor joints, which were re-sealed in 2016. Ongoing groundwater monitoring efforts associated with this release are also discussed in Section 3.5.4.2.1. Based on monitoring results, the extent of impact to groundwater resources is well delineated laterally and vertically.

<u>Onsite Groundwater Flow</u>

As discussed in Section 3.5.2.3 and shown in Figures 3.5-4 and 3.5-5, shallow groundwater in the UTA in the vicinity of RBS flows in a southwesterly direction towards the Mississippi River. Due to the localized extent of tritium-affected groundwater and the hydraulic gradient, no impact to groundwater wells that are screened in the UTA off site to the east, north, or southeast would be expected. Further, because the Mississippi River provides a hydraulic boundary to groundwater transport, no impact to groundwater wells on the west side of the river is expected.

Groundwater sampling results from monitoring wells downgradient of the release indicate the MRAA within the floodplain along the Mississippi River has not been affected. Therefore, impacts to water resources or ecological resources within the floodplain are not expected.

The UTA is hydraulically separated from the tertiary aquifers of the Southern Hills Aquifer by several hundred feet of clay of the Pascagoula Formation (Figure 3.4-4). Therefore, it is expected that the clays of the Pascagoula Formation would prevent the downward vertical migration of tritium-affected groundwater into the tertiary aquifers.

<u>Onsite Groundwater Wells</u>

RBS has four groundwater production wells utilized for industrial purposes: the P-1A, P-1B, BP-1, and P-05, designated in the Louisiana well registration records as well numbers 125-257, 125-246, 125-266, and 125-256, respectively (Table 3.5-8). All but one of these wells (P-05/125-256) are screened to withdraw groundwater from the tertiary aquifer 1,200-foot or 2,800-foot sands. Sampling results of the production wells nearest the tritium-affected groundwater (P-1A and P-1B) that are completed in the tertiary aquifer 2,800-foot sand indicate there has been no impact to these wells. The BP-1 production well completed in the tertiary aquifer 1,200-foot sand is located north-northwest, upgradient of the tritium-affected groundwater and, therefore, would not be affected. Most importantly, sampling results indicate that tritium has not affected the RBS production well that provides water from the UTA for the fire protection system (P-05).

Although groundwater in the UTA and tertiary aquifers are considered suitable for potable water purposes, no plant-related tritium or gamma-emitting radionuclides have been detected in the groundwater sampled from the Southern Hills Aquifer (the tertiary aquifer sands), or in RBS' onsite production wells that withdraw groundwater from the tertiary aquifer.

<u>Offsite Groundwater Wells</u>

There are five offsite downgradient wells near the RBS property boundary to the south-southeast along Powell Station Road between 1.10 and 1.35 miles from RBS. These wells are identified in Table 3.5-8 and shown in Figure 3.5-8 as wells 125-5053Z, 125-83, 125-5276Z, 125-88, and 125-5284Z, in order of the distance from RBS. Wells 125-83 (domestic), 125-5276Z (irrigation), and 125-5284Z (domestic) are all identified in Louisiana well records as being completed in the UTA, while wells 125-5053Z (domestic) and 125-88 (livestock) are identified as being completed in the tertiary aquifer 1,200-foot sand. None of these downgradient offsite wells are in the tritium plume path. RBS has installed well MW-18 (UTA) and T-14 (Tertiary Zone 1 Aquifer) near the property boundary; these wells have consistently yielded sample results that are below the lower limit of detection (LLD) for tritium. In addition, RBS REMP downgradient well, identified as well WD in Table 3.5-5, is located approximately 0.3 miles southwest of the plant and has consistently yielded sample results that are below the LLDs for tritium and gamma-emitting isotopes (Entergy 2016d).

Remediation Measures

Tritium has been the only isotope detected in any of the RBS groundwater monitoring wells. There have been no positive results for gamma emitters or hard-to-detect radionuclides. (Entergy 2014c) Table 4.5-1, which is based on data reported in the most recent Annual Radioactive Effluent Release Report, presents results of tritium groundwater monitoring for 2015, while Figure 4.5-1 identifies well locations where positive tritium results were detected during the fourth quarter of 2015. The six monitoring wells installed in 2016 that are discussed in Section 3.5.4.2.1, and presented in Table 3.5-5 and Figure 3.5-6, are not included in Table 4.5-1 or Figure 4.5-1, because tritium groundwater monitoring results for those wells will be reported in the Annual Radioactive Effluent Release Report for 2016. As shown in Figure 4.5-1, the tritium-affected groundwater is confined to the owner-controlled area and localized to the UTA. As discussed in Section 3.5.4.2.1, in addition to monitored natural attenuation, RBS periodically withdraws groundwater from the UTA via well MW-125 as a remedial measure to control the spread of the affected groundwater.

Summary

The tritium-affected groundwater is confined to the owner-controlled area and localized to the UTA near the RBS turbine building. The groundwater flow at the site is in a southwesterly direction toward the Mississippi River, and groundwater sampling results show there have been no impacts to either RBS' production wells or the nearest offsite wells located to the south-southeast. In addition to monitored natural attenuation, RBS is performing remediation to lower tritium levels in the groundwater. Radionuclides are currently confined to the RBS property, and RBS has a groundwater protection sampling program that monitors groundwater and provides for remediation of releases and spills to groundwater or soils. Therefore, it is concluded that radiological impacts to groundwater during the RBS license renewal term would be SMALL.

**Table 4.5-1**
**RBS Groundwater Monitoring Results, 2015**

| Well Identification | Sample Date | Tritium Activity (pCi/l) |
|---|---|---|
| MW-01 | 11-19-2015 | < 631 |
| MW-02 | 11-18-2015 | < 467 |
| MW-03 | 12-03-2015 | < 562 |
| MW-04 | 02-03-2015 | < 563 |
| MW-04 | 05-06-2015 | < 675 |
| MW-04 | 08-19-2015 | < 717 |
| MW-04 | 11-18-2015 | < 468 |
| MW-05 | 12-02-2015 | < 562 |
| MW-06 | 02-03-2015 | < 562 |
| MW-06 | 05-06-2015 | < 669 |
| MW-06 | 08-19-2015 | < 729 |
| MW-06 | 11-18-2015 | < 470 |
| MW-07 | 11-19-2015 | < 617 |
| MW-07[a] | 11-19-2015 | < 630 |
| MW-08 | 05-06-2015 | < 665 |
| MW-08 | 12-03-2015 | < 562 |
| MW-09 | 11-19-2015 | < 473 |
| MW-10 | 11-19-2015 | < 472 |
| MW-11 | 11-19-2015 | < 470 |
| MW-12 | 11-19-2015 | < 607 |
| MW-13 | 12-03-2015 | < 562 |
| MW-14 | 12-02-2015 | < 562 |
| MW-15 | 11-18-2015 | < 470 |
| MW-16 | 12-03-2015 | < 562 |
| MW-17 | 11-19-2015 | < 469 |
| MW-18 | 11-19-2015 | < 618 |
| MW-19 | 11-19-2015 | < 472 |
| MW-20 | 12-02-2015 | < 562 |
| MW-21 | 12-03-2015 | < 562 |
| MW-100 | 02-04-2015 | < 560 |
| MW-100 | 05-06-2015 | < 676 |
| MW-100[a] | 05-06-2015 | < 669 |
| MW-100 | 08-20-2015 | < 728 |

**Table 4.5-1 (Continued)
RBS Groundwater Monitoring Results, 2015**

| Well Identification | Sample Date | Tritium Activity (pCi/l) |
|---|---|---|
| MW-100 | 11-18-2015 | < 478 |
| MW-100[(a)] | 11-18-2015 | < 478 |
| MW-102 | 11-19-2015 | < 622 |
| MW-103 | 02-02-2015 | < 567 |
| MW-103 | 05-05-2015 | < 657 |
| MW-103[(a)] | 05-05-2015 | < 658 |
| MW-103 | 08-18-2015 | < 696 |
| MW-103[(a)] | 08-18-2015 | < 690 |
| MW-103 | 11-17-2015 | < 711 |
| MW-103[(a)] | 11-17-2015 | < 707 |
| MW-104 | 02-03-2015 | < 568 |
| MW-104 | 05-06-2015 | < 669 |
| MW-104 | 08-19-2015 | < 726 |
| MW-104 | 11-18-2015 | < 469 |
| MW-104[(a)] | 11-18-2015 | < 480 |
| MW-106 | 02-03-2015 | < 545 |
| MW-106 | 05-06-2015 | < 674 |
| MW-106 | 08-19-2015 | < 714 |
| MW-106 | 11-18-2015 | < 477 |
| MW-107 | 02-03-2015 | < 566 |
| MW-107 | 05-06-2015 | < 666 |
| MW-107 | 08-19-2015 | < 719 |
| MW-107[(a)] | 08-19-2015 | < 701 |
| MW-107 | 11-18-2015 | < 479 |
| MW-108 | 11-18-2015 | < 473 |
| MW-110 | 02-02-2015 | 73,100 |
| MW-110 | 05-05-2015 | 24,800 |
| MW-110 | 08-18-2015 | 34,600 |
| MW-110 | 11-17-2015 | 38,700 |
| MW-111 | 02-03-2015 | < 570 |
| MW-111 | 05-06-2015 | < 661 |
| MW-111 | 08-19-2015 | < 720 |
| MW-111 | 11-18-2015 | < 479 |

**Table 4.5-1 (Continued)**
**RBS Groundwater Monitoring Results, 2015**

| Well Identification | Sample Date | Tritium Activity (pCi/l) |
|---|---|---|
| MW-112 | 02-02-2015 | 10,900 |
| MW-112 | 05-05-2015 | 8,820 |
| MW-112 | 08-18-2015 | 8,830 |
| MW-112 | 11-17-2015 | 11,000 |
| MW-112[(a)] | 11-17-2015 | 10,700 |
| MW-114 | 02-02-2015 | 2,290 |
| MW-114[(a)] | 02-02-2015 | 2,420 |
| MW-114 | 05-05-2015 | 2,640 |
| MW-114 | 08-18-2015 | 1,670 |
| MW-114 | 11-17-2015 | 2,360 |
| MW-116 | 02-02-2015 | 3,700 |
| MW-116[(a)] | 02-02-2015 | 3,620 |
| MW-116 | 05-05-2015 | 4,300 |
| MW-116 | 08-18-2015 | 1,110 |
| MW-116 | 11-17-2015 | 6,410 |
| MW-118 | 02-02-2015 | 4,590 |
| MW-118 | 05-05-2015 | 3,490 |
| MW-118 | 08-18-2015 | 4,050 |
| MW-118 | 11-17-2015 | 4,910 |
| MW-120 | 02-03-2015 | < 570 |
| MW-120 | 05-06-2015 | < 656 |
| MW-120 | 08-18-2015 | < 720 |
| MW-120 | 11-18-2015 | < 475 |
| MW-122R | 02-03-2015 | < 570 |
| MW-122R | 05-06-2015 | < 670 |
| MW-122R | 08-19-2015 | < 726 |
| MW-122R | 11-18-2015 | < 473 |
| MW-124 | 02-03-2015 | 1,010 |
| MW-124 | 05-05-2015 | 2,740 |
| MW-124 | 08-19-2015 | 4,860 |
| MW-124 | 11-18-2015 | 4,710 |
| MW-125 | 02-03-2015 | 201,000 |

**Table 4.5-1 (Continued)**
**RBS Groundwater Monitoring Results, 2015**

| Well Identification | Sample Date | Tritium Activity (pCi/l) |
|---|---|---|
| MW-126 | 02-02-2015 | < 565 |
| MW-126 | 05-06-2015 | < 669 |
| MW-126 | 08-19-2015 | < 701 |
| MW-126 | 11-17-2015 | < 697 |
| MW-128 | 02-03-2015 | < 573 |
| MW-128 | 05-06-2015 | < 675 |
| MW-128 | 08-20-2015 | < 598 |
| MW-128 | 11-18-2015 | < 476 |
| MW-130 | 02-03-2015 | < 569 |
| MW-130[a] | 02-03-2015 | < 556 |
| MW-130 | 05-06-2015 | < 660 |
| MW-130 | 08-20-2015 | < 604 |
| MW-130 | 11-19-2015 | < 615 |
| MW-131 | 02-03-2015 | < 554 |
| MW-131 | 05-06-2015 | < 664 |
| MW-131 | 08-20-2015 | < 603 |
| MW-131 | 11-19-2015 | < 609 |
| MW-132 | 02-03-2015 | < 575 |
| MW-132 | 05-06-2015 | < 658 |
| MW-132 | 08-20-2015 | < 597 |
| MW-132 | 11-18-2015 | < 471 |
| MW-134 | 02-03-2015 | < 571 |
| MW-134 | 05-06-2015 | < 668 |
| MW-134 | 08-20-2015 | < 715 |
| MW-134[a] | 08-20-2015 | < 713 |
| MW-134 | 11-18-2015 | < 475 |
| MW-137 | 02-02-2015 | 28,200 |
| MW-137 | 05-05-2015 | 20,900 |
| MW-137 | 08-18-2015 | 26,600 |
| MW-137[a] | 08-18-2015 | 26,900 |
| MW-137 | 11-17-2015 | 32,400 |
| MW-139 | 02-02-2015 | 1,550 |
| MW-139 | 05-05-2015 | 1,130 |

**Table 4.5-1 (Continued)**
**RBS Groundwater Monitoring Results, 2015**

| Well Identification | Sample Date | Tritium Activity (pCi/l) |
|---|---|---|
| MW-139 | 08-18-2015 | 1,310 |
| MW-139 | 11-17-2015 | 2,070 |
| MW-141 | 02-02-2015 | 920 |
| MW-141 | 05-05-2015 | < 661 |
| MW-141 | 08-18-2015 | < 713 |
| MW-141 | 11-18-2015 | 1,550 |
| MW-141[(a)] | 11-18-2015 | 1,600 |
| MW-142 | 02-03-2015 | < 572 |
| MW-142 | 05-06-2015 | < 660 |
| MW-142 | 08-19-2015 | < 729 |
| MW-142 | 12-02-2015 | < 562 |
| MW-144 | 02-03-2015 | < 565 |
| MW-144 | 05-06-2015 | < 666 |
| MW-144 | 08-19-2015 | < 644 |
| MW-144 | 12-02-2015 | < 504 |
| MW-144[(a)] | 12-02-2015 | < 512 |
| MW-146 | 02-03-2015 | 139,000 |
| MW-146 | 05-06-2015 | 59,200 |
| MW-146 | 08-19-2015 | 91,900 |
| MW-146 | 12-01-2015 | 149,000 |
| MW-147 | 02-03-2015 | 82,200 |
| MW-147 | 05-06-2015 | 87,600 |
| MW-147 | 08-19-2015 | 49,600 |
| MW-147 | 12-01-2015 | 91,800 |
| MW-148 | 02-03-2015 | < 556 |
| MW-148 | 05-06-2015 | < 670 |
| MW-148 | 08-19-2015 | < 724 |
| MW-148 | 12-01-2015 | < 522 |
| MW-151 | 02-02-2015 | < 587 |
| MW-151 | 05-05-2015 | < 661 |
| MW-151 | 08-18-2015 | < 685 |
| MW-151 | 11-17-2015 | < 706 |

## Table 4.5-1 (Continued)
## RBS Groundwater Monitoring Results, 2015

| Well Identification | Sample Date | Tritium Activity (pCi/l) |
|---|---|---|
| MW-153 | 02-03-2015 | < 618 |
| MW-153 | 05-06-2015 | < 665 |
| MW-153 | 08-19-2015 | < 719 |
| MW-153 | 11-18-2015 | < 470 |
| MW-155 | 02-02-2015 | < 573 |
| MW-155 | 05-05-2015 | 17,000 |
| MW-155 | 08-19-2015 | < 688 |
| MW-155 | 11-17-2015 | 6,560 |
| MW-156 | 02-03-2015 | 857 |
| MW-156 | 05-05-2015 | 1,800 |
| MW-156 | 08-19-2015 | 1,950 |
| MW-156 | 11-17-2015 | 2,010 |
| MW-157 | 02-03-2015 | 260,000 |
| MW-157 | 05-05-2015 | 171,000 |
| MW-157 | 08-19-2015 | 105,000 |
| MW-157 | 11-17-2015 | 129,000 |
| MW-158[b] | 02-03-2015 | 575,000 |
| MW-158 | 05-06-2015 | 630,000 |
| MW-158 | 08-19-2015 | 510,000 |
| MW-158 | 12-01-2015 | 519,000 |
| MW-159 | 02-03-2015 | 3,800 |
| MW-159 | 05-06-2015 | 11,200 |
| MW-159[a] | 05-06-2015 | 11,800 |
| MW-159 | 08-19-2015 | 1,860 |
| MW-159[a] | 08-19-2015 | 2,080 |
| MW-159 | 12-01-2015 | 12,900 |
| MW-161 | 02-03-2015 | < 569 |
| MW-161[a] | 02-03-2015 | < 565 |
| MW-161 | 05-06-2015 | < 665 |
| MW-161[a] | 05-06-2015 | < 660 |
| MW-161 | 08-19-2015 | < 728 |
| MW-161 | 11-18-2015 | < 674 |

**Table 4.5-1 (Continued)
RBS Groundwater Monitoring Results, 2015**

| Well Identification | Sample Date | Tritium Activity (pCi/l) |
|---|---|---|
| MW-162 | 02-03-2015 | < 518 |
| MW-162[(a)] | 02-03-2015 | < 576 |
| MW-162 | 05-06-2015 | < 665 |
| MW-162 | 08-19-2015 | < 678 |
| MW-162 | 12-01-2015 | < 508 |
| MW-167 | 11-17-2015 | < 644 |
| MW-167[(a)] | 11-17-2015 | < 641 |
| MW-169 | 11-17-2015 | < 643 |
| MW-170 | 11-18-2015 | < 473 |
| MW-172 | 11-18-2015 | < 478 |
| MW-174 | 11-18-2015 | < 473 |
| MW-180 | 11-18-2015 | < 473 |
| MW-182 | 11-19-2015 | < 631 |
| MW-182[(a)] | 11-19-2015 | < 618 |
| MW-185 | 11-17-2015 | < 709 |
| MW-188 | 11-18-2015 | < 470 |
| PZ-01 | 02-02-2015 | 20,200 |
| PZ-01 | 05-05-2015 | 18,800 |
| PZ-01 | 08-18-2015 | 18,200 |
| PZ-01 | 11-17-2015 | 12,600 |
| PZ-02 | 05-05-2015 | < 670 |
| PZ-02 | 11-18-2015 | < 615 |
| PZ-03 | 02-03-2015 | < 570 |
| PZ-03 | 05-06-2015 | < 668 |
| PZ-03 | 08-19-2015 | < 596 |
| PZ-03 | 11-18-2015 | < 477 |
| SW-101 | 05-07-2015 | < 660 |
| SW-101 | 08-19-2015 | < 719 |
| SW-101 | 12-03-2015 | < 562 |
| SW-102 | 05-07-2015 | < 667 |
| SW-102 | 08-19-2015 | < 635 |
| SW-102 | 11-19-2015 | < 612 |

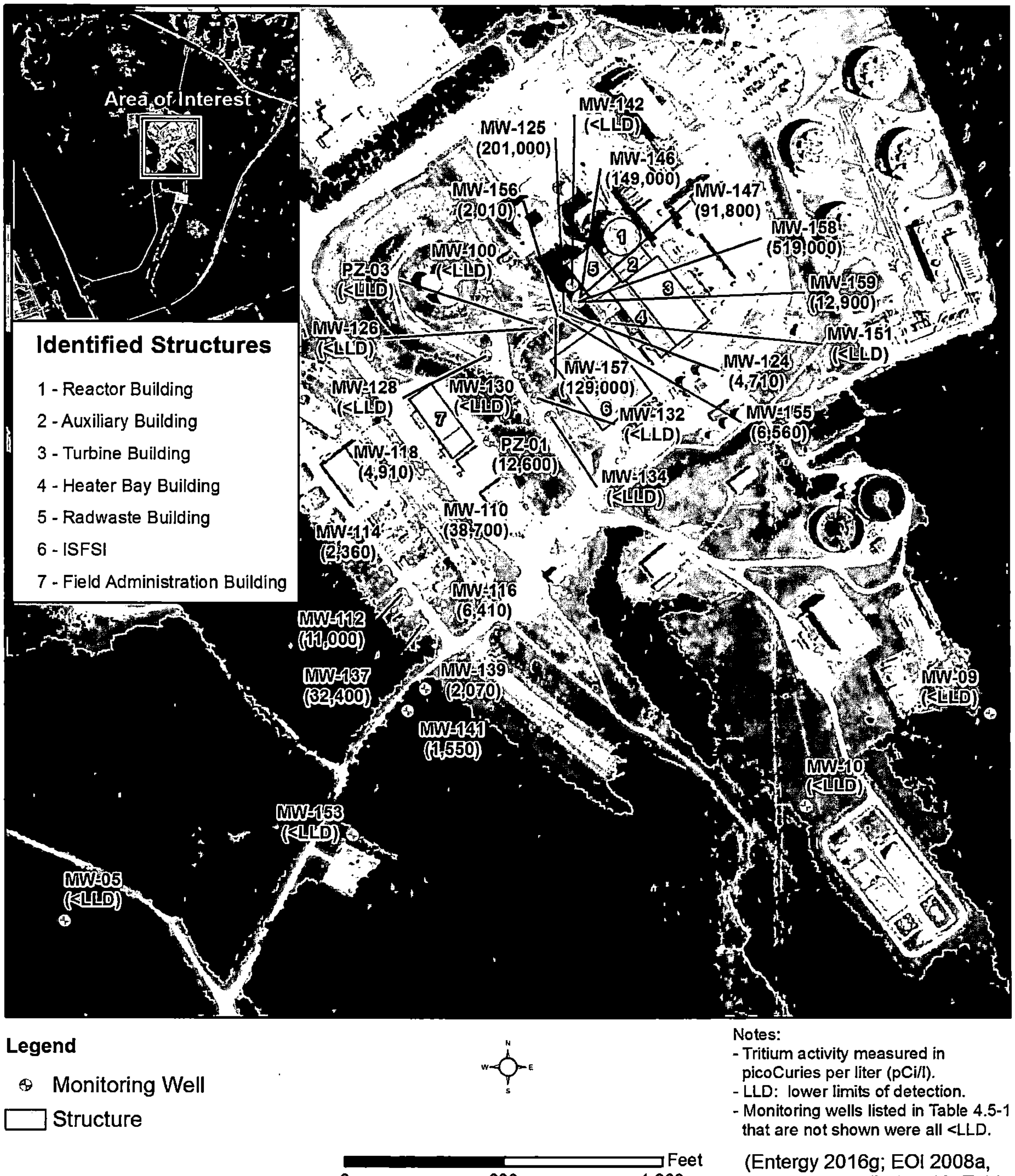
**Table 4.5-1 (Continued)**
**RBS Groundwater Monitoring Results, 2015**

| Well Identification | Sample Date | Tritium Activity (pCi/l) |
|---|---|---|
| SW-103 | 02-04-2015 | < 579 |
| SW-103 | 05-07-2015 | < 667 |
| SW-103 | 08-19-2015 | < 732 |
| SW-103 | 11-19-2015 | < 629 |
| SW-104 | 05-07-2015 | < 670 |
| SW-104 | 08-19-2015 | < 733 |
| SW-104 | 11-19-2015 | < 470 |
| T-14 | 11-19-2015 | < 622 |

(Entergy 2016g, Table 7)

a. Duplicate sample.

b. No hard-to-detect radionuclides detected.




Notes:
- Tritium activity measured in picoCuries per liter (pCi/l).
- LLD: lower limits of detection.
- Monitoring wells listed in Table 4.5-1 that are not shown were all <LLD.

(Entergy 2016g; EOI 2008a, Figure 2.1-3; FTN 2012, Table 2.1; FTN 2014a, Table 2; FTN 2014c, Table 1; USDA 2015a)

**Figure 4.5-1**
**RBS Groundwater Tritium Results, 4th Quarter 2015**

# 4.6 Ecological Resources

## 4.6.1 Aquatic Resources

### 4.6.1.1 Impingement and Entrainment of Aquatic Organisms (Plants with Once-Through Cooling Systems or Cooling Ponds)

#### 4.6.1.1.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL, MODERATE, or LARGE. The impacts of impingement and 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, depending on cooling system withdrawal rates and volumes and the aquatic resources at the site.

#### 4.6.1.1.2 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 and entrainment.

#### 4.6.1.1.3 Analysis

As discussed in Section 2.2.2 of this ER, RBS utilizes a closed-cycle cooling heat dissipation system equipped with mechanical draft cooling towers for condenser cooling purposes. Therefore, this issue is not applicable, and further analysis is not required.

### 4.6.1.2 Thermal Impacts on Aquatic Organisms (Plants with Once-Through Cooling Systems or Cooling Ponds)

#### 4.6.1.2.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL, MODERATE, or LARGE. Most of the effects associated with thermal discharges are localized and are not expected to affect overall stability of populations or resources. The magnitude of impacts, however, would depend on site-specific thermal plume characteristics and the nature of aquatic resources in the area.

#### 4.6.1.2.2 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 . . . a 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 thermal changes . . . .

4.6.1.2.3 Analysis

As discussed in Section 2.2.2 of this ER, RBS utilizes a closed-cycle cooling heat dissipation system equipped with mechanical draft cooling towers for condenser cooling purposes. Therefore, this issue is not applicable, and further analysis is not required.

4.6.1.3 Water Use Conflicts with Aquatic Resources (Plants with Cooling Ponds or Cooling Towers Using Makeup Water from a River)

4.6.1.3.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL or MODERATE. Impacts on aquatic resources in stream communities affected by water use conflicts could be of moderate significance in some situations.

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

If the applicant's plant utilizes cooling towers or cooling ponds and withdraws makeup water from a river, an assessment of the impact of the proposed action on water availability and competing water demands, the flow of the river, and related impacts on stream (aquatic) . . . ecological communities must be provided.

4.6.1.3.3 Analysis

As discussed in Section 4.5.1.1.3, with an average discharge of 593,000 cfs, the Mississippi River is the largest river in the United States. As discussed in Section 3.5.1, during the period 1965–2015, the minimum and maximum flows recorded near the RBS site were 111,000 cfs (May 2011) and 1,619,000 cfs (July 1988), respectively. The mean flow rate during this same period was 514,080 cfs. The probable minimum flow rate of the Mississippi River at RBS during the operating life of the station is not anticipated to be less than 100,000 cfs.

As discussed in Section 3.5.3.1, RBS withdraws cooling water from the Mississippi River through two intake screens at a design flow rate of 23.0 MGD (35.6 cfs), which represents approximately 0.04 percent of the flow in the Mississippi River at its lowest anticipated flow rate of 100,000 cfs. As discussed in Section 4.5.1.1.3, the drift/evaporation rate from the CWS and SWCS cooling towers is 17.7 MGD (27.4 cfs) and 0.38 MGD (0.6 cfs), respectively, based on design maximum. Therefore, of the volume of water withdrawn, 4.9 MGD (7.6 cfs) would be returned to the Mississippi River, and 18.1 MGD (28.0 cfs) would be lost to the atmosphere from drift and evaporation. Conservatively using the lowest anticipated flow of 100,000 cfs during the operating life of the station, the 28.0 cfs would represent only approximately 0.03 percent of the Mississippi River flow at the RBS intake structure.

Based on 2013 surface water withdrawals from the Mississippi River for parishes within a 6-mile radius of RBS that withdraw from the river (East Baton Rouge, Pointe Coupee, and West Feliciana), approximately 374.6 MGD (579.5 cfs) of surface water was withdrawn as shown in Table 3.5-6. Based on the lowest anticipated flow rate (100,000 cfs), this volume would represent only approximately 0.6 percent of the Mississippi River flow. As discussed in Section 3.5.3.1, the state of Louisiana does not currently restrict the quantity of water that can be withdrawn from the Mississippi River.

During the license renewal term, RBS is expected to consume water from the Mississippi River at current rates; therefore, there would be no increase in consumptive water use. As discussed above, the amount of water withdrawn by RBS and lost through cooling tower drift and evaporation when conservatively using the lowest anticipated flow rate (100,000 cfs) would be a very small fraction of the Mississippi River flow at the RBS intake structure. Therefore, Entergy concludes that the impacts on aquatic resources during the license renewal term would be SMALL and do not warrant additional mitigation measures.

### 4.6.2 Terrestrial Resources

#### 4.6.2.1 Effects on Terrestrial Resources (Non-Cooling System Impacts)

##### 4.6.2.1.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL, MODERATE, or LARGE. Impacts resulting from continued operations and refurbishment associated with license renewal may affect terrestrial communities. Application of best management practices would reduce the potential for impacts. The magnitude of impacts would depend on the nature of the activity, the status of the resources that could be affected, and the effectiveness of mitigation.

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

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

##### 4.6.2.1.3 Analysis

###### 4.6.2.1.3.1 Refurbishment Activities

As discussed in Section 2.3, no license-renewal-related refurbishment activities have been identified. Therefore, there would be no license-renewal-related refurbishment impacts to important plant and animal habitats, and no further analysis is required.

###### 4.6.2.1.3.2 Operational Activities

Terrestrial resources are described in Section 3.6.7. No license-renewal-related construction activities or changes in operational practices have been identified that would involve disturbing habitats. Entergy would continue to conduct ongoing plant operational and maintenance activities during the license renewal period. However, these activities are expected to have minimal impacts on terrestrial resources because activities would not occur within previously undisturbed habitats.

Operational and maintenance activities that Entergy might undertake during the renewal term, such as maintenance and repair of plant infrastructure (e.g., roadways, piping installations, fencing, and other security infrastructure), would likely be confined to previously disturbed areas of the site. Furthermore, as discussed in Section 9.6, Entergy has administrative controls in place at the RBS site to ensure that operational changes or construction activities are reviewed and the impacts minimized through implementation of BMPs, permit modifications, or acquisition of new permits as needed. In addition, regulatory programs that the site is currently subject to such as stormwater management, spill prevention, dredging, and herbicide usage further serve to minimize impacts to terrestrial resources.

In summary, adequate management programs and regulatory controls are in place to ensure that important plant and animal habitats are protected during the RBS license renewal period. Therefore, Entergy concludes the impacts to the terrestrial ecosystems from license renewal are SMALL, and no additional mitigation measures beyond current management programs and existing regulatory controls are required.

#### 4.6.2.2 Water Use Conflicts with Terrestrial Resources (Plants with Cooling Ponds or Cooling Towers Using Makeup Water from a River)

##### 4.6.2.2.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL or MODERATE. Impacts on terrestrial resources in riparian communities affected by water use conflicts could be of moderate significance.

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

If the applicant's plant utilizes cooling towers or cooling ponds and withdraws makeup water from a river, an assessment of the impact of the proposed action on water availability and competing water demands, the flow of the river, and related impacts on . . . riparian (terrestrial) ecological communities must be provided.

##### 4.6.2.2.3 Analysis

As discussed in Section 4.5.1.1.3, with an average discharge of 593,000 cfs, the Mississippi River is the largest river in the United States. As discussed in Section 3.5.1, during the period 1965–2015, the minimum and maximum flows recorded near the RBS site were 111,000 cfs (May 2011) and 1,619,000 cfs (July 1988), respectively. The mean flow rate during this same period was 514,080 cfs. The probable minimum flow rate of the Mississippi River at RBS during the operating life of the station is not anticipated to be less than 100,000 cfs.

As discussed in Section 3.5.3.1, RBS withdraws cooling water from the Mississippi River through two intake screens at a design flow rate of 23.0 MGD (35.6 cfs), which represents approximately 0.04 percent of the flow in the Mississippi River at its lowest anticipated flow rate of 100,000 cfs. As discussed in Section 4.5.1.1.3, the drift/evaporation rate from the CWS and SWCS cooling towers is 17.7 MGD (27.4 cfs) and 0.38 MGD (0.6 cfs), respectively, based on design maximum.

Therefore, of the volume of water withdrawn, 4.9 MGD (7.6 cfs) would be returned to the Mississippi River, and 18.1 MGD (28.0 cfs) would be lost to the atmosphere from drift and evaporation. Conservatively using the lowest anticipated flow of 100,000 cfs during the operating life of the station, the 28.0 cfs would represent only approximately 0.03 percent of the Mississippi River flow at the RBS intake structure.

Based on 2013 surface water withdrawals from the Mississippi River for parishes within a 6-mile radius of RBS that withdraw from the river (East Baton Rouge, Pointe Coupee, and West Feliciana), approximately 374.6 MGD (579.5 cfs) of surface water was withdrawn as shown in Table 3.5-6. Based on the lowest anticipated flow rate (100,000 cfs), this volume would represent only approximately 0.6 percent of the Mississippi River flow. As discussed in Section 3.5.3.1, the state of Louisiana does not currently restrict the quantity of water that can be withdrawn from the Mississippi River.

During the license renewal term, RBS is expected to consume water from the Mississippi River at current rates; therefore, there would be no increase in consumptive water use. As discussed above, the amount of water withdrawn by RBS and lost through cooling tower drift and evaporation when conservatively using the lowest anticipated flow rate (100,000 cfs) would be a very small fraction of the Mississippi River flow at the RBS intake structure. Therefore, Entergy concludes that the impacts on riparian resources during the license renewal term would be SMALL and do not warrant additional mitigation measures.

### 4.6.3 Special Status Species and Habitats

#### 4.6.3.1 Threatened, Endangered, and Protected Species, and Essential Fish Habitat

##### 4.6.3.1.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

The magnitude of impacts on threatened, endangered, and protected species, critical habitat, and EFH would depend on the occurrence of listed species and habitats and the effects of power plant systems on them. Consultation with appropriate agencies would be needed to determine whether special status species or habitats are present and whether they would be adversely affected by continued operations and refurbishment associated with license renewal.

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

All license renewal applicants shall assess the impact of refurbishment, continued operations, 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 Federal laws protecting wildlife, including but not limited to, the Endangered Species Act, and EFH in accordance with the Magnuson-Stevens Fishery Conservation and Management Act.

#### 4.6.3.1.3 Analysis

##### 4.6.3.1.3.1 Refurbishment Activities

As discussed in Section 2.3, no license-renewal-related refurbishment activities have been identified. Therefore, there would be no license-renewal-related refurbishment impacts to threatened, endangered, and protected species, and no further analysis is required.

##### 4.6.3.1.3.2 Operational Activities

Section 3.6.11.1 of this ER describes the special status species and habitats that have the potential to be affected by the proposed action. As discussed in Section 3.6.11.1, there are four federally listed species which are either threatened or endangered within East Baton Rouge, East Feliciana, Pointe Coupee, and West Feliciana parishes. Three of these species (Alabama heelsplitter, Atlantic sturgeon, and West Indian manatee) are not anticipated to be present in the "action area" because there are no documented known/possible occurrences in West Feliciana Parish, and the Mississippi River at RBS would not provide suitable habitat for these species. Although the remaining species (pallid sturgeon) could transit the "action area," the pallid sturgeon is a deepwater, channel-dwelling species and would be unaffected by water withdrawals and discharges.

As discussed in Section 3.6.11.3, no species or habitats under the NMFS's jurisdiction occur within the action area because RBS is located beyond tidal influence. Therefore, the proposed action would have no effect on EFH under the NMFS's jurisdiction.

Entergy is not aware of any adverse impacts regarding threatened, endangered, and protected species attributable to the site. Maintenance activities necessary to support license renewal likely would be limited to previously disturbed areas on site, and no additional land disturbance has been identified for the purpose of license renewal. In addition, there are no plans to alter plant operations during the license renewal term that would affect threatened, endangered, and protected species.

As discussed in Section 9.6, Entergy has administrative controls in place at RBS to ensure that operational changes or construction activities are reviewed, and the impacts minimized through implementation of BMPs. In addition, regulatory programs, such as those discussed in Chapter 9 that the site is subject to, further serve to minimize impacts to any threatened, endangered, and protected species.

In an effort to obtain an independent review, the USFWS and LDWF were also consulted. Neither agency evidenced any concerns as it related to the renewal of the RBS OL. Copies of the consultation letters to the USFWS and LDWF and their responses are included in Attachment B.

In summary, no license-renewal-related refurbishment activities have been identified. As discussed above, the continued operation of the site would have no adverse effects on any federally listed species. Therefore, Entergy concludes that license renewal would have no effect on threatened, endangered, and protected species, and mitigation measures beyond Entergy's current management programs and existing regulatory controls are not warranted.

## 4.7 Historic and Cultural Resources

### 4.7.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

Continued operations and refurbishment associated with license renewal are expected to have no more than small impacts on historic and cultural resources located onsite and in the transmission line ROW because most impacts could be mitigated by avoiding those resources. The National Historic Preservation Act (NHPA) requires the Federal agency to consult with the State Historic Preservation Officer (SHPO) and appropriate Native American Tribes to determine the potential effects on historic properties and mitigation, if necessary.

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

All applicants shall identify any potentially affected historic or archaeological properties and assess whether any of these properties will be affected by future plant operations and any planned refurbishment activities in accordance with the National Historic Preservation Act.

### 4.7.3 Analysis

#### 4.7.3.1 Refurbishment Activities

As discussed in Section 2.3, no license-renewal-related refurbishment activities have been identified. Therefore, there would be no license-renewal-related refurbishment impacts on historic and cultural resources, and no further analysis is required.

#### 4.7.3.2 Operational Activities

As discussed in Section 3.7.4.1, there have been several previous cultural resource surveys conducted either on the RBS property or within the vicinity. In addition, a Phase 1A sensitivity assessment was conducted in 2015 in support of license renewal (Section 3.7.4.2). As shown in Table 3.7-1, 12 archaeological sites have been identified within the limits of the RBS property. Although none have been identified as being eligible for inclusion on the NRHP, 9 sites require additional investigation to determine their significance in terms of NRHP eligibility (16WF19, 16WF36, 16WF54, 16WF55, 16WF56, 16WF61, 16WF84, 16WF111, and 16WF181). No standing structures have previously been recorded on the RBS property.

As discussed in Section 3.7.5, although no license-renewal-related ground-disturbing activities have been identified, Entergy has administrative controls in place for management of cultural resources ahead of any future ground-disturbing activities at the plant. These controls consist of a fleet cultural resources protection plan to protect those areas on the property determined to be eligible for the NRHP. Therefore, no adverse effects on these sites are anticipated during the RBS license renewal term.

The area within a 6-mile radius of the site, consisting of land primarily within East Baton Rouge, East Feliciana, West Feliciana, and Pointe Coupee parishes, may be archaeologically sensitive (Table 3.7-1). However, adverse impacts would occur to such sites only as a result of soil-intrusive activities. Because Entergy has no plans to conduct such soil-intrusive activities at any location outside of the property boundary under a renewed license, no adverse effects on these archaeological sites would occur.

There are also 14 NRHP-listed aboveground historic properties within a 6-mile radius of the site (Table 3.7-2). Because the aboveground historic properties are located at distances ranging from 1.0 to 5.9 miles away from RBS and the presence of a significant tree buffer around the site and changes in elevations (Section 3.1.3), aesthetic and noise impacts to these resources as a result of the continued operations of RBS are not expected. Therefore, no adverse effects on the physical or historical integrity of these sites are anticipated.

As discussed above, no license-renewal-related refurbishment or construction activities have been identified. No offsite NRHP-listed historic properties will be adversely impacted as a result of continued operations of RBS, and there are no plans to alter operations, expand existing facilities, or disturb additional land for the purpose of license renewal. In addition, administrative procedural controls are in place for management of cultural resources ahead of any future ground-disturbing activities at the plant. Finally, the LDHP concurred that the renewal of the RBS OL will have no effect on historic properties (Attachment C).

Although historic properties are present within the vicinity of RBS, Entergy concludes they would not be adversely affected as a result of continued operation of RBS during the license renewal period, and additional mitigation measures beyond Entergy's existing procedural administrative controls are not warranted.

## 4.8 Socioeconomics

### 4.8.1 Employment and Income, Recreation and Tourism

#### 4.8.1.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. Although most nuclear plants have large numbers of employees with higher than average wages and salaries, employment, income, recreation, and tourism impacts from continued operations and refurbishment associated with license renewal are expected to be small.

#### 4.8.1.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

#### 4.8.1.3 Analysis

Information related to employment and income, and recreation and tourism is presented in Sections 3.8.1 and 3.8.7 of this ER. No license-renewal-related refurbishment activities have been identified as discussed in Section 2.3. In addition, as discussed in Section 2.5, there are no plans to add workers to support plant operations during the license renewal period. As discussed in Section 3.1.3, none of the RBS plant structures are visible from US-61 because of the presence of a significant tree buffer around the site. From the highway entrance, only the RBS training center building is visible, and it has the appearance of an office building. The only visual effect of RBS, which is not anticipated to affect recreation and tourism, would be the plume from the mechanical draft cooling towers. Therefore, no changes in employment and income, and recreation and tourism during the license renewal period are anticipated.

In the GEIS, the NRC determined that employment and income, and recreation and tourism impacts from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.8.1.1). Based on Entergy's review, no new and significant information was identified as it relates to employment and income, and recreation and tourism, and further analysis is not required.

### 4.8.2 Tax Revenues

#### 4.8.2.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. Nuclear plants provide tax revenue to local jurisdictions in the form of property tax payments, payments in lieu of tax (PILOT), or tax payments on energy production. The amount of tax revenue paid during the license renewal term as a result of continued operations and refurbishment associated with license renewal is not expected to change.

#### 4.8.2.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

#### 4.8.2.3 Analysis

Information related to tax revenues is presented in Section 3.8.5 of this ER. No license-renewal-related refurbishment activities have been identified as discussed in Section 2.3. Entergy Louisiana, LLC's annual property taxes are expected to remain relatively constant through the license renewal period.

In the GEIS, the NRC determined that tax revenue impacts from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.8.1.2). Based on Entergy's review, no new and significant information was identified as it relates to tax revenues, and further analysis is not required.

### 4.8.3 Community Services and Education

#### 4.8.3.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. Changes resulting from continued operations and refurbishment associated with license renewal to local community and educational services would be small. With little or no change in employment at the licensee's plant, value of the power plant, payments on energy production, and PILOT payments expected during the license renewal term, community and educational services would not be affected by continued power plant operations.

#### 4.8.3.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

#### 4.8.3.3 Analysis

Information related to community services and education is presented in Section 3.8.4 of this ER. No license-renewal-related refurbishment activities have been identified as discussed in Section 2.3. In addition, as discussed in Section 2.5, there are no plans to add workers to support plant operations during the license renewal period. As discussed in Section 4.8.2.3, Entergy Louisiana, LLC's annual property taxes are expected to remain relatively constant through the license renewal period.

In the GEIS, the NRC determined that community services and education impacts from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.8.1.3). Based on Entergy's review, no new and significant information was identified as it relates to community services and education, and further analysis is not required.

### 4.8.4 Population and Housing

#### 4.8.4.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. Changes resulting from continued operations and refurbishment associated with license renewal to regional population and housing availability and value would be small. With little or no change in employment at the licensee's plant expected during the license renewal term, population and housing availability and values would not be affected by continued power plant operations.

#### 4.8.4.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

#### 4.8.4.3 Analysis

Information related to population and housing is presented in Section 3.8.2 of this ER. No license-renewal-related refurbishment activities have been identified, as discussed in Section 2.3. In addition, as discussed in Section 2.5, there are no plans to add workers to support plant operations during the license renewal period.

In the GEIS, the NRC determined that population and housing impacts from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.8.1.4). Based on Entergy's review, no new and significant information was identified as it relates to population and housing, and further analysis is not required.

### 4.8.5 Transportation

#### 4.8.5.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. Changes resulting from continued operations and refurbishment associated with license renewal to traffic volumes would be small.

#### 4.8.5.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

#### 4.8.5.3 Analysis

Information related to transportation is presented in Section 3.8.6 of this ER. No license-renewal-related refurbishment activities have been identified as discussed in Section 2.3. As discussed in Section 2.5, there are no plans to add workers to support plant operations during the license renewal period. In addition, as discussed in Section 3.8.6, roads in the immediate vicinity of the RBS plant site would operate at acceptable LOSs.

In the GEIS, the NRC determined that transportation impacts from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.8.1.5). Based on Entergy's review, no new and significant information was identified as it relates to transportation, and further analysis is not required.

## 4.9 Human Health

### 4.9.1 Microbiological Hazards to the Public (Plants with Cooling Ponds or Canals, or Cooling Towers that Discharge to a River)

#### 4.9.1.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

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, or that discharge into rivers. Impacts would depend on site-specific characteristics.

#### 4.9.1.2 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, an assessment of the impact of the proposed action on public health from thermophilic organisms in the affected water must be provided.

#### 4.9.1.3 Analysis

As discussed in Section 3.5.1.1.1, RBS is authorized under LPDES Permit No. LA0042731 to discharge cooling tower blowdown water to the Mississippi River. The public could potentially be exposed to *Naegleria* in the Mississippi River, but most likely not as a result of RBS's thermal discharges. As described in Section 3.9.2, the probability of a *Naegleria* infection in the Mississippi River in the vicinity of RBS is low for the following reasons: (1) it was determined that the combined heated effluent from RBS and RBS3 would result in a limited thermal discharge plume into the Mississippi River within a small mixing zone, limiting the area of conditions necessary for optimal growth of these etiological agents; (2) the area of the thermal plume with temperatures elevated above 90°F is only approximately 54 feet by 5 feet; (3) the discharge flow rate would be minor when compared with river flows exhibited by the Mississippi River; (4) point of discharge of heated effluent from the RBS site is not typically utilized for primary contact recreation, because it is limited by strong, swift currents; and (5) the LDHH has stated that from 2004 to 2014, there has not been a reported case of *Naegleria* infection attributable to the Mississippi River.

Therefore, Entergy concludes that the risk to public health from human exposure to thermophilic organisms resulting from the operation of RBS is SMALL and does not warrant additional mitigation.

### 4.9.2 Electric Shock Hazards

#### 4.9.2.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL, MODERATE, or LARGE. Electrical shock potential is of small significance for transmission lines that are operated in adherence with the National Electrical Safety Code (NESC). Without a review of conformance with NESC criteria of each nuclear power plant's in-scope transmission lines, it is not possible to determine the significance of the electrical shock potential.

#### 4.9.2.2 Requirement [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 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.

#### 4.9.2.3 Analysis

Objects located 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 sudden 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 and 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 how 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 induced current due to electrostatic effects to 5 mA if the largest anticipated truck, vehicle, or equipment were short-circuited to ground. By way of comparison, the setting of ground fault circuit interrupters used in residential wiring (special breakers for outside circuits or those with outlets around water pipes) is 4 to 6 mA.

As discussed in Section 2.2.5.4, it was determined that the transmission lines would meet the applicable shock prevention provisions of the NESC. In addition, as discussed in Section 2.2.5.1, all in-scope transmission lines are located completely within the RBS property. Therefore, the public does not have access to this area and, as a result, no induced shock hazards would exist for the public.

OSHA governs the occupational safety and health of plant operations staff. As discussed in Section 2.2.5.4, all electric shock hazards, including those from induced current shock, are managed by Entergy in compliance with OSHA occupational health and safety requirements to protect onsite workers. It was determined in the GEIS that occupational safety and health hazard issues are generic to all types of electricity generating stations, including nuclear power plants, and are of small significance if the workers adhere to safety standards and use protective equipment (NRC 2013b, Section 3.9.5.1).

Therefore, because RBS's existing in-scope transmission lines were constructed to meet the NESC's 5-mA standard, the public does not have access to the area, and occupational safety and health measures are in place to protect plant workers from shock hazards from overhead lines at the site, Entergy concludes that impacts from the electrical shock hazard potential are SMALL.

## 4.10 Environmental Justice

### 4.10.1 Minority and Low-Income Populations

#### 4.10.1.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

Impacts to minority and low-income populations and subsistence consumption resulting from continued operations and refurbishment associated with license renewal will be addressed in plant-specific reviews. See NRC Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions (69 FR 52040; August 24, 2004).

#### 4.10.1.2 Requirement [10 CFR 51.53(c)(3)(ii)(N)]

Applicants shall provide information on the general demographic composition of minority and low-income populations and communities (by race and ethnicity) residing in the immediate vicinity of the plant that could be affected by the renewal of the plant's operating license, including any planned refurbishment activities, and ongoing and future plant operations.

#### 4.10.1.3 Analysis

##### 4.10.1.3.1 Refurbishment Activities

As discussed in Section 2.3, no license-renewal-related refurbishment activities have been identified. Therefore, there would be no license-renewal-related refurbishment impacts to minority and low-income populations, and no further analysis is applicable.

##### 4.10.1.3.2 Operational Activities

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 RBS during the license renewal period would either be SMALL or non-adverse. Therefore, high or adverse impacts to the general human population would not occur.

As described in Section 3.9.1.2, Entergy maintains a REMP. In this program, Entergy monitors important radiological pathways and considers potential radiation exposure to plant and animal life in the environment surrounding RBS. There has been no detectable plant-related activity associated with this monitoring. Therefore, no environmental pathways have been adversely impacted and are not anticipated to be impacted during the RBS license renewal term.

Section 3.10.2.2 identifies the locations of minority and low-income populations as defined by NRR Office Instruction LIC-203 (NRC 2013c). Section 3.10.1.2 describes the search for subsistence-like populations near RBS, of which none were found. The figures accompanying Section 3.10.2 show the locations of minority and low-income populations within a 50-mile radius of RBS. None of those locations, when considered in the context of impact pathways described in Chapter 4 of this ER, is expected to be disproportionately impacted. Each location is sufficiently distant from RBS to not present a focal point of impacts that would be disproportionate compared to other locations.

Therefore, no disproportionately high and adverse impacts or effects on members of the public, including minority and low-income populations, are anticipated as a result of RBS OL renewal.

## 4.11 Waste Management

### 4.11.1 Low-Level Waste Storage and Disposal

#### 4.11.1.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. The comprehensive regulatory controls that are in place and the low public doses being achieved at reactors ensure that the radiological impacts to the environment would remain small during the license renewal term.

#### 4.11.1.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

#### 4.11.1.3 Analysis

As discussed in Section 2.2.3.4, Entergy has developed long-term plans which would ensure that radwaste generated during the license renewal term would be sent directly for disposal, stored on site in existing structures, or shipped to an offsite licensed facility for processing and disposal.

In addition, as discussed in Section 2.2.3.4, the majority of LLRW generated at RBS would be Class A waste and can be shipped to licensed processors, such as the EnergySolutions facilities (Bear Creek and Gallaher) in Oak Ridge, Tennessee, or the Studsvik facility in Erwin, Tennessee, for reduction and repackaging, and then shipped to a Class A disposal facility such as the EnergySolutions facility in Clive, Utah. Classes B and C wastes constitute a low percentage by volume of the total LLRW generated, and they are currently stored in the LLRW storage facility at RBS. As indicated in Section 2.2.3.4, Classes B and C wastes could potentially be shipped to the EnergySolutions facility in Oak Ridge, Tennessee, where they can then be shipped to the Waste Control Specialist facility in Texas, which is licensed for disposal of Classes A, B, and C wastes.

In the GEIS, the NRC determined that low-level waste storage and disposal impacts from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.11.1.1). Based on Entergy's review, no new and significant information was identified as it relates to onsite LLRW storage and disposal, and further analysis is not required.

### 4.11.2 Onsite Storage of Spent Nuclear Fuel

#### 4.11.2.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

During the license renewal term, SMALL. The expected increase in the volume of spent nuclear fuel from an additional 20 years of operation can be safely accommodated onsite during the license renewal term with small environmental impacts through dry or pool storage at all plants.

For the period after the licensed life for reactor operations, the impacts of onsite storage of spent nuclear fuel during the continued storage period are discussed in NUREG-2157 and as stated in § 51.23(b), shall be deemed incorporated into this issue.

#### 4.11.2.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

#### 4.11.2.3 Analysis

Compliance with regulatory requirements for spent fuel storage ensures that environmental impacts are minimized. In the GEIS, the NRC determined that onsite storage of spent nuclear fuel impacts from continued plant operations during the license renewal term would be SMALL, and designated this as a Category 1 issue (NRC 2013b, Section 4.11.1.2). The environmental impact of this issue for the time frame beyond the licensed life for reactor operations is discussed in NUREG-2157, *Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel* (NRC 2014a). Based on Entergy's review, no impacts were identified beyond those discussed in NUREG-1437 and NUREG-2157. Therefore, further analysis is not required.

## 4.11.3 Offsite Radiological Impacts of Spent Nuclear Fuel and High-Level Waste Disposal

### 4.11.3.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

For the high-level waste and spent-fuel disposal component of the fuel cycle, the EPA established a dose limit of 0.15 mSv (15 millirem) per year for the first 10,000 years and 1.0 mSv (100 millirem) per year between 10,000 years and 1 million years for offsite releases of radionuclides at the proposed repository at Yucca Mountain, Nevada.

The Commission concludes that the impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR part 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the impacts of spent fuel and high level waste disposal, this issue is considered Category 1.

### 4.11.3.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

### 4.11.3.3 Analysis

Compliance with regulatory requirements for spent nuclear fuel and high-level waste disposal ensures that offsite radiological impacts are minimized. Offsite radiological impacts of spent nuclear fuel and high-level waste disposal are discussed in the GEIS (NRC 2013b, Section 4.11.1.3). In the final "Continued Storage of Nuclear Spent Fuel" rulemaking, 10 CFR Part 51, Subpart A, Appendix B, Table B-1 was revised to reclassify the impact determination for this issue as a Category 1 issue with no impact level assigned (79 FR 56238). The environmental impacts of away-from-reactor storage and the technical feasibility of disposal in a geologic repository are discussed in NUREG-2157 (NRC 2014a). Based on Entergy's review, no impacts were identified beyond those discussed in NUREG-1437 and NUREG-2157. Therefore, further analysis is not required.

## 4.11.4 Mixed-Waste Storage and Disposal

### 4.11.4.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. The comprehensive regulatory controls and the facilities and procedures that are in place ensure proper handling and storage, as well as negligible doses and exposure to toxic materials for the public and the environment at all plants. License renewal would not increase the small, continuing risk to human health and the environment posed by mixed waste at all plants. The radiological and nonradiological environmental impacts of long-term disposal of mixed waste from any individual plant at licensed sites are small.

#### 4.11.4.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

#### 4.11.4.3 Analysis

As discussed in Section 2.2.3.5 of this ER, the generation of LLMW at RBS occurs on an infrequent basis and in small quantities. When generated, LLMW are managed and transported to an offsite facility licensed to accept and manage the wastes in accordance with appropriate site and company procedures.

In the GEIS, the NRC determined that mixed waste storage and disposal impacts from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.11.1.4). Based on Entergy's review, no new and significant information was identified as it relates to mixed waste storage and disposal, and further analysis is not required.

### 4.11.5 Nonradioactive Waste Storage and Disposal

#### 4.11.5.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. No changes to systems that generate nonradioactive waste are anticipated during the license renewal term. Facilities and procedures are in place to ensure continued proper handling, storage, and disposal, as well as negligible exposure to toxic materials for the public and the environment at all plants.

#### 4.11.5.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

#### 4.11.5.3 Analysis

Section 2.2.4 discusses the type of nonradioactive wastes generated at RBS and typical quantities generated on an annual basis. These nonradioactive wastes are collected in central collection areas and managed in accordance with appropriate regulatory requirements and BMPs that are specified in company waste management procedures. In addition, waste minimization measures such as material control, process control, waste management, recycling, and feedback are considerations that are an integral part of all work planning and implementation at the facility to reduce, to the extent feasible, waste generated, treated, accumulated, or disposed. No changes to systems that generate nonradioactive waste are anticipated during the license renewal term.

In the GEIS, the NRC determined that nonradioactive waste storage and disposal impacts from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.11.1.5). Based on Entergy's review, no new and significant information was identified as it relates to nonradioactive waste storage and disposal, and further analysis is not required.

## 4.12 Cumulative Impacts

### 4.12.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

Cumulative impacts of continued operations and refurbishment associated with license renewal must be considered on a plant-specific basis. Impacts would depend on regional resource characteristics, the resource-specific impacts of license renewal, and the cumulative significance of other factors affecting the resource.

### 4.12.2 Requirement [10 CFR 51.53(c)(3)(ii)(O)]

Applicants shall provide information about other past, present, and reasonably foreseeable future actions occurring in the vicinity of the nuclear plant that may result in a cumulative effect.

### 4.12.3 Analysis

Entergy considered potential cumulative impacts during the license renewal period in its environmental analysis associated with the resources discussed in the following sections. 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 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.

As discussed in Section 3.0.5, to date, no future federal or non-federal projects have been identified as taking place in the vicinity of the RBS property during the license renewal term. Also, no future new business developments or current business expansions have been announced for the RBS vicinity during the license renewal term. Therefore, this discussion focuses on past and present actions.

#### 4.12.3.1 Air Quality and Noise

As described in Sections 4.2 and 4.3, the incremental impacts on air quality and noise levels from the proposed renewal of the RBS OL would be SMALL.

#### 4.12.3.1.1 Air Quality

The geographic area considered in the cumulative air quality analysis is the county of the proposed action, as air quality designations for criteria air pollutants are generally made at the county level. Counties are further grouped together based on a common airshed, known as an AQCR, to provide for the attainment and maintenance of the NAAQS. The RBS site is located in West Feliciana Parish, Louisiana, which along with 34 other parishes in Louisiana and 15 counties in Texas is part of the Southern Louisiana-Southeast Texas Interstate AQCR, as discussed in Section 3.2.4.

Section 3.2.4 presents a summary of the air quality designation status for parishes surrounding RBS. As noted in Section 3.2.4, the EPA regulates six criteria pollutants under the NAAQS: CO, Pb, $NO_2$, particulate matter ($PM_{2.5}$ and $PM_{10}$), ozone, and $SO_2$. West Feliciana Parish is in attainment with respect to all criteria pollutants.

Criteria pollutant air emissions associated with RBS's plant operations are presented in Table 3.2-4. These emissions are from permitted sources such as emergency diesel generators, portable diesel engines, mechanical draft cooling towers, and gasoline/diesel fuel oil storage tanks. As discussed in Section 3.2.5, no increase or decrease of air emissions is expected over the license renewal period. Therefore, cumulative changes to air quality in West Feliciana Parish would be the result of changes to present-day emissions.

Major air emission sources emit, or have the potential to emit, 10 tons per year of any one hazardous air pollutant (HAP), 25 tons per year of any combination of HAPs, or 100 tons per year of any other regulated air contaminant. A minor source has a potential to emit air emissions that are less than the threshold levels for a major source. As discussed in Section 3.2.5, RBS is a synthetic minor source because conditions in the facility's air permit restrict emissions below the threshold levels for a major source. A minor source classification typically indicates that the facility has little to no potential for significantly impacting air quality or interfering with plans to achieve compliance with the NAAQS.

Climate change can affect air quality as a result of changes in meteorological conditions. Air pollutant concentrations are sensitive to wind, temperature, humidity, and precipitation. Ozone levels have been found to be particularly sensitive to climate change influences. Sunshine, high temperatures, and air stagnation are favorable meteorological conditions leading to higher levels of ozone. Although surface temperatures are expected to increase in the southeast, ozone levels will not necessarily increase, because ozone formation is also dependent on the relative amount of precursors available. The combination of higher temperatures, stagnant air masses, sunlight, and emissions of precursors may make it difficult to meet ozone NAAQS. States, however, must continue to comply with the CAA and ensure air quality standards are met. (NRC 2015b, Section 4.16.1.1) Because RBS's fuel source for generating electricity does not produce GHG emissions, RBS would have a beneficial impact on climate change.

Because of the small quantity of emissions from RBS and no expected emissions increase associated with license renewal, RBS's contribution to cumulative effects on air quality during the license renewal term would be SMALL.

##### 4.12.3.1.2 Noise

Section 3.3 presents a summary of noise sources at RBS. The loudest noise generated at the RBS site is from the mechanical draft cooling towers. Periodic use of the gun range is another onsite activity that creates occasional noise. With the exception of emergency sirens, most of the noise sources at nuclear plants are not audible at the site boundary, and are intermittent and considered a minor nuisance (NRC 2015b, Section 4.16.1.2). Therefore, RBS's contribution to cumulative effects on noise during the license renewal term would be SMALL.

#### 4.12.3.2 Geology and Soils

As described in Section 4.4, the incremental impacts on geology and soils from continued operation of RBS during the license renewal term would be SMALL. Ongoing operation and maintenance activities at the RBS site are expected to be confined to previously disturbed areas. Any geologic materials, such as aggregates used to support operation and maintenance activities, would be procured from local and regional sources. These materials are abundant in the region.

Geologic conditions are not expected to change during the license renewal term. Thus, activities associated with continued operations are not expected to affect the geologic environment. Therefore, RBS's contribution to cumulative effects on geology and soils during the license renewal term would be SMALL.

#### 4.12.3.3 Water Resources

##### 4.12.3.3.1 Surface Water

Water Use Considerations

The region of influence for surface water resources is concentrated in the Mississippi River with regard to the potential for consumptive water use to impact users.

As discussed in Section 3.5.3.1, RBS withdraws a maximum of approximately 0.04 percent of the flow in the Mississippi River at its lowest anticipated flow rate. The volume of water lost to the atmosphere from drift and evaporation would represent only approximately 0.03 percent of the Mississippi River flow at the RBS intake structure. During the license renewal term, RBS is expected to consume water from the Mississippi River at current rates.

A summary of surface water use in West Feliciana, East Feliciana, Pointe Coupee, and East Baton Rouge parishes is presented in Table 3.5-6. As shown in Table 3.5-6, approximately 374.6 MGD of surface water was withdrawn from the Mississippi River Basin during 2013. In West

Feliciana Parish, river withdrawals in 2013 were reported as 31.85 MGD. In neighboring Pointe Coupee Parish, which is by far the largest user of the Mississippi River Basin, surface water withdrawals were reported as 322.42 MGD.

As discussed above, RBS withdraws a maximum of approximately 0.04 percent of the flow in the Mississippi River at its lowest anticipated flow rate. The cumulative surface water withdrawals from the Mississippi River, as shown in Table 3.5-6, was 374.6 MGD. Based on the lowest anticipated flow rate (100,000 cfs) as discussed in Section 3.5.3.1, this volume would represent approximately 0.6 percent of the Mississippi River. Therefore, RBS's contribution to cumulative effects on surface water use from the Mississippi River during the license renewal term would be SMALL.

Water Quality Considerations

As discussed in Section 3.5.4.1, segment 070201 of the Mississippi River that stretches from Old River Control Structure to Monte Sano Bayou is classified suitable for primary contact recreation, secondary contact recreation, fish and wildlife propagation, and drinking water supply. In addition, based on LDEQ's *2014 Louisiana Water Quality Inventory: Integrated Report Fulfilling Requirements of the Federal Clean Water Act, Sections 305(b) and 303(d)*, which was finalized in 2015, the Mississippi River segment on which RBS is located is not impaired. Therefore, water quality in this segment of the Mississippi River is considered good.

Point source and stormwater discharges at RBS are monitored and controlled by LPDES Permit No. LA0042731 (Attachment A). The LPDES permit ensures that discharges to the Mississippi River from RBS's operations comply with limitations established in the permit that would be protective of the water quality in the Mississippi River. Therefore, RBS's contribution to cumulative effects on surface water quality during the license renewal term would be SMALL.

Climate Change Considerations

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 could affect the surface water resources. The environmental changes that could affect surface water include floods, prolonged drought, and temperature increases.

In general, climate models predict a gradual increase in the number of high heat days (greater than 90°F) for the southern and central United States (USGCRP 2009, page 34). Potential increases in the Mississippi River water temperature resulting from climate change could increase the amount of cooling water needed for the operation of RBS and other major users. Therefore, the operation of RBS and other thermoelectric plants on the Mississippi River could be altered as a result of climate change. (USGCRP 2009, page 56)

The magnitude of impacts in the Mississippi River associated with climate change remains speculative. Long-term warming could potentially affect navigation, power production, and municipal and industrial users, although the magnitude of the impact is uncertain. However, the Mississippi River is the largest river in the United States and continued regulation of the flow by the USACE is expected to preserve the course and flow of the river. Because RBS's fuel source for generating electricity does not produce GHG emissions, RBS's contribution to global warming effects as it relates to surface water during the license renewal term would be beneficial and SMALL.

4.12.3.3.2 Groundwater

Water Use Considerations

Groundwater use in parishes located within a 6-mile radius of RBS (West Feliciana, East Feliciana, Pointe Coupee, and East Baton Rouge) is presented in Table 3.5-7. Total groundwater withdrawals in 2013 for these parishes were reported as 201.72 MGD. The largest use of groundwater was associated with public water supplies at 81.42 MGD, followed by industrial companies at 80.21 MGD. The largest usage of groundwater occurs in East Baton Rouge Parish at 151.87 MGD. In West Feliciana Parish where RBS is located, groundwater usage was reported as 9.64 MGD.

The parishes listed above withdraw groundwater from the Mississippi River alluvial, Chicot equivalent, Evangeline equivalent (800–1,700-foot sands), Jasper equivalent (2,000–2,800-foot sands), and Catahoula aquifers. The Jasper equivalent and Evangeline equivalent aquifers are by far the most used aquifers within the vicinity of RBS. In 2013, groundwater withdrawals were reported as 84.75 and 69.93 MGD for the Jasper equivalent and Evangeline equivalent aquifers, respectively. Groundwater withdrawals from the Chicot equivalent aquifer, which would include the UTA, were reported as 20.72 MGD in 2013. (USGS 2015j)

As discussed in Section 3.5.3.2, RBS has four water supply wells and one monitoring well that withdraw groundwater. Two of the wells (P-1A and P-1B) are screened within the tertiary Zone 3 aquifer (2,800-foot sand), one well (BP-1) screened in the tertiary Zone 1 aquifer (1,200-foot sand), and two wells (P-05 and MW-125) screened within the UTA. Based on the previous 5 years (2011–2015), annual average water withdrawals from the five wells listed above have ranged from 7 to 42 gpm in the tertiary Zone 3 aquifer (2,800-foot sand), 0.3 to 2.0 gpm in the tertiary Zone 1 aquifer (1,200-foot sand), and 1 to 4 gpm in the UTA, as shown in Table 3.5-9. Therefore, RBS's contribution to cumulative effects on groundwater use during the license renewal term would be SMALL.

Water Quality Considerations

Historical and current releases of liquids containing tritium have not affected groundwater quality beyond the site boundary. As discussed in Section 3.5.2.3, the shallow groundwater flow in the UTA in the vicinity of RBS can be expected to be in a southwesterly direction towards the Mississippi River. As described in Sections 3.5.2.4 and 3.5.4.2.2 of this ER, programs are in place to safeguard groundwater quality. RBS operations have not affected and are not expected to affect the quality of groundwater in any aquifers that are a source of water for offsite users.

Therefore, RBS's contribution to cumulative effects on groundwater quality during the license renewal term would be SMALL.

Climate Change Considerations

Climate change impacts on groundwater availability depend on basin geology, frequency and intensity of high-rainfall periods, recharge, soil moisture, and groundwater-surface water interactions. Precipitation and evapotranspiration are key drivers in aquifer recharge. Although exact responses in groundwater storage and flow to climate change are not well understood, recent studies have started to consider the effects that climate change has on groundwater resources. (NRC 2015c, Section 4.15.3.2) Because RBS's fuel source for generating electricity does not produce GHG emissions, RBS's contribution to climate change as it relates to groundwater resources would be SMALL.

#### 4.12.3.4 Aquatic Resources

The region of influence is concentrated in the Mississippi River, but also extends into the surrounding backwater areas with regard to the potential for consumptive water use to impact aquatic resources. Section 3.6 describes the existing environmental conditions for aquatic and riparian communities.

Many natural and human activities can influence the current and future aquatic life in the area surrounding RBS. Potential biological stressors include continued surface water withdrawals and thermal discharges from RBS operations; modifications to the Mississippi River; runoff from industrial, agricultural, and urban areas; other water users and dischargers; and climate change.

Proposed Action

As discussed in Sections 4.6.1.1 and 4.6.1.2, RBS utilizes a closed-cycle cooling heat dissipation system equipped with mechanical draft cooling towers. Therefore, RBS's contribution to cumulative effects on aquatic resources as it relates to impingement, entrainment, and thermal stress during the license renewal term would be SMALL.

Modifications to the Mississippi River

The relative abundance of hard substrate, deep channel, and river bank habitat has been largely influenced by human activities to decrease flooding events and increase navigability. The USACE and Mississippi River Commission continue to oversee a comprehensive river management program that includes the following (NRC 2014b, Section 4.12.3.1):

- Levees for containing flood flows.
- Floodways for the passage of excess flows past critical reaches of the Mississippi River.

- Channel improvement and stabilization to provide an efficient and reliable navigation channel, increase the flood-carrying capacity of the river, and protect the levee system.
- Tributary basin improvements for major drainage basins to include dams and reservoirs, pumping plants, auxiliary channels, and pumping stations.

Implementing this management program will continue to affect the relative availability of aquatic habitats, resulting in, for example, a decrease in the amount of soft sediment river bank habitat and an increase in the amount of hard substrates (e.g., riprap or other materials used to line the river bank). Consequently, invertebrates that depend on a hard surface for attachment and can colonize manmade materials such as tires, concrete, or riprap used to line river banks, likely will continue to increase in relative abundance as compared to species that require soft sediments along the river bank. (NRC 2014b, Section 4.12.3.1)

The Mississippi River Commission also implements various programs to support the sustainability of aquatic life within the Mississippi River. For example, the Davis Pond and Caernarvon freshwater diversion structures divert more than 18,000 cfs of fresh water to coastal marshlands. The input of fresh water helps to preserve the marsh habitat and reduce coastal land loss. In addition, the Mississippi River Commission conducted research and determined that using grooved articulated concrete mattresses to line river banks can help support benthic invertebrate and fish populations. For example, using grooved articulated concrete mattresses increases larval insect production, which is an important source of prey for many fish. (NRC 2014b, Section 4.12.3.1)

Runoff from Industrial, Agricultural, and Urban Areas

Nearly 40 percent of the land within the contiguous United States drains into the Mississippi River. Land use changes and industrial activities within this area have had a substantial impact on aquatic habitat and water quality within the Mississippi River. For example, historically, the Mississippi River has experienced decreased water quality as a result of industrial discharges, agricultural runoff, municipal sewage discharges, surface runoff from mining activity, and surface runoff from municipalities. However, over the past few decades, water quality within the Mississippi River has improved because of the implementation of the Clean Water Act (CWA) and other environmental regulations. For example, most of the older, first-generation chlorinated insecticides have been banned since the late 1970s. Similarly, the addition and upgrading of numerous municipal sewage treatment facilities, rural septic systems, and animal waste management systems have helped to significantly decrease the concentration of median fecal coliform bacteria in the Mississippi River. Despite the trend of improving water quality within the Mississippi River, trace levels of some contaminants and increased nutrients from agricultural lands remain a source of concern for aquatic life. (NRC 2014b, Section 4.12.3.2)

Other Water Users and Discharges

Several other existing facilities also withdraw water from the Mississippi River. Climate patterns and increased water demands upstream of RBS may increase the number of water users and rate of withdrawal from the Mississippi River. Aquatic life, especially threatened and endangered species, rely on sufficient flow within streams and rivers to survive. Also, fish and other aquatic life could be impinged and entrained within other facility water intake systems. Continued regulation of the flow by the USACE is expected to preserve the course and flow of the Mississippi River. Therefore, existing water withdrawals and other activities beyond RBS would not be expected to noticeably alter aquatic resources within the Mississippi River. (NRC 2014b, Section 4.12.3.3)

Existing and other water users along the Mississippi River would also discharge cooling water and other effluents into the Mississippi River. Entergy considered the impacts to aquatic resources from discharge of heated effluent (e.g., water temperature, dissolved oxygen, thermal stratification, and impacts to fauna), cold shock, and chemical treatment of the cooling water, and determined that the effluent would not noticeably alter aquatic resources. Additionally, Entergy and other water dischargers would be required to comply with LPDES permits that must be renewed every 5 years, allowing the LDEQ to ensure the permit limits provide the appropriate level of environmental protection. (NRC 2014b, Section 4.12.3.3)

Climate Change

Climate change could noticeably alter aquatic resources near RBS. In the southeastern United States, precipitation during the fall season has increased and the overall amount of heavy downpours also has increased. Heavy downpours can increase the rate of runoff and pollutants reaching the Mississippi River because the heavier precipitation and the pollutants washed away in the runoff have less time to be absorbed in the soil before reaching the river and other surface waterbodies. Higher amounts of nitrogen have been noted in the Mississippi River Basin and have been linked to increases in rainfall. High nitrogen levels can result in low oxygen levels that impact aquatic life. (NRC 2014b, Section 4.12.3.4)

Climate change models predict continued increases in heavy downpours in the southeastern United States accompanied by a decrease in water quality and ecosystem health. Climate models also predict increasing temperatures in the southeast, especially during summer. Increased temperatures and nutrients in runoff could lead to a decline in oxygen within small streams, lakes, and shallow aquatic habitats. During periods of low oxygen, many fish and other aquatic life may not be able to survive. Increased temperatures also may increase the frequency of shellfish-borne illness, alter the distribution of native fish, increase the local loss of threatened and endangered species, and increase the displacement of native species by non-native species. (NRC 2014b, Section 4.12.3.4)

Since the 1970s, there has been an increase in the amount of moderate to severe drought, especially during spring and summer. Climate models predict a continued increase in the amount and severity of droughts, which can lead to water use conflicts. Regulatory programs will be required to ensure sufficient water and flow is available within surface water bodies to provide habitat for aquatic life, especially threatened and endangered species. (NRC 2014b, Section 4.12.3.4) Because RBS's fuel source for generating electricity does not produce GHG emissions, RBS's contribution to climate change as it relates to aquatic resources would be SMALL.

#### 4.12.3.5 Terrestrial Resources

Historic Conditions

As discussed in Section 3.6.4, the LMR ecoregion once was dominated by swamps, marshes, wetlands, and bottomland forests (primarily oak-hickory-pine forests). Although these areas still exist in many places, they are not as extensive as in pre-settlement times. The LMR region is heavily converted, with just under half of the area covered by forest. One-third has been converted to agriculture and the remaining area comprises water, wetlands, urban, and barren areas.

Proposed Action

Sections 4.6.2 and 4.6.3 of this ER conclude that the impact from the renewal of the RBS OL would not noticeably alter the terrestrial environment or affect special status species and, therefore, would be SMALL.

No refurbishment or other license-renewal-related construction activities have been identified; therefore, no terrestrial habitat areas would be impacted by renewal of the RBS OL. In addition, any land disturbance activities are reviewed to ensure that the BMPs appropriate for the environment are used to protect terrestrial habitat and wildlife, threatened and endangered species, wetland areas, and water quality. Currently, no known populations of plants or animals that have been identified as endangered, threatened, or potentially listed have been found on the RBS property. Therefore, RBS's contribution to cumulative effects on the terrestrial environment or special status species would be SMALL.

Climate Change

Since 1970, the average annual temperature in the southeastern United States has risen by about 2°F and the number of freezing days has declined by 5 to 9 days per year. Over the next several decades, average temperatures in the region will rise by an additional 1.5 to 3.5°F. The Gulf Coast states, including Louisiana, will have less rainfall in winter and spring, and higher temperatures will increase the frequency, duration, and intensity of drought. Future hurricane intensity is uncertain; however, model projections agree that hurricane precipitation will increase by 20 percent. Changes in the climate will shift many wildlife population ranges and alter migratory patterns. Such changes could favor non-native invasive species and promote population increases of insect pests and plant pathogens. Climate change will likely alter the severity or frequency of precipitation, flooding, and fire. Climate change may also exacerbate the effects of existing stresses in the natural environment, such as those caused by habitat fragmentation, invasive species, industrial and agricultural runoff, and air emissions. (NRC 2014b, Section 4.12.4.5) Because RBS's fuel source for generating electricity does not produce

GHG emissions, RBS's contribution to climate change as it relates to terrestrial resources would be SMALL.

#### 4.12.3.6 Historic and Cultural Resources

As discussed in Section 4.7, it was determined that the renewal of the RBS OL would not adversely affect historic aboveground properties or archaeological sites. No license-renewal-related refurbishment activities have been identified as discussed in Section 2.3. In addition, no license-renewal-related construction activities have been identified. However, as discussed in Section 3.7.5, Entergy has a fleet procedure in place for management of cultural resources ahead of any future ground-disturbing activities at the plant. This fleet procedure requires reviews, investigations, and consultations, as needed, to ensure that existing or potentially existing cultural resources are adequately protected, and assists RBS in meeting state and federal expectations. Therefore, the operation of RBS during the license renewal term would not contribute to cumulative adverse effects on historic and cultural resources.

#### 4.12.3.7 Socioeconomics

RBS employees reside in 16 different Louisiana parishes and 9 other states, as shown in Table 2.5-1. Therefore, the primary geographic area of interest considered in this cumulative analysis was East Baton Rouge and West Feliciana parishes where approximately 69 percent of RBS employees reside. This area is where the economy, tax base, and infrastructure would most likely be affected given that a large number of RBS employees and their families reside, spend their income, and use their benefits within these parishes.

Socioeconomic conditions of East Baton Rouge and West Feliciana parishes are presented in Section 3.8, and evaluated for new and significant information in Section 4.8 to determine if the generic analysis in the GEIS bounds existing conditions. Section 3.10.2 presents information on minority and low-income populations within a 50-mile radius of RBS, and was evaluated in Section 4.10 for disproportionately adverse effects on minority and low-income populations as a result of license renewal.

As discussed in Section 4.8, no new and significant information was identified, and the generic analysis in the GEIS bounds existing conditions. Therefore, continued operation of RBS during the license renewal term would have no impact on socioeconomic conditions in the region beyond those already experienced. Because Entergy has no plans to hire additional workers during the license renewal term, overall expenditures and employment levels at RBS would remain relatively constant with no additional demand for permanent housing and public services. In addition, because employment levels and tax payments would not change, there would be no population- or tax revenue-related land use impacts. In addition, as discussed in Section 4.10, Entergy determined that there would be no disproportionately high and adverse health or environmental impacts to minority or low-income populations in the region from the renewal of the RBS OL.

Therefore, RBS's contribution to cumulative effects on socioeconomics during the license renewal term would be SMALL.

#### 4.12.3.8 Human Health

The NRC and EPA established radiological dose limits for protection of the public and workers from both acute and long-term exposure to radiation and radioactive materials. As discussed in Section 3.9.1.1, the doses resulting from the operation of RBS are below regulatory limits, and the impacts of these exposures would be SMALL.

EPA regulations in 40 CFR Part 190 limit the annual cumulative radiation dose to members of the public from all sources in the nuclear fuel cycle, including nuclear power plants, fuel fabrication facilities, waste disposal facilities, and transportation of fuel and waste. As discussed in Section 3.9.1.1, radioactive releases from RBS show that the annual radiation dose to the public has been less than 1.0 mrem (0.01 mSv), which is well within the NRC's and EPA's radiation protection standards.

In addition, as discussed in Section 3.9.1.2, RBS conducts an REMP around its site. The program measures radiation and radioactive materials in the environment from RBS and all other sources (i.e., area hospitals, industrial facilities). Therefore, the REMP would monitor any cumulative impacts. As discussed in Section 3.9.1.2, radiological environmental monitoring results for RBS shows no significant environmental impact associated with the operation of the plant.

There are no other nuclear power generating stations within a 50-mile radius of the RBS site. Entergy does plan to operate the onsite ISFSI at RBS, and there are likely to be medical, industrial, and research facilities that use radioactive materials within a 50-mile radius of the RBS site. However, as discussed above, the NRC and EPA established radiological dose limits for protection of the public and workers from both acute and long-term exposure to radiation and radioactive materials which would minimize the effect.

Therefore, Entergy concludes that RBS's contribution to cumulative effects on human health during the license renewal term would be SMALL.

#### 4.12.3.9 Waste Management

As with any major industrial facility, RBS generates waste as a consequence of normal operations. The expected waste generation rates during the license renewal term would be the same as during current operations, and radioactive waste (low-level, high-level, and spent nuclear fuel) and nonradioactive waste will continue to be generated. Hazardous waste would continue to be packaged and shipped to offsite RCRA-permitted treatment and disposal facilities. Typically, hazardous waste is not held in long-term storage at RBS because it is shipped to an approved licensed facility for disposition on a frequent basis.

As discussed in Chapter 2 of this ER, Entergy maintains waste management programs for all radioactive and nonradioactive waste generated at RBS and is required to comply with federal and state permits and other regulatory requirements for the management of waste material. Current waste management activities at RBS would likely remain unchanged during the license renewal term. Waste generated during the license renewal term would continue to be shipped off site by commercial haulers to licensed treatment and disposal facilities.

Therefore, RBS's contribution to cumulative effects on waste management during the license renewal term would be SMALL.

## 4.13 Impacts Common to All Alternatives: Uranium Fuel Cycle

### 4.13.1 Offsite Radiological Impacts—Individual Impacts from other than the Disposal of Spent Fuel and High-Level Waste

#### 4.13.1.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. The impacts to the public from radiological exposures have been considered by the Commission in Table S-3 of this part. Based on information in the GEIS, impacts to individuals from radioactive gaseous and liquid releases, including radon-222 and technetium-99, would remain at or below the NRC's regulatory limits.

#### 4.13.1.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

#### 4.13.1.3 Analysis

This issue concerns the direct impacts from facilities involved in supplying nuclear fuel to nuclear power plants. The impact of the fuel cycle was addressed in Appendix C of the RBS FES and was determined to be insignificant (NRC 1985). No changes in RBS fueling practices have been identified for the license renewal term.

In the GEIS, the NRC determined that offsite radiological impacts—individual impacts from other than the disposal of spent fuel and high-level waste—from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.12.1.1). Based on Entergy's review, no new and significant information was identified as it relates to offsite radiological impacts—individual impacts from other than the disposal of spent fuel and high-level waste, and further analysis is not required.

### 4.13.2 Offsite Radiological Impacts—Collective Impacts from other than the Disposal of Spent Fuel and High-Level Waste

#### 4.13.2.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

There are no regulatory limits applicable to collective doses to the general public from fuel-cycle facilities. The practice of estimating health effects on the basis of collective doses may not be meaningful. All fuel-cycle facilities are designed and operated to meet the applicable regulatory limits and standards. The Commission concludes that the collective impacts are acceptable.

The Commission concludes that the impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR part 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the collective impacts of the uranium fuel cycle, this issue is considered Category 1.

#### 4.13.2.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

#### 4.13.2.3 Analysis

This issue concerns the direct impacts from facilities involved in supplying nuclear fuel to nuclear power plants. The impact of the fuel cycle was addressed in Appendix C of the RBS FES and was determined to be insignificant (NRC 1985). The impacts were based on the values given in 10 CFR Part 51, Subpart A, Table S-3, and the NRC staff's estimates for radon-222 and technetium-99 releases (NRC 1985).

In the GEIS, it was concluded that offsite radiological impacts—collective impacts from other than the disposal of spent fuel and high-level waste—are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR Part 54 should be eliminated. The GEIS did not assign a single level of significance for the collective effects of the fuel cycle; however, it is considered a Category 1 issue. (NRC 2013b, Section 4.12.1.1) Based on Entergy's review, no new and significant information was identified as it relates to offsite radiological impacts—collective impacts from other than the disposal of spent fuel and high-level waste, and further analysis is not required.

### 4.13.3 Nonradiological Impacts of the Uranium Fuel Cycle

#### 4.13.3.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. The nonradiological impacts of the uranium fuel cycle resulting from the renewal of an operating license for any plant would be small.

#### 4.13.3.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

#### 4.13.3.3 Analysis

This issue concerns the direct impacts from facilities involved in supplying nuclear fuel to nuclear power plants. The impact of the fuel cycle was addressed in Appendix C of the RBS FES and was determined to be insignificant (NRC 1985). The impacts were based on the values given in 10 CFR Part 51, Subpart A, Table S-3, and the NRC staff's estimates for radon-222 and technetium-99 releases (NRC 1985). No changes in RBS fueling practices have been identified for the license renewal term.

In the GEIS, the NRC determined that nonradioactive impacts from the uranium fuel cycle from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.12.1.1). Based on Entergy's review, no new and significant information was identified as it relates to nonradiological impacts of the uranium fuel cycle, and further analysis is not required.

### 4.13.4 Transportation of Radiological Waste

#### 4.13.4.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. The impacts of transporting materials to and from uranium-fuel-cycle facilities on workers, the public, and the environment are expected to be small.

#### 4.13.4.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

#### 4.13.4.3 Analysis

As discussed in Section 2.2.1.1 of this ER, fuel enrichment and average bundle exposure at time of discharge are no more than 5 percent uranium-235 and 60,000 MWd/MTU, respectively. Utilizing Table S-4 of 10 CFR Part 51, Subpart A, to form the basis of transportation impacts, the NRC determined in the GEIS that impacts to and from the uranium fuel cycle from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Section 4.12.1.1). Based on Entergy's review, no new and significant information was identified as it relates to transportation of materials to and from uranium-fuel-cycle facilities, and further analysis is not required.

## 4.14 Termination of Nuclear Power Plant Operations and Decommissioning

### 4.14.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. License renewal is expected to have a negligible effect on the impacts of terminating operations and decommissioning on all resources.

### 4.14.2 Requirement [10 CFR 51.53(c)(3)(iv)]

The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware.

### 4.14.3 Analysis

The only impacts of license termination and decommissioning attributable to operation during an extended license period are the effects of an additional 20 years of operations on the impacts of decommissioning.

In the GEIS, the NRC determined that termination of nuclear power plant operations and decommissioning from continued plant operations over the license renewal term would be SMALL for all nuclear plants, and designated this as a Category 1 issue (NRC 2013b, Table 2.1-1). Based on Entergy's review, no new and significant information was identified as it relates to termination of nuclear power plant operations and decommissioning, and further analysis is not required.

## 4.15 Postulated Accidents

### 4.15.1 Severe Accidents

#### 4.15.1.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. The probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to groundwater, 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.

#### 4.15.1.2 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.

### 4.15.1.3 Analysis

This section summarizes the RBS analysis of alternatives for mitigating the impacts of severe accidents. Attachment D provides a detailed description of the Severe Accident Mitigation Alternatives (SAMA) analysis.

The term "accident" refers to any unintentional event (i.e., outside the normal or expected plant operation envelope) that results in the release or a potential for release of radioactive material to the environment. The NRC categorized accidents as "design basis" (i.e., the plant is designed specifically to accommodate these) or "severe" (i.e., those involving multiple failures of equipment or function and, therefore, whose likelihood is generally lower than design-basis accidents but where consequences may be higher).

The NRC concluded in its license renewal rulemaking that the probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to groundwater, and societal and economic impacts from severe accidents are small for all plants. However, the NRC made consideration of severe accident mitigation alternatives a Category 2 issue (requiring site-specific evaluation for license renewal) because not all plants had performed a site-specific analysis of measures that could mitigate severe accidents (NRC 1996, Section 5.5.2.5).

The method used to perform the SAMA analysis was based on the *Regulatory Analysis Technical Evaluation Handbook* used by the NRC to analyze benefits and costs of its regulatory activities (NRC 1997) and followed the accepted industry guidance (NEI 2005).

Environmental impact statements and ERs 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.

- RBS Probabilistic Risk Assessment (PRA) Model

  The RBS PRA internal events model, Level 1 and Level 2, was used to determine total accident frequency (core damage frequency [CDF] and containment release frequency) and to identify and characterize the leading contributors to CDF and offsite risk. A multiplier was applied to the internal events PRA results to account for the risk contribution for external events and internal flooding. The external events and internal flooding analyses were also used to identify leading contributors to risk.

- Level 3 PRA

  Levels 1 and 2 PRA output and site-specific meteorology, demographic, economic, land use, and emergency response data were used as input in performing a Level 3 PRA using Version 3.10.0 of the Windows Interface for MACCS2, MELCOR Accident Consequence Code System (WinMACCS).

- Baseline Risk Monetization

  The analysis techniques specified in NEI 05-01, Revision A (NEI 2005) and NUREG/BR-0184 (NRC 1997) were used to calculate the monetary value of the unmitigated RBS severe accident risk. This becomes the maximum averted cost-risk (MACR) that is possible. The MACR represents the monetary value of the base risk of dose to the public and workers, offsite and onsite economic impacts, and replacement power. The value became a cost/benefit screening tool for potential SAMAs. A SAMA whose estimated cost of implementation exceeded the MACR was rejected as being not cost-beneficial.

- Identification of Potential SAMA Candidates

  Potential SAMA candidates were identified from sources such as

  - SAMA analyses for other BWR plants,
  - NRC and industry documentation discussing potential plant improvements,
  - RBS Individual Plant Examination of internal and external events reports and their updates, and
  - RBS updated PRA model lists of risk significant contributors.

- Preliminary Screening (Phase I)

  Potential SAMA candidates were screened out if they were not applicable to RBS, already implemented, could be combined with another SAMA, had excessive implementation costs, or had very low benefit.

- Final Screening and Cost-Benefit Evaluation (Phase II)

  A cost-benefit analysis was performed for each SAMA candidate remaining after preliminary screening. The benefit of implementing a SAMA candidate was estimated in terms of averted consequences as described below.

  - The PRA Level 1 or Level 2 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 PRA 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.

- Severe accident impacts were evaluated in four areas.

  1. Offsite exposure costs: Monetary value of consequences (dose) to offsite population.

     The PRA model was used to determine total accident frequency (CDF and containment release frequency). WinMACCS was used to convert release to public dose. Dose was converted to present worth dollars (based on a valuation of $5,500 per person-rem and a present worth discount rate of 7 percent).

  2. Offsite economic costs: Monetary value of damage to offsite property.

     The PRA model was used to determine total accident frequency (CDF and containment release frequency). WinMACCS was used to convert release to offsite property damage. Offsite property damage was converted to present worth dollars based on a discount rate of 7 percent.

  3. Onsite 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 $5,500 per person-rem and a present worth discount rate of 7 percent.

  4. Onsite economic costs: Monetary value of damage to onsite property.

     Best-estimate cleanup and decontamination costs were used. Onsite 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 and refurbishment costs were not included in onsite costs. Replacement power costs were considered.

- The cost associated with each impact area following implementation of the SAMA candidate was estimated by combining the revised accident frequency and the costs.

- 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 and the revised plant following implementation of the SAMA candidate.

- The cost of implementing a SAMA was estimated by one of the two methods described below. 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.

  1. An estimate for a similar modification considered in a previously performed SAMA analysis was used. It should be noted that these estimates were conservative for comparison against an estimated benefit at RBS because they were developed in the past and no credit was taken for inflation when applying them to RBS.

  2. Estimates of the cost associated with procedure changes, engineering analyses, testing, training, and hardware modifications were based on engineering judgment and past experience.

- Sensitivity Analyses

Two sensitivity analyses were conducted to gauge the impact of key assumptions upon the analysis.

<u>Sensitivity Case 1: Conservative Discount Rate</u>

The purpose of this case was to investigate the sensitivity of each analysis case to the discount rate. In accordance with NUREG/BR-0184 (NRC 1997), a real discount rate of 7 percent was used in the base case analyses. A lower discount rate of 3 percent was assumed in this sensitivity to investigate the impact on each analysis case.

<u>Sensitivity Case 2: 95th-Percentile Uncertainty</u>

The purpose of this case was to investigate the sensitivity of the PRA model underestimating averted plant risk. If the best estimate failure probability values were consistently lower than the "actual" failure probabilities, the PRA model would underestimate plant risk and yield lower than "actual" averted cost-risk values for potential SAMAs. Re-assessing the cost benefit calculations using the high end of the failure probability distributions is a means of identifying the impact of having consistently underestimated failure probabilities for plant equipment and operator actions included in the PRA model. This sensitivity uses a multiplier of 4, which is conservative with respect to the ratio of the CDF 95th-percentile results to the point estimate results, to examine the impact of uncertainty in the PRA model.

#### 4.15.1.4 Conclusion

This analysis addressed 206 SAMA candidates for mitigating severe accident impacts. Phase I screening eliminated 158 SAMA candidates from further consideration. One of the remaining SAMA candidates was split into three different SAMAs to better evaluate the benefits, which resulted in 50 remaining candidates. During the Phase II cost-benefit evaluation of the remaining 50 SAMA candidates, an additional 47 SAMA candidates were eliminated because their cost was expected to exceed their benefit. The Phase II analysis identified three SAMAs that are potentially cost beneficial.

- SAMA 97: Perform study and analysis to add steps to trip unneeded emergency core cooling system (ECCS) pumps on loss of heating, ventilation, and air conditioning (HVAC).
- SAMA 169: Improve internal flooding procedures.
- SAMA 205: Revise FLEX (diverse and flexible strategies [in response to NRC Order EA-12-049]) procedures to allow use of FLEX equipment in non-extended loss of alternating current (AC) power (ELAP) conditions.

The sensitivity analyses identified five SAMA candidates that are potentially cost beneficial.

- SAMA 94a: Enhance procedures for actions on loss of HVAC, high-pressure core spray (HPCS) room (3-percent discount rate).
- SAMA 94b: Enhance procedures for actions on loss of HVAC, residual heat removal (RHR) B and RHR C rooms (95th-percentile uncertainty).
- SAMA 94c: Enhance procedures for actions on loss of HVAC, low-pressure core spray (LPCS) and RHR A rooms (3-percent discount rate).
- SAMA 102: Operator procedure revisions to provide additional space cooling to the emergency diesel generator (EDG) room via the use of portable equipment (95th-percentile uncertainty).
- SAMA 198: Develop a procedure for alternating operation of low-pressure ECCS pumps for loss of standby service water (3-percent discount rate).

Although the above SAMA candidates do not relate to adequately managing the effects of aging during the period of extended operation, they have been entered into the action tracking process to be evaluated for implementation.

Attachment D provides a detailed description of the SAMA analysis.

# 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 NRC has resolved most license renewal environmental issues generically and requires an applicant to analyze only those issues the NRC has not resolved generically. While NRC regulations do not require an applicant's environmental report to contain analyses of the impacts of those Category 1 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)]

## 5.1 New and Significant Information

The NRC provides guidance on new and significant information in Regulatory Guide 4.2, Supplement 1, Revision 1 (NRC 2013a, pages 7 and 8). In this guidance, new and significant information is defined as follows:

(1) Information that identifies a significant environmental issue that was not considered or addressed in the GEIS and, consequently, not codified in Table B-1, "Summary of Findings on NEPA Issues for License Renewal of Nuclear Plants," in Appendix B, "Environmental Effect of Renewing the Operating License of a Nuclear Power Plant," to Subpart A, "National Environmental Policy Act—Regulations Implementing Section 102(2)," of 10 CFR Part 51; or

(2) Information not considered in the assessment of impacts evaluated in the GEIS leading to a seriously different picture of the environmental consequences of the action than previously considered, such as an environmental impact finding different from that codified in Table B-1.

Further, a significant environmental issue includes, but is not limited to, any new activity or aspect associated with the nuclear power plant that can act upon the environment in a manner or an intensity and/or scope (context) not previously recognized (NRC 2013a, page 8).

The NRC does not specifically define the term "significant." Accordingly, for the purposes of this review, Entergy relied on Council on Environmental Quality regulations, which include a lengthy definition of "significant" that requires consideration of the context of the action and the intensity or severity of the impact(s) [40 CFR 1508.27]. Entergy considered that MODERATE or LARGE impacts, as defined by the NRC, would be significant. Chapter 4 presents the NRC definitions of SMALL, MODERATE, and LARGE impacts.

## 5.2 New and Significant Information Review Process

During preparation of the RBS ER, Entergy reviewed the analyses of the Category 1 issues discussed in the GEIS (NRC 2013b) that were applicable to RBS, 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 RBS, 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 RBS OL was identified, reviewed, and addressed as appropriate.

This process is collectively conducted by departments within Entergy Nuclear's corporate group and 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.

This process identifies issues relevant to environmental matters through several avenues as follows:

- Participation in industry utility groups such as Edison Electric Institute, Electric Power Research Institute, NEI, and Utility Solid Waste Activities Group.
- Participation in non-utility groups such as the Institute of Hazardous Materials Management and National Registry of Environmental Professionals.
- Routine interface with regulatory agencies having oversight of the facility.
- Routine interface with non-nuclear Entergy business units such as Fossil, Transmission, and Corporate.
- Periodic reviews of proposed regulatory and legislative changes.
- Review of plant and site activities that are evaluated by Entergy fleet procedure EN-EV-115 (Environmental Reviews and Evaluations).

Additional actions conducted by Entergy during the development of the RBS ER included the following:

- Interviews with site subject matter experts.
- Review of current site activities relating to the resource areas identified in the GEIS.

- Review of state and federal regulatory agency inspections and associated inspection results.

- Consultations with the USFWS, LDWF, Louisiana SHPO, and Native American tribes.

As a result of this review, Entergy is aware of no new and significant information regarding the environmental impacts of license renewal associated with RBS (Entergy 2016p).

# 6.0 SUMMARY OF LICENSE RENEWAL IMPACTS AND MITIGATING ACTIONS

## 6.1 License Renewal Impacts

Entergy reviewed the NRC findings on the 53 Category 1 issues that were applicable to RBS and identified no new and significant information that would invalidate the findings for the site. For the 17 Category 2 issues listed in Table 4.0-3 of this ER, Table 6.1-1 identifies the environmental impacts associated with these issues as they relate to the renewal of the RBS OL.

In summary, Entergy has reviewed the environmental impacts of renewing the RBS OL and has concluded that further mitigation measures beyond those discussed in Section 6.2 and listed in Table 6.1-1 of this ER to avoid, reduce the severity of, or eliminate adverse impacts are not warranted. This ER documents the basis for Entergy's conclusion.

**Table 6.1-1**
**Environmental Impacts Related to License Renewal at RBS**

| Issue | ER Section | Environmental Impact |
|---|---|---|
| ***Surface Water Resources*** | | |
| Surface water use conflicts (plants with cooling ponds or cooling towers using makeup water from a river) [10 CFR 51.53(c)(3)(ii)(A)] | 4.5.1.1 | SMALL impact. Water withdrawals represent 0.04 percent of Mississippi River flow at lowest anticipated flow (100,000 cfs); water withdrawn and lost through drift and evaporation at lowest anticipated flow represents 0.03 percent of flow; water withdrawals and consumption expected to remain at current rates. |
| ***Groundwater Resources*** | | |
| Groundwater use conflicts (plants that withdraw more than 100 gpm) [10 CFR 51.53(c)(3)(ii)(C)] | 4.5.2.1 | No impact. Issue is <u>not applicable</u> because RBS's annual average groundwater withdrawal rates are less than 100 gpm. |
| Groundwater use conflicts (plants with closed-cycle cooling systems that withdraw makeup water from a river) [10 CFR 51.53(c)(3)(ii)(A)] | 4.5.2.2 | SMALL impact. Onsite groundwater withdrawals less than 100 gpm; surface water withdrawals represent 0.04 percent of Mississippi River flow at lowest anticipated flow (100,000 cfs); river water withdrawn and lost through drift and evaporation at lowest anticipated flow represents 0.03 percent of flow; water withdrawals and consumption expected to remain at current rates. |
| Groundwater quality degradation (plants with cooling ponds at inland sites) [10 CFR 51.53(c)(3)(ii)(D)] | 4.5.2.3 | No impact. Issue is <u>not applicable</u> because RBS does not utilize cooling ponds. |
| Radionuclides released to groundwater [10 CFR 51.53(c)(3)(ii)(P)] | 4.5.2.4 | SMALL impact. Tritium contaminated groundwater confined within the RBS property; groundwater flow at the site is in a southwesterly direction toward the Mississippi River; no offsite wells will be affected; no tritium has been detected in groundwater wells used for plant industrial purposes. |
| ***Aquatic Resources*** | | |
| Impingement and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds) [10 CFR 51.53(c)(3)(ii)(B)] | 4.6.1.1 | No impact. Issue is <u>not applicable</u> because RBS utilizes a closed-cycle cooling heat dissipation system equipped with mechanical draft cooling towers. |

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

| Issue | ER Section | Environmental Impact |
|---|---|---|
| Thermal impacts on aquatic organisms (plants with once-through cooling systems or cooling ponds) [10 CFR 51.53(c)(3)(ii)(B)] | 4.6.1.2 | No impact. Issue is not applicable because RBS utilizes a closed-cycle cooling heat dissipation system equipped with mechanical draft cooling towers. |
| Water use conflicts with aquatic resources (plants with cooling ponds or cooling towers using makeup water from a river) [10 CFR 51.53(c)(3)(ii)(A)] | 4.6.1.3 | SMALL impact. Water withdrawals represent 0.04 percent of Mississippi River flow at lowest anticipated flow (100,000 cfs); water withdrawn and lost through drift and evaporation at lowest anticipated flow represents 0.03 percent of flow; water withdrawals and consumption expected to remain at current rates. |
| ***Terrestrial Resources*** | | |
| Effects on terrestrial resources (non-cooling system impacts) [10 CFR 51.53(c)(3)(ii)(E)] | 4.6.2.1 | SMALL impact. No refurbishment or other license-renewal-related construction activities have been identified; adequate management programs and regulatory controls in place to protect onsite important terrestrial ecosystems. |
| Water use conflicts with terrestrial resources (plants with cooling ponds or cooling towers using makeup water from a river) [10 CFR 51.53(c)(3)(ii)(A)] | 4.6.2.2 | SMALL impact. Water withdrawals represent 0.04 percent of Mississippi River flow at lowest anticipated flow (100,000 cfs); water withdrawn and lost through drift and evaporation at lowest anticipated flow represents 0.03 percent of flow; water withdrawals and consumption expected to remain at current rates. |
| ***Special Status Species and Habitats*** | | |
| Threatened, endangered, and protected species and essential fish habitat [10 CFR 51.53(c)(3)(ii)(E)] | 4.6.3.1 | No effect. No refurbishment or other license-renewal-related construction activities have been identified; management programs in place to protect threatened and endangered species; no EFH designated in the Mississippi River in the vicinity of RBS. |

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

| Issue | ER Section | Environmental Impact |
|---|---|---|
| ***Historic and Cultural Resources*** | | |
| Historic and cultural resources [10 CFR 51.53(c)(3)(ii)(K)] | 4.7 | Historic properties are present but not adversely affected. No refurbishment or other license-renewal-related construction activities have been identified; no plans to conduct offsite soil-intrusive activities; administrative procedure ensures protection of these type resources in the event of onsite excavation activities. |
| ***Human Health*** | | |
| Microbiological hazards to the public (plants with cooling ponds or canals or cooling towers that discharge to a river) [10 CFR 51.53(c)(3)(ii)(G)] | 4.9.1 | SMALL impact. Conditions necessary for optimal growth are limited at discharge area; discharge flow rate minor when compared with Mississippi River flows; point of discharge of heated effluent not typically utilized for primary contact recreation; from 2005 to 2013, no reported cases of *Naegleria* infection attributable to Mississippi River. |
| Electric shock hazards [10 CFR 51.53(c)(3)(ii)(H)] | 4.9.2 | SMALL impact. Transmission lines constructed to meet NESC 5-mA Rule; transmission lines located entirely within RBS property; public does not have access to the area; occupational safety and health measures in place to protect plant workers from shock hazards associated with overhead lines. |
| ***Environmental Justice*** | | |
| Minority and low-income populations [10 CFR 51.53(c)(3)(ii)(N)] | 4.10.1 | No disproportionately high and adverse impacts. Impacts from renewal of the RBS OL would be SMALL for all resource areas; locations of minority and low-income populations within a 50-mile radius of RBS are not expected to be disproportionally affected by any activities described in Chapter 4 of this ER; no subsistence-like populations live in the area. |

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

| Issue | ER Section | Environmental Impact |
|---|---|---|
| ***Cumulative Impacts*** | | |
| Cumulative impacts [10 CFR 51.53(c)(3)(ii)(O)] | 4.12 | SMALL impact. Future RBS operations will be similar to past operations; evaluations in Chapter 4 of this ER of past impacts to the Mississippi River, groundwater, air quality and noise, geology and soils, terrestrial resources, threatened or endangered species, cultural resources, socioeconomics, radiological doses, and waste management conclude that future impacts from RBS would be SMALL; releases of air pollutants and thermal releases to the Mississippi River are limited by permit; radiological doses are limited by regulation; threatened and endangered species and cultural resources are protected by state and federal regulations; changes to population or tax-related land use impacts from RBS are not expected because Entergy has no plans to hire additional workers during the license renewal term. |
| ***Postulated Accidents*** | | |
| Severe accidents [10 CFR 51.53(c)(3)(ii)(L)] | 4.15.1 | SMALL impact. Potentially cost-effective SAMAs are not related to adequately managing the effects of aging during the period of extended operation. |

## 6.2 Mitigation

> The environmental report must include an analysis that considers and balances . . . alternatives available for reducing or avoiding adverse environmental effects. [10 CFR 51.45(c)]
>
> The report must contain a consideration of alternatives for reducing adverse impacts . . . for all Category 2 license renewal issues . . . . [10 CFR 51.53(c)(3)(iii)]

Regulatory Guide 4.2, *Preparation of Environmental Reports for Nuclear Power Plant License Renewal Applications*, specifies that the applicant should identify any ongoing mitigation and should discuss the potential for additional mitigation. However, applicants are only required to consider mitigation alternatives in proportion to the significance of the impact. (NRC 2013a, page 8)

As discussed in Section 3.5.4.2.1, tritium is present in the UTA beneath the site as a result of tritium-contaminated water seeping through degraded turbine building and heater bay floor joints, which were re-sealed in 2016. Remediation activities included installation of monitoring wells, increased groundwater sampling frequency, natural monitored attenuation, and withdrawal of groundwater to control the spread of the affected groundwater. To date, no tritium has migrated off site, and tritium migration off site is not expected. Geological estimates concluded that due to decay, dilution, and dispersion, the activity present is not likely to be detected in the Mississippi River if it were to infiltrate to the UTA and migrate off site.

As discussed in Section 6.1, impacts associated with RBS license renewal do not require the implementation of additional mitigation measures. The permits and programs discussed in Chapter 9 (i.e., LPDES permit; stormwater program; air permit; spill prevention, control and countermeasure [SPCC] program; hazardous waste management program; cultural resource protection plan; and environmental review programs), in addition to the groundwater protection program (Section 3.5.2.4), radioactive effluents release program (Section 3.9.1.1), and REMP (Section 3.9.1.2), that currently mitigate the operational environmental impacts of RBS are adequate. Therefore, additional mitigation measures are not sufficiently beneficial as to be warranted.

## 6.3 Unavoidable Adverse Impacts

> The environmental report shall . . . discuss . . . any adverse environmental effects which cannot be avoided should the proposal be implemented . . . . [10 CFR 51.45(b)(2)]

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 2.3, no license-renewal-related refurbishment activities have been identified. In addition, no license-renewal-related construction activities have been identified. Therefore, the environmental impacts to be evaluated for license renewal are those associated with continued operation during the renewal term.

Entergy adopts by reference NRC findings for the 53 Category 1 issues (NRC 2013b) applicable to RBS, including discussions of any unavoidable adverse impacts. In addition, Entergy identified the following site-specific unavoidable adverse impacts associated with license renewal:

- The majority of the land use at RBS would continue to be designated as industrial until the plant is shut down and decommissioned (decommissioning can take up to 60 years after permanent shutdown of RBS). Uranium mining associated with the nuclear fuel cycle also has offsite land use implications.

- Normal plant operations result in industrial wastewater discharges containing small amounts of water treatment chemical additives to the Mississippi River at or below LDEQ-approved concentrations. Compliance with the LPDES permit would ensure that impacts remain SMALL.

- Operation of RBS results in consumptive use of groundwater. However, annual average groundwater withdrawals are less than 100 gpm.

- Operation of RBS results in consumptive use of Mississippi River water as a result of plant operations. However, this consumptive use is negligible, amounting to approximately 0.03 percent of the river's average flow rate as discussed in Section 3.5.3.1.

- Operation of RBS results in the generation of spent nuclear fuel and waste material, including LLRW, hazardous waste, and nonhazardous waste. However, specific plant design features in conjunction with a waste minimization program; employee safety training programs and work procedures; and strict adherence to applicable regulations for storage, treatment, transportation, and ultimate disposal of this waste ensure that the impact is SMALL.

- Operation of RBS results in a very small increase in radioactivity in the air and water. However, doses to the members of the public from RBS's gaseous releases would be well within the allowable limits of 10 CFR Part 20 and 10 CFR Part 50, Appendix I. The incremental radiation dose to the local population resulting from RBS operations is typically less than the magnitude of the fluctuations that occur in natural background radiation. Operation of RBS also creates a very low probability of accidental radiation exposure to inhabitants of the area.

## 6.4 Irreversible or Irretrievable Resource Commitments

> The environmental report shall . . . discuss . . . any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented. [10 CFR 51.45(b)(5)]

The term "irreversible" applies to the commitment of environmental resources (e.g., permanent use of land) that cannot by practical means be reversed to restore the environmental resources to their former state. In contrast, the term "irretrievable" applies to the commitment of material resources (e.g., irradiated steel, petroleum) that, once used, cannot by practical means be recycled or restored for other uses.

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

- Uranium in the nuclear fuel consumed in the reactor that becomes high-level radioactive waste if the used fuel is not recycled through reprocessing.
- Land required for permanent storage or disposal of spent nuclear fuel, LLRW 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 RBS that cannot be recovered or recycled, or that are consumed or reduced to unrecoverable forms.

Other than the above, no license-renewal-related refurbishment activities have been identified that would irreversibly or irretrievably commit significant environmental components of land, water, and air.

However, if RBS ceases operations on or before the expiration of the current OL, the likely power generation alternatives would require a commitment of resources for construction of the replacement plants as well as for fuel to run the plants. Significant resource commitments would also be required if transmission lines are needed to connect the plant to the electrical grid.

## 6.5 Short-Term Use Versus Long-Term Productivity

> The environmental report shall . . . discuss . . . the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity . . . . [10 CFR 51.45(b)(4)]

The current balance between short-term use and long-term productivity of the environment at the site has remained relatively constant since RBS began operations in 1986. The RBS 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 RBS (NRC 1985, 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 RBS FES. The period of extended operation will postpone the availability of the site resources (land, air, water) for other uses. Denial of the application to renew the RBS 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 RBS site into a park or an industrial facility after decommissioning are quite different. However, extending RBS operations would not alter, but only postpone, the potential long-term uses of the site that are currently possible.

In summary, no license-renewal-related refurbishment activities have been identified that would alter the evaluation of the RBS 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 TO THE PROPOSED ACTION

> The environmental report shall . . . discuss . . . alternatives to the proposed action . . . . [10 CFR 51.45(b)(3)]
>
> The applicant shall discuss in this report the environmental impacts of alternatives and any other matters . . . . The report is not required to include discussion of need for power or economic costs and benefits of . . . alternatives to the proposed action except insofar as such costs and benefits are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation . . . . [10 CFR 51.53(c)(2)]

Each energy alternative should meet the purpose of the proposed action (i.e., renewal of a commercial nuclear power plant OL), which is to provide the option to continue plant operations beyond the current OL term. If the RBS OL is not renewed, the approximately 967 net MWe of reliable base-load power produced by RBS would not be available to continue to meet Entergy's system generating needs during the RBS license renewal period, December 2025 to December 2045. Therefore, because Entergy, a regulated utility, is required to furnish the Louisiana Public Service Commission its plan for meeting customers' long-term power needs and because RBS's power generation is included in this long-term plan, an alternative approach to meeting the electric power requirements of its customers would be needed.

## 7.1 Replacement Power Alternatives

As discussed in Section 2.6.2, Entergy considered a full range of alternatives for replacement power in the event that the RBS OL is not renewed. Entergy considered each of the replacement power alternatives reviewed in NRC's GEIS for license renewal (NRC 2013b, Section 2.3) for their reasonableness as an alternative to continued operation of RBS to meet power demands of Entergy customers with regard to several criteria. The NRC has defined a "reasonable alternative" as one that is commercially viable on a utility scale and operational prior to the expiration of the reactor's OL, or expected to become commercially viable on a utility scale and operational prior to the expiration of the reactor's OL. In addition, the amount of replacement power generated must equal the base-load capacity previously supplied by the nuclear plant, and the alternative must reliably operate at or near the nuclear plant's demonstrated capacity factor. (NRC 2013b, Section 2.3) In evaluating reasonable alternatives to the renewal of the RBS OL, Entergy reviewed both discrete power generation sources for replacement of the base-load generating capacity of RBS and a combination of sources. If the RBS OL is not renewed, the approximately 967 net MWe of reliable base-load power produced by RBS would not be available to continue to meet Entergy's system generating needs during the license renewal period, 2025–2045. Any alternative that did not include replacing the base-load generating capacity of RBS and reliably operate at or near the nuclear plant's demonstrated capacity factor would be unreasonable.

### 7.1.1 Energy Alternatives Considered As Reasonable

Entergy's review determined that the alternatives listed below met the NRC's criteria for reasonableness for the replacement of RBS's generating capacity during the license renewal period. Each of the following hypothetical alternatives is discussed further in the following subsections.

- NGCC plant at the RBS site.
- SCPC plant at the RBS site.
- New nuclear plant at the RBS site.
- Combination of hypothetical alternatives consisting of an NGCC plant and biomass plants at the RBS site, plus energy savings from DSM programs.

As explained in Section 2.6.2, Entergy determined that the most likely alternative to replace RBS is an NGCC plant due to economic reasons, and the relatively short development and construction time (approximately 3 years).

#### 7.1.1.1 Natural Gas-Fired Generation

Typical power trains for large-scale NGCC power generation would involve one, two, or three combined-cycle units, available in a variety of standard sizes, mated to a heat-recovery steam generator. Entergy assumes that appropriately sized units could be assembled to annually produce electrical power in amounts equivalent to RBS. For purposes of this assessment, Entergy evaluated an alternative that consists of three, parallel, Advanced F-Class units, 400 MWe (gross) each, equipped with dry, low-nitrogen-oxide combustors to suppress nitrogen oxide formation and provide selective catalytic reduction (SCR) of the exhaust with ammonia for post-combustion control of nitrogen oxide emissions. Based on a capacity factor of 87 percent (EIA 2015a, Table 1), this alternative would result in a net capacity of 1,044 MWe. For the NGCC plant alternative, Entergy assumes (1) the plant would be located on previously disturbed land, (2) the plant would utilize closed-cycle cooling with mechanical draft cooling towers, (3) the source of cooling water would be the Mississippi River, (4) the existing transmission line infrastructure would be adequate, and (5) the existing intake and discharge structures could be utilized with some modifications.

#### 7.1.1.2 Coal-Fired Generation

As discussed in Section 2.6.2, Entergy's IRP selected SCPC with carbon capture as a technology for further consideration. A myriad of sizes of pulverized coal boilers and steam turbine generators are available. However, for purposes of this analysis, Entergy assumed the coal-fired alternative would be composed of two 600-MWe (gross) ultra-supercritical coal-fired boilers. Based on an 85-percent capacity factor (EIA 2015a, Table 1), the two units would have a net capacity of 1,020 MWe. For the SCPC plant alternative, Entergy assumes (1) the plant would be located on previously disturbed land, (2) the Mississippi River would be utilized for supporting delivery of coal, (3) the plant would be equipped with carbon capture and storage (CCS) technology, (4) a geological formation capable of storing carbon emissions to meet new power plant standards (80 FR 64510) would be available near the site, (5) the plant would utilize closed-cycle cooling with mechanical draft cooling towers, (6) the source of cooling water would be the Mississippi River, (7) the existing transmission line infrastructure would be adequate, and (8) the existing intake and discharge structures could be utilized with some modifications.

#### 7.1.1.3 New Nuclear Generation

Several designs are possible for a new nuclear facility. However, a single-unit nuclear power plant similar to the existing RBS in output is most likely. Therefore, Entergy chose a 1,200-MWe (gross) plant operating at a capacity factor of 90 percent (EIA 2015a, Table 1) with a net capacity of 1,080 net MWe. For the nuclear plant alternative, Entergy assumes (1) the plant would be located on previously disturbed land, (2) the plant would utilize closed-cycle cooling with mechanical draft cooling towers, (3) the source of cooling water would be the Mississippi River, (4) the existing transmission infrastructure would be adequate, and (5) the existing intake and discharge structures could be utilized with some modifications.

#### 7.1.1.4 Combination of Alternatives

A combination of hypothetical alternatives for replacing the generating capacity of RBS consists of the following:

- Two 400-MWe (gross) NGCC units operating at an 87-percent capacity factor (EIA 2015a, Table 1) for a total net capacity of 696 MWe.
- Four 50-MWe (gross) biomass units operating at an 83-percent capacity factor (EIA 2015a, Table 1) for a total net capacity of 166 MWe.
- DSM programs providing 105 MWe.

For the NGCC plant and biomass plants, Entergy assumes (1) the plants would be located on previously disturbed land; (2) closed-cycle cooling with mechanical draft cooling towers would be utilized; (3) the source of cooling water would be the Mississippi River; (4) the existing transmission line infrastructure would be adequate; (5) the existing intake and discharge structures could be utilized with some modifications; and (6) the biomass-fired units would be capable of using a variety of biomass fuels such as wood waste, crop residue, energy crops, and municipal solid waste (MSW) to take advantage of the feedstock options available in the area as well as for greater assurance of reliable feedstock.

The selection of the combination of alternatives listed above was based on the combination of alternative energy sources used in the Waterford 3 LRA ER.

### 7.1.2 Energy Alternatives Not Considered Reasonable

The NRC reviewed a full range of energy alternatives in the GEIS, including alternatives that require new generating capacity and those that do not (NRC 2013b, Section 2.3). Entergy considered alternatives, as presented in the GEIS, for its analysis as discussed in Section 2.6.2. The following sections discuss the energy alternatives not considered reasonable.

#### 7.1.2.1 Alternatives Not Requiring New Generating Capacity

##### 7.1.2.1.1 Purchased Power

Power to replace the capacity of a nuclear unit would have to be purchased from sources within the United States, Mexico, and/or Canada. The power purchased would likely be generated from coal, natural gas, nuclear, or some amount of intermittent renewables such as wind or solar, or a combination of these. Thus, the environmental impacts of purchased power would still occur, but would be located elsewhere within the region, nation, or another country. The description of the environmental impacts of generating technologies presented in Chapter 8 of the 1996 GEIS is representative of the purchased power alternative. In addition, purchased power is generally economically adverse in that the cost of generated power has historically been less than the cost of the same power provided by a third party (NRC 2013d, Section 9.2.1).

Purchased power could require new transmission lines to import the amount of energy needed to replace RBS. RBS electricity is distributed through the Entergy electric system, which interconnects Entergy's operating companies. Entergy Louisiana, LLC is also a member of Midcontinent Independent System Operator, Inc. (MISO). The resource adequacy for the MISO region was projected for the period 2015 to 2024. RBS is located in the MISO south region in Zone 9. Shortfalls in generating resources were identified for the entire MISO region beginning in 2020, with an expected shortfall of 13,785 megawatts (MW) by 2024. The shortfalls are primarily driven by other regions and zones within the MISO footprint and are predicted even with the inclusion of 100 percent of unclaimed merchant generating capacity. Zone 9 is expected to experience its first shortfall by 2023 or 2024. (NETL 2015) This indicates that excess capacity available for purchase by Entergy Louisiana, LLC within the MISO region is not anticipated and could not replace RBS's generating capacity.

Purchase of power from within or outside the MISO region would be subject to transmission constraints and could require the construction of new transmission lines. The construction of transmission lines could have both environmental and aesthetic consequences, particularly if new transmission line ROWs have to be acquired. It is not possible to accurately predict the number of acres of land required for transmission system expansion to accommodate replacement of RBS's base-load generating capacity without knowing the location and grid access for generating facilities with reserve capacity available for purchase. 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 more than 1,800 acres per 100 miles of transmission line ROW. Therefore, the local environmental impacts from purchased power would be SMALL where existing transmission line ROWs could be used, and could range from SMALL to LARGE if development of new ROWs were required.

Purchasing power from other utilities or power generators is not considered a reasonable or environmentally preferred alternative for the replacement of RBS's base-load generation due to anticipated capacity shortfalls, potential for transmission constraints, and potential land impacts from the need for transmission line expansion.

#### 7.1.2.1.2 Plant Reactivation or Extended Service Life

Entergy's integrated resource planning process involves looking at sustaining existing units, as well as adding generating capacity and implementing DSM programs to meet projected electricity demand. The process reviews the entire Entergy Louisiana, LLC fleet, its viability, and its maintenance needs, and makes informed assumptions with regard to plant life and continued operations. The IRP assumes the deactivation of approximately 5,950 MWe of older gas-fired generating units within the aging Entergy Louisiana, LLC fleet (Entergy 2015j, Part 5). Even if investments in maintenance were economically sound and allowed for delayed retirement/ refurbishment of some of the units in the aging Entergy Louisiana, LLC generating fleet, given expected demand, Entergy projects that it will be necessary to add additional generating capacity.

Thus, even if substantial capacity scheduled for retirement could be delayed, the delayed retirement would be needed just to meet load growth, and the delayed retirement of other Entergy generating units would not provide a replacement for RBS's base-load generation. Therefore, delayed retirement is not considered a reasonable alternative.

#### 7.1.2.1.3 Conservation or Demand-Side Management

DSM includes energy efficiency programs, energy conservation, and demand response initiatives to reduce energy usage during peak demand periods. To be considered a reasonable alternative, a DSM alternative would need to reduce the base-load demand within Entergy Louisiana, LLC's service territory by 967 MWe, which is equivalent to the amount generated by RBS. To develop its IRP, Entergy reviewed deployment of a full range of existing and potentially deployable DSM programs across the residential, commercial, and industrial sectors served by Entergy. Entergy's portfolio for meeting the reference case demand scenario has 403 MW of the projected supply for 2025 stemming from DSM programs. The reference case demand scenario is one of four scenarios. It has the second-highest forecasted demand and assumes that the regional industrial renaissance will continue. Entergy's projected supply for this scenario assumes that RBS would continue to operate, with the DSM projection component a means of meeting demand in addition to RBS, not as a replacement. DSM projections were based on a "DSM Potential Study" that estimated the peak load, annual energy reduction, and program costs that result from a low reference and high level of spending on program incentives. (Entergy 2015j, Part 2 and Table 19) The DSM Potential Study projected a cumulative DSM savings high in 2025 of approximately 4 million megawatt hours (MWh) (ICF 2015, Slide 16) or 457 MWe.

The DSM potential within the Entergy Louisiana, LLC service area is not adequate for the replacement of RBS's generating capacity. The energy savings for 2025 were projected for three levels of implementation and funding, with all the projections falling short of what is needed for replacement of RBS's base-load generating capacity (ICF 2015, Slide 16). Therefore, DSM is not considered a reasonable alternative by itself. However, DSM is a component of the combination of alternatives included as a reasonable alternative for replacing RBS's base-load generation.

### 7.1.2.2 Alternatives Requiring New Generating Capacity

#### 7.1.2.2.1 Wind

The National Renewable Energy Laboratory (NREL) reviewed wind energy potential for Louisiana utilizing current and near-term commercial wind turbine technology. The results of NREL's review indicate that land area in Louisiana with the potential for wind resource development using current wind turbine technology of 110-meter hub height is 36,689 square kilometers, representing a capacity of 92,823 MW (NREL 2015). The potential for using wind to replace RBS's generating capacity exists, but for wind to be a replacement for a base-load generating facility such as RBS, it must provide equivalent power generation and provide energy storage to overcome the intermittency of the wind resource. Sandia National Laboratories recently prepared a handbook on energy storage for utility decisionmakers (Sandia 2015), which discusses the existing and emerging energy storage options for deployment to meet a range of energy storage needs. The handbook presents two existing technologies for bulk power management: pumped hydro and compressed air energy storage (CAES) (Sandia 2015, Sections 2.2, 2.3, and 2.4). Pumped hydro would have similar constraints and impacts to those discussed below in Section 7.1.2.2.3. CAES systems use off-peak electricity to compress air and store it in a reservoir, either an underground cavern or aboveground pipes or vessels. When electricity is needed, the compressed air is heated, expanded, and directed through an expander or conventional turbine-generator to produce electricity. Underground CAES storage systems have larger storage capacities than aboveground ones, up to 400 MW versus 3 to 50 MW. (Sandia 2015, Section 2.4) Louisiana has geologic formations such as salt caverns suitable for energy storage (USGS 1990). While a CAES system is an existing technology and Louisiana has geologic formations to serve as a large reservoir, only two other large-scale facilities are in operation, one in Alabama and another in Germany (Sandia 2015, Section 2.4).

The land use requirement for wind generation is 0.3 acres per MW (NRC 2013b, Section 4.2.2.3). The generating capacity factor for onshore wind facilities is 36 percent (EIA 2015a, Table 1); thus replacement of RBS's generating capacity would require 2,685 MW of generating capacity. The land required for wind generation at this scale would be approximately 806 acres.

During operations, migratory bird, eagle, other raptor, and bat mortalities are potential impacts 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. Concerns about the potential impacts of wind power deployment have led the USFWS to release voluntary guidance on siting wind energy facilities to avoid and minimize impacts to ecological resources. (USFWS 2012)

The environmental impacts of a large-scale wind farm are described in the GEIS (NRC 1996, Section 8.3.1; updated in NRC 2013b, Chapter 4). Impacts on aesthetics, land use, and terrestrial ecology from large-scale, land-based wind power facilities could range from SMALL to LARGE. For the potentially LARGE impacts of siting wind energy facilities on a large scale and the need for an energy storage system that provides adequate storage and capabilities to inject the stored energy into the grid, Entergy does not consider standalone wind power as a reasonable alternative to RBS license renewal, which is consistent with determinations made by the NRC in previous industry supplemental environmental impact statements such as those for Sequoyah, Fermi 2, and LaSalle nuclear power plants (NRC 2015b, Section 2.3.1; NRC 2016b, Section 2.3.3; NRC 2016c, Section 2.3.3).

NREL also reviewed the offshore wind energy potential for the United States and reported Louisiana's offshore wind potential to be 38,798 MW within 3 nautical miles of shoreline at wind speeds of 7.0 to 7.5 meters/second at a turbine height of 90 meters, with the potential increasing at distances of 3 to 12 and 12 to 50 nautical miles from shore (NREL 2014a). Using NREL data from 2011, the NRC determined Louisiana's offshore areas to have the lowest classification (fair) for potential wind energy development (NRC 2013b, Figure D.10-17). 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, and boating and yachting safety, due to the impacts from construction and maintenance (DOI 2009, Table E-1).

Therefore, given the offshore wind energy potential for Louisiana and the potential impacts that could result as discussed above, offshore wind as a replacement for RBS's base-load generation is not considered a reasonable alternative. Nonetheless, even if wind were considered to be reasonable, the impacts discussed above show that the impacts from wind (with or without CAES) would be higher than the impacts for renewal of the RBS license, summarized in Table 8.0-1, and therefore, wind (with or without CAES) would not be superior to continued operation of RBS.

#### 7.1.2.2.2 Solar Technologies: Photovoltaic Cells and Solar Thermal Power

Generation from solar power is available in two different technologies: concentrating solar power (CSP) and photovoltaic (PV). CSP requires direct solar radiation, but PV can make use of both direct solar radiation and diffuse horizontal radiation.

NREL estimates direct solar radiation for the majority of Louisiana is 4.0 to 4.5 kilowatt hours per square meter per day ($kWh/m^2/day$). For the coastline and New Orleans area, estimates are 4.5 to 5.0 $kWh/m^2/day$. (NREL 2012a) The premium viable level is 6.75 $kWh/m^2/day$ to facilitate overcoming significant economic barriers for the development of utility-scale CSP generating facilities (NREL 2012b, Appendix D). Such a level of direct solar radiation is not found in the Entergy Louisiana, LLC service territory (NREL 2012a). The PV solar resource for Louisiana and much of Entergy's territory is estimated by NREL to be higher, 5.0 to 5.5 $kWh/m^2/day$ (NREL 2012c).

A recent NREL study for the United States reviewed the amount of land required for utility-scale solar generation. The capacity-weighted average direct land use for large PV installations is 7.2 acres/MW and 7.7 acres/MW for CSP installations (NREL 2013, Table 8). These land use per MW factors substantially increase land requirements beyond those of other alternatives considered. Based on these factors, land use for a solar facility to replace RBS would require a 3,870-MW facility and approximately 27,900 to 29,800 acres of land. Depending on the location of the solar generation, this amount of land disturbance could result in MODERATE to LARGE impacts on affected resources (terrestrial habitat, land use, and aesthetic impacts).

Because CSP is a thermoelectric technology, like a fossil fuel-fired or nuclear power plant, a cooling system would be required. A CSP plant uses 1,000 gallons/MWh average, comparable with a nuclear plant with wet cooling towers, which uses 780 gallons/MWh (Meldrum et al. 2013). More recently, dry cooling technology using air cooling has been deployed (NREL 2014b). Thus, water consumption for cooling, as well as other water requirements for the CSP facility, would result in SMALL water use impacts.

Solar power is an intermittent power source because solar radiation is not available throughout the 24-hour day. Therefore, like a wind facility, a solar facility would need to be coupled with energy storage to overcome its inherent intermittency. The storage facility would further increase land requirements and other environmental impacts.

Given the relatively modest amount of solar radiation in Louisiana, increased land requirements for a utility-scale facility to provide replacement power, intermittency of the power source, need for energy storage, and a capacity factor of 20 to 25 percent when producing electricity from solar power versus RBS's capacity factor of 90 percent (EIA 2015a), solar is not considered a reasonable alternative for replacement of RBS's base-load generation. Nonetheless, even if solar were considered to be reasonable, the impacts discussed above show that the impacts from solar would be higher than the impacts for renewal of the RBS license, summarized in Table 8.0-1, and therefore, solar would not be superior to continued operation of RBS.

#### 7.1.2.2.3 Hydropower

Recent studies funded by the DOE reviewed the potential for new hydropower resources in the United States (ORNL 2012; ORNL 2014). The first study reviewed existing unpowered dams in the United States for their potential as hydropower sources. Louisiana was determined to have the potential for approximately 847 MW (ORNL 2012). Therefore, powering all the identified dams would not provide replacement generating capacity for RBS.

The second study reviewed the hydropower potential of undeveloped stream reaches. The median generating capacity of the undeveloped stream reaches in the LMR region is 3 MW in Louisiana, and southwest Mississippi has potential resources up to only the 10-MW range (ORNL 2014, Section 11.3). The downstream area of the LMR tends to be larger in flow but lower in hydraulic head, requiring low-head technology that is generally more expensive and less efficient (ORNL 2014, Section 11.1). For development of these streams, land would have to be inundated to provide water storage capacity, with the median inundation being 2,000 acres per stream (ORNL 2014, Section 11.3). Replacement of RBS's base-load generating capacity would therefore require flooding a substantial amount of land. Also, instream navigation is a more important function than hydropower in this region (ORNL 2014, Section 11.1). In addition, protected species are found in many of these streams (ORNL 2014, Section 11.4).

Due to the large land use requirements of undeveloped stream reaches to provide water storage capacity, as well as the development of transmission corridors for both unpowered existing dams and newly developed stream reaches, and related environmental and ecological resource impacts associated with siting hydroelectric facilities with cumulative capacity to replace RBS, it can be concluded that local hydropower alone is not a reasonable alternative to the renewal of the RBS OL. Any attempts to site hydroelectric facilities with cumulative capacity to replace RBS would result in LARGE environmental impacts.

#### 7.1.2.2.4 Geothermal

Geothermal energy facilities have demonstrated capacity factors of 90 to 98 percent, making geothermal energy clearly eligible as a source of base-load electric power (NRC 2013b, Section 2.3.3.2). However, as with other renewable energy technologies, the ultimate feasibility of geothermal energy serving as a base-load power replacement for RBS depends on the quality and accessibility of geothermal resources within or proximate to the region of interest—in this case, the Entergy Louisiana, LLC, or Southeast Electric Reliability Corporation region. Geothermal plants are most likely to be sited in the western continental United States, Alaska, and Hawaii, where hydrothermal reservoirs are prevalent (NRC 2013b, Section 2.3.3.2; NREL 2011, Figure 22). Therefore, geothermal resources are not considered a reasonable alternative for the replacement of RBS's base-load generation.

#### 7.1.2.2.5 Wood Waste

Use of wood waste as a fuel for generating electricity depends on supply volume and proximity to the site of the proposed project. The volume of the supply of fuel would be dependent on the volume of wood waste from lumber or other wood product production to avoid harvesting timber just for fuel. NREL profiled the supply of forest residue in the United States using 2012 data collected by the U.S. Forest Service. Specifically, NREL reported that most parishes or counties within a 50-mile radius of the RBS site have an annual supply ranging from 25,000 to 50,000 dry tonnes per year (55,125,000 to 110,250,000 pounds), with two having 50,000 to 100,000 dry tonnes per year (110,250,000 to 220,500,000 pounds) of forest residue (NREL 2014c). Based on 8,570 British thermal units (Btu)/pound (dry) (EPA 2007), this amount of forest residue would supply approximately 50 to 200 million Btu/hour, or an estimated 15 to 60 MW based on 3.41 Btu/hour per watt. It would require the total supply from many parishes or counties within a 50-mile radius of the RBS site to provide the feedstock for replacement power for RBS. The feedstock would also have to be sustained for 20 years to serve as a replacement alternative for RBS, which would result in ecological impacts due to large-scale timber harvesting. Like coal-fired plants, wood-waste plants also require large land areas for fuel storage and processing, and they involve the same type of combustion equipment. To replace the base-load generating capacity of RBS, several wood-waste plants would be required. Therefore, development of wood waste-fired plants is not considered a reasonable alternative as a replacement for RBS's base-load generation. However, biomass plants are a component of the combination alternative included as a reasonable alternative for replacing RBS's base-load generation.

7.1.2.2.6 Municipal Solid Waste

As with wood waste, MSW as a fuel is dependent on supply. The proximity of Louisiana's large cities of New Orleans and Baton Rouge provide the potential for a steady and sustainable supply of MSW.

Louisiana does not have any active MSW-fired generating plants. As of 2016, there are 77 waste-to-energy plants currently operating in the United States. These waste-to-energy plants have an aggregate generating capacity of 2,747 MWe, with the largest plant having a gross generating capacity of 224 MWe. (ERC 2016) More than four of the largest plants would be necessary to provide the same level of output as RBS.

The average air emission rates in the United States from MSW-fired generation are 1.2 pounds/MWh of $SO_2$ and 6.7 pounds/MWh of nitrogen oxides ($NO_x$) (EPA 2013). MSW combustion also results in approximately 1,016 pounds of carbon dioxide ($CO_2$) per MW. The toxins generated by MSW combustion facilities are tightly regulated by the Maximum Achievable Control Technology standards under the CAA, and a variety of air pollution control technologies are used to reduce toxic air pollutants from MSW-fired power plants. (EPA 2014)

The overall level of impact from construction of a waste-fired plant would be approximately the same as that for a coal-fired power plant. In addition, waste-fired plants have the same or greater operational impacts as coal-fired technologies (including impacts on the aquatic environment, air, and waste disposal). (NRC 2013d, Section 9.2.3.7)

Given the limitations in generating capacity due to supply, land use impacts, and operational air emission impacts, Entergy does not consider an MSW-fired plant a reasonable replacement alternative for RBS's base-load generation. However, biomass plants are a component of the combination alternative included as a reasonable alternative for replacing RBS's base-load generation.

7.1.2.2.7 Other Biomass-Derived Fuels

Biomass fuels other than wood and MSW include waste sources such as crop residue, methane from animal facilities and wastewater treatment facilities, and energy crops such as switchgrass cultivated and harvested for use as a biofuel. These energy sources have comparable or less energy content than wood waste. (EPA 2007)

The availability of annual crop residue in the parishes and counties within a 50-mile radius of RBS as reported by NREL (2014c) varies widely, from a low of less than 20 dry tonnes to greater than 300 dry tonnes. As with wood residue, the feedstock of multiple parishes/counties would be required. The feedstock would also have to be sustained for 20 years to serve as a replacement for RBS's base-load generation.

Generally, biomass-fueled facilities are small-scale facilities, and co-firing with other fuels such as coal is common. As with wood waste, many multiple biomass-fueled plants would be required to replace the generating capacity of RBS, resulting in impacts on land use and air quality as a result of HAP emissions. Therefore, development of biomass-derived, fuel-fired plants is not considered a reasonable replacement alternative for RBS's base-load generation. However, biomass plants are a component of the combination alternative included as a reasonable alternative for replacing RBS's base-load generation.

#### 7.1.2.2.8 Fuel Cells

Fuel cells as an alternative source for generating base-load electricity are not presently economically or technologically competitive with other alternatives. This non-competitiveness is due to various challenges, including the cost for commercial applications, the lack of reliability and durability of fuel cells, and the need for improvements in fuel processing systems to convert fuel such as natural gas to hydrogen (DOE 2014; DOE 2015). The Energy Information Administration (EIA) projects that fuel cells may cost $7,108 per installed kilowatt (total overnight capital costs, 2012 dollars), which is higher than most other technologies analyzed, and fuel cell units are generally small in scale (EIA's analysis was based on a 10-MWe model) (EIA 2013, page 6). The world's largest operating fuel cell plant, a 59-MWe plant located in South Korea, began operations in 2014 (National Geographic 2014). A 63.3-MW plant is planned for Beacon Falls, Connecticut (Hartford Courant 2015). RBS replacement generating capacity would require approximately 16 plants the size of the plant planned for Beacon Falls. It would be extremely costly to replace the base-load generation provided by RBS. Given the immature status of fuel cell technology and high cost, fuel cells are not considered a reasonable alternative for replacing RBS's base-load generating capacity.

#### 7.1.2.2.9 Oil

The variable costs of oil-fired generation tend to be greater than those of nuclear or coal-fired operations, and oil-fired generation tends to have greater environmental impacts than natural gas-fired generation. For example, in addition to $CO_2$ emissions, oil-fired generation would also emit HAPs. Based on existing and pending air emission regulations for HAPs (77 FR 9304) and $CO_2$, including carbon capture requirements (80 FR 64510), and the fact that oil-fired generation is one of the largest energy-related contributors to $CO_2$ emissions in the world, Entergy considers oil an unreasonable alternative to replace RBS's base-load generation, and does not consider it an environmentally preferred alternative.

#### 7.1.2.2.10 Ocean Wave and Current Energy

The Electric Power Research Institute assessed the potential for wave energy along the continental shelf of the United States and estimated the available wave energy resource for Louisiana to be 29 terrawatt hours per year along the outer shelf, and 19 terrawatt hours per year along the inner shelf (EPRI 2011, Table 4-6). There are modest wave energy resources available off the Gulf Coast. However, wave energy technology is still in the early stages of development. The potential for wave and ocean energy is limited because the Gulf of Mexico is shallow and semi-enclosed (TCPA 2008, Chapter 20). Because most technologies are relatively undeveloped (and none are developed on the scale of RBS), and because the Gulf of Mexico has limited potential for wave and ocean energy, Entergy does not consider wave and ocean energy as a reasonable alternative to the renewal of the RBS OL.

#### 7.1.2.2.11 Coal-Fired Integrated Gasification Combined-Cycle

IGCC is a technology for generating electricity with coal that combines modern coal gasification technology with both gas turbine and steam turbine power generation. Gasifiers, similar to those used in oil refineries, use heat pressure and steam to pyrolyze (thermally reform complex organic molecules without oxidation) coal to produce synthesis gases (generically referred to as syngas) typically composed of CO, hydrogen, and other flammable constituents. After processing to remove contaminants and produce various liquid chemicals, the syngas is combusted in a combustion turbine to produce electric power. Separating the $CO_2$ from the syngas before combustion is also possible. Latent heat is recovered both from the syngas as it exits the gasifier and from the combustion gases exiting the combustion turbine, and directed to a heat recovery steam generator feeding a conventional Rankine cycle steam turbine generator to produce additional amounts of electricity. Emissions of criteria pollutants would likely be slightly higher than those from the NGCC plant alternative, but significantly lower than those from the SCPC plant alternative. Depending on the gasification technology employed, an IGCC plant would use less water than an SCPC plant, but slightly more than an NGCC plant. Long-term maintenance costs of this relatively complex technology would likely be greater than those for a similarly sized SCPC or an NGCC plant. (NRC 2014c, Section 8.6.13)

Operating at higher thermal efficiencies than SCPC-fired boilers, IGCC plants can produce electrical power with fewer air pollutants and solid wastes than SCPC-fired boilers. Currently, there is an operating IGCC plant at Edwardsport, Indiana, and another is being constructed in Mississippi. IGCC technology may become more commonplace in the future due to potential environmental regulations mandating CCS systems as the best method of emission reduction. CCS is less expensive to operate with IGCC than SCPC, primarily because the $CO_2$ is separated from the syngas before combustion, whereas with SCPC, the $CO_2$ is separated after combustion (NRC 2014c, Section 8.6.13).

Based on Entergy's 2015 IRP, the IGCC plant was not evaluated as a resource alternative. The coal resource alternative evaluated in the IRP was an SCPC plant with carbon capture. (Entergy 2015j) Although Entergy acknowledges that air emissions from an IGCC plant would be less than those from an SCPC plant, and that there is an increased interest in IGCC, Entergy currently has no plans to include an IGCC plant in its long-term resource portfolio as this technology is not an economically attractive near-term option relative to gas-fired technology. Therefore, Entergy has dismissed this technology as a reasonable alternative to the renewal of the RBS OL.

### 7.1.3 Environmental Impacts of Alternatives

Each of the alternatives considered as reasonable (Section 7.1.1) are discussed below. To compare the environmental impacts of alternative electricity generation with the renewal of the RBS OL on an equal basis, Entergy set the existing approximate net average annual generating capacity of RBS, 967 MWe, as the approximate net electrical generating capacity that any reasonable alternative would need to supply. However, because some alternative technologies are manufactured in standard unit sizes, it was not always possible to aggregate such technologies to match RBS capacity exactly.

It must be emphasized, however, that all scenarios are hypothetical. Entergy has no current plans for new facility construction to replace RBS.

#### 7.1.3.1 Natural Gas-Fired Generation

As discussed in Section 7.1.1.1, the natural gas-fired alternative would be an NGCC plant, consisting of three combined-cycle, gas-fired units mated to a heat-recovery steam generator. Based on a capacity factor of 87 percent (EIA 2015a, Table 1), the three 400-MWe (gross) gas-fired units net capacity would be 1,044 MWe. The environmental impacts associated with constructing and operating the NGCC plant alternative based on the assumptions described in Section 7.1.1.1 are discussed below.

##### 7.1.3.1.1 Land Use and Visual Resources

Land Use

The entire RBS site is zoned for industrial use (M2—General Industry District) by West Feliciana Parish as discussed in Section 3.1.1. Approximately 24 acres of land would be required to construct the NGCC plant alternative based on the National Energy Technology Laboratory's (NETL's) scaling factor of 0.02 acres/MW (Entergy 2015q). Due to the acreage available on the RBS property, encroachment into wetlands from construction activities is not anticipated; therefore, there would be no associated impacts on wetlands.

The natural gas pipeline closest to the RBS site that has adequate supply to operate the NGCC plant alternative is the Texas Eastern Transmission Corporation/Spectra Energy pipeline, approximately 2 miles east of RBS on the same side of the Mississippi River (EOI 2008a, Section 2.2.1.7). Therefore, a new pipeline segment with an associated 100-foot-wide ROW connecting the site to the existing natural gas distribution infrastructure would be needed. However, locating a new pipeline within an existing ROW would minimize land use impacts. Because the NGCC plant alternative would be built at an existing power plant site on previously disturbed land and the potential exists that the new pipeline could be located within an existing ROW, construction-related impacts on land use are assumed to be SMALL.

In addition to onsite land requirements, offsite land is typically required for natural gas wells and collection stations during operations. The 1996 GEIS estimated that approximately 3,600 acres would be needed for wells, collection stations, and associated pipelines to support a 1,000-MWe gas-fired plant (NRC 1996, Section 8.3.10). Therefore, for the 1,200-MWe NGCC plant alternative, up to approximately 4,320 acres could be needed for the gas extraction and collection. Partially offsetting some, but not all, of these offsite land requirements, is the elimination of approximately 967 acres of uranium mining to supply fuel for RBS, estimated at approximately 1 acre per MWe (NRC 1996, Section 8.3.12). Overall, operations-related land use impacts from the NGCC plant alternative are anticipated to be SMALL.

Visual Resources

During construction, all clearing and excavation activities would not be visible off site because, as discussed in Section 3.1.3, a significant tree buffer around the RBS site blocks the site from view along US-61. Therefore, construction-related aesthetic impacts from the NGCC plant alternative would be SMALL.

During operations, the tallest structures at the NGCC plant alternative would include exhaust stacks and mechanical draft cooling towers. The associated condensate plumes from the mechanical draft cooling towers could potentially be visible off site. However, none of the NGCC plant structures are anticipated to be visible off site due to the presence of a significant tree buffer around the site. Therefore, operations-related aesthetic impacts from the NGCC plant alternative would be SMALL.

#### 7.1.3.1.2 Air Quality

Construction of the NGCC plant alternative would result in the release of various criteria pollutants such as CO, $NO_x$, sulfur oxides ($SO_x$), particulate matter, and volatile organic compounds (VOCs), as well as various GHGs from the operation of internal combustion engines in construction vehicles, equipment, delivery vehicles, and vehicles used by the commuting construction workforce. VOC releases would also result from the onsite storage and dispensing of vehicle and equipment fuels.

Onsite activities would also generate fugitive dust. These impacts would be intermittent and short-lived, however, and adherence to well-developed and well-understood construction BMPs, such as the development and execution of a fugitive dust control plan, would mitigate such impacts.

Air emissions would be intermittent and vary based on the level and duration of a specific activity throughout the construction phase. Gas-fired power plants are constructed relatively quickly; construction lead times for NGCC plants are approximately 2 to 3 years (NRC 2015b, Section 4.3.3.1). Therefore, construction-related impacts on air quality from the NGCC plant alternative would be of relatively short duration and SMALL.

During operations, the NGCC plant would be equipped with air pollution controls to ensure compliance with air quality regulations, minimizing emissions of criteria air pollutants. The facility would consume approximately 81.4 billion cubic feet of natural gas annually (Table 7.1-1).

Emission estimates for the NGCC plant alternative, based on EPA emission factors, are shown in Table 7.1-1.

A new NGCC plant would qualify as a major emitter and be subject to a new source review under requirements of the CAA to ensure air emissions are minimized and the local air quality is not substantially degraded. The NGCC plant would need to comply with the standards of performance for stationary combustion turbines set forth in 40 CFR Part 60, Subpart KKKK. (NRC 2015b, Section 4.3.3.1)

Subpart P of 40 CFR 51.307 contains the visibility protection regulatory requirements, including review of new sources that may affect visibility in any federal Class I area. If the NGCC plant alternative were located near a mandatory Class I area, additional air pollution control requirements would be required. (NRC 2015b, Section 4.3.3.1) However, because the nearest federal Class 1 area is 154 miles east-southeast of the RBS site, as discussed in Section 3.2.4, RBS is beyond the 62-mile requirement to contact federal land managers for the operation of any new major stationary source, and these regulatory requirements would not apply to the NGCC plant alternative.

A new NGCC plant would also have to comply with Title IV of the CAA [42 USC 7651] reduction requirements for $SO_x$ and $NO_x$, which are the main precursors of acid rain and the major causes of reduced visibility. Title IV establishes maximum $SO_x$ and $NO_x$ emission rates from the existing plants and a system of $SO_x$ emission allowances that can be used, sold, or saved for future use by new plants. (NRC 2015b, Section 4.3.3.1)

More recently, the EPA has promulgated additional rules and requirements that apply to certain fossil-fuel-based power plants, such as NGCC generation. The Clean Air Interstate Rule and the Title V GHG Tailoring Rule impose several additional standards to limit ozone, particulate, and GHG emissions from fossil-fuel-based power plants. (NRC 2015b, Section 4.3.3.1) Furthermore, the NGCC alternative would be subject to $CO_2$ emission performance rate standards set forth in the Clean Power Plan aimed at reducing carbon pollution from power plants (80 FR 64662).

As noted above, a new NGCC plant would be subject to several EPA regulations designed to minimize air quality impacts from operations. Nevertheless, a new NGCC plant would be a major source of criteria pollutants and GHGs. Therefore, the overall operations-related impacts on air quality from the NGCC plant alternative could range from SMALL to MODERATE.

#### 7.1.3.1.3 Noise

During construction, noise would increase with the operation of vehicles, earthmoving equipment, materials-handling equipment, impact equipment, other stationary equipment (such as pumps and compressors), and the increase in human activity. The site on which the NGCC plant alternative would be constructed has been zoned for industrial use, As discussed in Section 7.1.3.1.1. As discussed in Section 3.0.3, the sensitive receptor closest to RBS is a residence located approximately 0.8 miles to the northwest, and as shown in Table 3.0-1, the parks nearest to RBS are approximately 3 miles north-northeast, west-northwest, and northwest. Because noise activities associated with construction are intermittent and last only through the duration of construction, construction-related noise impacts from the NGCC plant alternative are anticipated to be effectively managed and kept SMALL.

Noise impacts from operations would include cooling towers (water pumps, cascading water, or fans), transformers, turbines, pumps, compressors, exhaust stack, the combustion inlet filter house, condenser fans, high-pressure steam piping, and vehicles. Entergy does not expect noise impacts from the operation of an NGCC plant alternative to be any greater than those currently associated with RBS, because the site is zoned for industrial use, the closest residence is approximately 0.8 miles northwest, and the parks nearest to RBS are approximately 3 miles north-northeast, west-northwest, and northwest. Therefore, operations-related noise impacts from the NGCC plant alternative are anticipated to be SMALL.

#### 7.1.3.1.4 Geology and Soils

During construction, sources of aggregate material, such as crushed stone, sand, and gravel, would be required to construct buildings, foundations, roads, and parking lots. It is presumed that these resources would likely be obtained from commercial suppliers using local or regional sources. Land clearing during construction, the installation of power plant structures and impervious surfaces, and a new natural gas pipeline would expose soils to erosion and alter surface drainage. However, any ground disturbance of one or more acres would require a construction stormwater permit from the LDEQ. The construction stormwater permit specifies BMPs to reduce erosion caused by stormwater runoff, thereby minimizing the risk of pollution from soil erosion and sediment, and potentially from other pollutants the stormwater may contact. Removed soils and any excavated materials would be stored on site for redistribution as backfill at the end of construction. Construction activities would be temporary and localized. Therefore, construction-related impacts from the NGCC plant alternative on geology and soils would be minimized and SMALL.

Land disturbance during operations would be conducted in accordance with applicable permits, site procedures, and plans. The NGCC plant alternative would have to comply with stormwater permitting requirements to develop and maintain a SWPPP. The SWPPP would identify potential sources of pollution reasonably expected to affect the quality of stormwater, such as erosion, and identify BMPs to prevent or reduce the pollutants in stormwater discharges. Therefore, operations-related impacts on geology and soils from the NGCC plant alternative would also be SMALL.

#### 7.1.3.1.5 Hydrology (Surface Water and Groundwater)

Surface Water

Entergy assumes that there would be no direct use of surface water during construction.

For the NGCC plant alternative, Entergy assumes that RBS's existing intake and discharge infrastructure at the RBS property would be modified to maximize use of existing facilities. This would reduce construction-related impacts on surface water quality. Dredge-and-fill operations, if needed, would be conducted under a USACE permit and equivalent state permits requiring the implementation of BMPs to minimize impacts. Construction activities associated with this alternative would alter onsite surface water drainage features. Some temporary impacts on surface water quality may result from increased sediment loading and any pollutants in stormwater runoff from disturbed areas, excavation, and dredge-and-fill activities. Stormwater runoff from construction areas, as well as spills and leaks from construction equipment, could potentially affect downstream surface water quality. Nevertheless, for this alternative, appropriate soil erosion and sediment control measures would be observed. Application of BMPs in accordance with an LDEQ stormwater construction permit, including appropriate waste management, a SWPPP, and spill prevention practices, would prevent or minimize surface water quality impacts during construction. Therefore, construction-related impacts on surface water use and quality from the NGCC plant alternative are anticipated to be SMALL.

Depending on the path of any required new gas pipelines to service the NGCC plant alternative, some stream crossings could be necessary. However, because of the short-term nature of any required dredge-and-fill and stream-crossing activities, the hydrologic alterations and sedimentation would be localized, and water-quality impacts would be temporary. In addition, modern pipeline construction techniques, such as horizontal directional drilling, would further minimize the potential for water-quality impacts on the affected streams. Such activities, including any dredge-and-fill operations, would be conducted under a USACE permit and equivalent state permits for dredge-and-fill and stream encroachment, requiring the implementation of BMPs to minimize impacts. Therefore, construction-related impacts on surface water use and quality as a result of new gas pipelines are anticipated to be SMALL.

During operations, the NGCC plant alternative would use mechanical draft cooling towers with makeup water supplied by the Mississippi River. Water withdrawals would be similar to those required by RBS's closed-cycle cooling system and therefore constitute impacts similar to the continued operation of RBS, as discussed in Section 4.5.1.1.3. Cooling water treatment additives and effluent discharges would also essentially be the same as those for RBS and would be regulated under an LPDES permit to protect water quality. Therefore, operations-related impacts on surface water use and quality from the NGCC plant alternative would be SMALL.

Groundwater

Entergy assumes that water for potable and sanitary uses during construction would be provided by the West Feliciana Parish Consolidated Water District No. 13 water supply system, whose source is groundwater. Water for concrete production, equipment washdown, dust suppression, and soil compaction is assumed to be provided by RBS's onsite wells described in Section 3.5.3.2.

Groundwater could be affected by runoff that could contain contaminants; however, compliance with appropriate waste management practices, construction stormwater permit and pollution prevention requirements, and spill prevention practices would prevent or minimize such adverse impacts. Therefore, construction-related impacts on groundwater use and quality from the NGCC plant alternative would be SMALL.

During operations, it is assumed that the West Feliciana Parish Consolidated Water District No. 13 water supply system would continue to supply potable water. Although minor amounts of domestic water for plant operations may be provided by RBS's onsite wells described in Section 3.5.3.2, the majority of water for plant operations would be provided by the Mississippi River. Impacts to groundwater quality are anticipated to be prevented or minimized through appropriate waste management, stormwater management, and spill prevention practices. Therefore, operations-related impacts on groundwater use and quality from the NGCC plant alternative would be SMALL.

#### 7.1.3.1.6 Ecological Resources (Aquatic and Terrestrial)

Aquatic

Impacts on aquatic ecosystems during construction would be minimal, due to the relatively small amount of water required and controls on the quality of surface water discharges imposed by a construction stormwater permit and USACE permit. The construction stormwater permit would contain control measures to minimize the flow of disturbed soils into aquatic features while the USACE permit would require BMPs for in-water work to minimize sedimentation and erosion. Therefore, construction-related impacts on aquatic ecological resources from the NGCC plant alternative are anticipated to be SMALL.

During operations, water withdrawals from the Mississippi River for the NGCC plant alternative would be similar to RBS (Section 3.5.3.1). Therefore, the number of fish and other aquatic resources affected by cooling-water intake and discharge operations (i.e., affected by entrainment, impingement, and thermal stress) would be minimal. In addition, the cooling system for the NGCC plant alternative would have similar chemical discharges as RBS which would be regulated by an LPDES permit (Section 3.5.1.1.1). Therefore, operations-related impacts on aquatic ecological resources from the NGCC plant alternative are anticipated to be SMALL.

Terrestrial

Terrestrial ecology impacts from construction of the NGCC plant alternative would primarily occur from land disturbance. As discussed in Section 7.1.3.1.1, the NGCC plant alternative would require approximately 24 acres of land on site. The site has available acreage that is already disturbed and would not encroach on the wetlands of the site. Furthermore, the site is zoned for industrial use (M2—General Industry District) by West Feliciana Parish.

Up to approximately 4,320 acres could be needed for wells, collection stations, and associated pipelines to support the 1,200-MWe NGCC plant alternative. This construction would likely occur on land where gas extraction is occurring already. Siting any new gas pipelines or transmission lines along existing utility corridors would minimize impacts. Erosion and sedimentation, fugitive dust, and construction debris impacts would be minor with implementation of appropriate BMPs.

Plant communities in the proposed construction footprint would be cleared to accommodate the new plant site and gas pipeline, and wildlife would relocate by their own means. Erosion and sedimentation, fugitive dust, and construction debris impacts would be minor with implementation of appropriate BMPs. Disturbed areas would be revegetated with native and non-invasive flora species, as appropriate. Therefore, construction-related impacts on terrestrial resources from the NGCC plant alternative are anticipated to be SMALL.

The impacts on terrestrial resources from operation of the NGCC plant alternative would be similar to the continued operation of RBS. Operation of the cooling towers would cause some deposition of dissolved solids on surrounding vegetation and soil from cooling tower drift. Other impacts such as fogging and shadowing, etc., would also occur. Cooling tower operational noise could also impact terrestrial wildlife, and there is the potential for bird collisions. However, these impacts would be similar to existing nuclear plants with cooling towers, which the NRC determined in the GEIS to be SMALL (NRC 2013b, Table 2.1-1). Therefore, overall operations-related impacts on terrestrial resources under the NGCC plant alternative are anticipated to be SMALL.

Special Status Species

Unlike the proposed action, no-action alternative, and new nuclear alternative, the NRC does not license NGCC facilities, and the NRC would not be responsible for initiating Section 7 consultation if listed species or habitats might be adversely affected under this alternative. The facilities themselves would be responsible for protecting listed species because the ESA forbids the taking of a listed species.

However, as discussed above, the site has available acreage already disturbed to support construction of the NGCC plant alternative. In addition, construction activities associated with the new gas pipeline would be subject to LDEQ construction stormwater permitting requirements, which would consider protection of special status species and associated designated habitats. Operational impacts to special status species are anticipated to be similar to that of RBS, which were determined to have no effect as discussed in Section 4.6.3. Therefore, construction- and operations-related impacts on special status species from the NGCC plant alternative would have no effect.

#### 7.1.3.1.7 Historic and Cultural Resources

As discussed in Section 7.1.3.1.1, the NGCC plant alternative would require approximately 24 acres of land on the RBS property, and the site has available acreage that is already disturbed.

The cultural resources on site and in the vicinity are detailed in Section 3.7. As discussed in Section 3.7, none of the properties on the RBS site are listed on the NRHP, nor have any been determined to be eligible for inclusion on the NRHP. Only three of the sites have been examined sufficiently to determine their NRHP eligibility, with at least two of these sites likely containing *in situ* archaeological deposits: the Magnolia Plantation Sugarhouse (16WF36) and Cottonmouth Mound (16WF61). However, because portions of the RBS site have already been previously identified as not containing significant historic and cultural resources, use of these areas for an NGCC plant alternative would have no adverse effect on historic and cultural resources.

The NGCC plant alternative could also require up to approximately 4,320 acres for wells, collection stations, and associated pipelines as discussed in Section 7.1.3.1.1. The new gas pipeline to connect the NGCC plant alternative to the gas infrastructure could be located within an existing ROW, or if not located within an existing ROW, the area could be surveyed to identify and record historic and cultural resources.

Given that the preference is to use previously surveyed and/or disturbed areas, avoidance of significant historic and cultural resources should be possible and effectively managed under current laws and regulations. Therefore, the construction and operational impacts on historic and cultural resources from the NGCC plant alternative are projected to have no adverse effect.

7.1.3.1.8 Socioeconomics

<u>Socioeconomic Issues Other than Transportation</u>

Scaling from the NRC's 1996 GEIS (NRC 1996, Table 8.1) estimate of 1,200 workers needed to construct a 1,000-MWe natural gas plant, the NGCC plant alternative would have a peak construction workforce of approximately 1,440. Given the proximity of New Orleans and Baton Rouge, the majority of a construction workforce would be expected to reside within the region. It is expected that the remainder of the construction-related workforce would in-migrate from outside the region in the same residential distribution as the current RBS workforce. It is not expected that many in-migrating construction workers would permanently relocate to the region, so any socioeconomic effect induced by the in-migrating workers would be temporary. Therefore, construction-related socioeconomics impacts from the NGCC plant alternative are anticipated to be SMALL.

Scaling from the 1996 GEIS (NRC 1996, Table 8.2) estimate of 150 workers needed for operation of a 1,000-MWe natural gas plant, the operations workforce under the NGCC plant alternative would be approximately 180, significantly smaller than the RBS operations workforce. The NGCC plant alternative workforce would continue to contribute beneficial socioeconomic impacts in the area albeit on a smaller scale as compared to RBS's current contribution and, as a smaller workforce, would have less of a demand for community services.

This alternative would also result in a loss of approximately 680 relatively high-paying jobs at RBS and a corresponding reduction in purchasing activity and revenue contributions to the regional economy. Should RBS cease operations, there would be an immediate socioeconomic impact to local communities and businesses from the loss of jobs (some, but not all, of the 680 employees would begin to leave), and tax payments may be reduced. In addition, the housing market could experience increased vacancies and decreased prices if operations workers and their families move out of the region. The impact of the job loss, however, may not be noticeable in local communities given the amount of time required for decommissioning the existing RBS facilities. Based on this information and given the number of operations workers, socioeconomic impacts during NGCC power plant operations on local communities could range from SMALL to MODERATE.

Transportation

Transportation impacts associated with construction and operation of the NGCC plant alternative would consist of commuting workers and truck deliveries of construction materials to the RBS site. During periods of peak construction activity, up to 1,440 workers could be commuting daily to the construction site. In addition to commuting workers, trucks would be transporting construction materials and equipment to the work site, thus increasing the amount of traffic on local roads. The increase in vehicular traffic would peak during shift changes, resulting in temporary levels of service impacts and delays at intersections. Pipeline construction and modification of existing natural gas pipeline systems could also have a temporary impact. Larger components for the NGCC plant would most likely arrive by barge, which would avoid potential traffic congestion and stoppages for transport of large components. The traffic capacity of these roads and the ability to stagger workforce shifts, if needed, would minimize traffic congestion; however, the construction-related impacts from the NGCC plant alternative could still be MODERATE.

Traffic-related transportation impacts would be greatly reduced after construction of the NGCC plant. Transportation impacts would include daily commuting by the operating workforce, equipment and materials deliveries, and the removal of commercial waste material to offsite disposal or recycling facilities by truck. The operations workforce of approximately 180 likely would not be noticeable relative to total traffic volumes on local roadways. Because fuel is transported by pipeline, the transportation infrastructure would experience little to no increased traffic from plant operations. Overall, given the relatively small operations workforce, operations-related transportation impacts from the NGCC plant alternative would be SMALL.

#### 7.1.3.1.9 Human Health

Impacts on human health from construction of the NGCC plant alternative, including the construction of a new gas pipeline, would be similar to effects associated with the construction of any major industrial facility. Compliance with OSHA worker protection rules would control those impacts on workers at acceptable levels. The radiological human health impact on construction workers due to the proximity of RBS still operating at that time would also be SMALL due to compliance with NRC regulations and adherence to ALARA principles. The NRC reviewed radiation exposures to workers in its license renewal GEIS and found the impacts to be SMALL (NRC 2013b, Table 2.1-1). Impacts on the general public from construction would be minimal because crews would limit access to active construction areas to authorized individuals. Therefore, construction-related impacts on human health from the NGCC plant alternative would be SMALL.

During the operations period, the NGCC plant alternative would emit criteria air pollutants (Table 7.1-1). The risk may be attributable to $NO_X$ emissions that contribute to ozone formation, which in turn contribute to health risk. Regulatory agencies, including the EPA and state agencies, base air emission standards and requirements on human health impacts. These agencies also impose site-specific emission limits as needed to protect human health. Given the regulatory oversight exercised by the EPA and state agencies, human health impacts from criteria air pollutant emissions under the NGCC plant alternative would be minimal. Operations would also be conducted in accordance with OSHA worker protection rules, minimizing exposures and hazards. Therefore, operations-related impacts on human health from the NGCC plant alternative would be SMALL.

#### 7.1.3.1.10 Environmental Justice

Potential impacts on minority and low-income populations from the construction of the NGCC plant alternative would mostly consist of environmental and socioeconomic effects (e.g., noise, dust, traffic, employment, and housing impacts). Noise and dust impacts during construction would be short term and managed to limit offsite impacts. Minority and low-income populations residing along site access roads would be directly affected by increased commuter vehicle and truck traffic. However, because of the temporary nature of construction, these effects are not likely to be high and adverse, and would be confined to a limited time period during certain hours of the day.

Increased demand for rental housing during construction could cause rental costs to rise disproportionately, affecting low-income populations residing in the vicinity of the RBS site who rely on inexpensive housing. However, given the proximity of the New Orleans and Baton Rouge metropolitan areas, and their volume of temporary and permanent housing, any upward pressure on housing expenses would not be expected to be disproportionately felt within minority or low-income populations.

Minority and low-income populations living in close proximity to the NGCC power generating facility could be disproportionately affected by emissions associated with plant operations. However, because emissions are expected to remain within regulatory standards, impacts from emissions are not expected to be high and adverse.

Based on this information and the analysis of human health and environmental impacts presented in Section 7.1.3.1 of this ER, the construction and operation of the NGCC plant alternative would not have disproportionately high and adverse human health and environmental effects on minority and low-income populations residing in the vicinity of the RBS site.

#### 7.1.3.1.11 Waste Management

Sanitary wastes resulting from the support of the construction crew and industrial wastes (some hazardous) would be generated during construction. Construction-related wastes are expected to be properly characterized and initially managed on site, and eventually removed to properly permitted offsite treatment or disposal facilities. Waste impacts from construction are expected to be SMALL.

During operation of the NGCC plant alternative, spent SCR catalysts used to control $NO_x$ emissions would make up the majority of the waste. Wastes generated during operations would be properly managed and disposed of as hazardous or nonhazardous waste in permitted offsite facilities. Recycling and waste minimization programs such as those at RBS would also be implemented as appropriate. Therefore, waste management impacts during operations from the NGCC plant alternative are anticipated to be SMALL.

### 7.1.3.2 Coal-Fired Generation

As discussed in Section 7.1.1.2, the coal-fired plant alternative would be composed of two ultra-supercritical coal-fired boilers. Based on a capacity factor of 85 percent (EIA 2015a, Table 1), the two 600-MWe (gross) units total net capacity would be 1,020 MWe. The environmental impacts associated with constructing and operating the SCPC plant alternative, based on the assumptions described in Section 7.1.1.2, are discussed below.

#### 7.1.3.2.1 Land Use and Visual Resources

Land Use

The entire RBS site is zoned for industrial use (M2—General Industry District) by West Feliciana Parish, as discussed in Section 3.1.1. Approximately 60 acres of land would be required to construct the SCPC plant alternative based on NETL's scaling factor of 0.05 acres/MW (Entergy 2015q). Due to the acreage available on the RBS property, encroachment into wetlands from construction activities is not anticipated; therefore, there would be no associated impacts. As discussed in Section 7.1.1.2, the Mississippi River would be utilized for supporting coal deliveries to the SCPC plant alternative, requiring only the development of an unloading dock at the river. Because the SCPC plant alternative would be built at an existing power plant site on previously disturbed land, construction-related impacts on land use under the SCPC plant alternative would be SMALL.

In its 1996 GEIS, the NRC estimated that approximately 22,000 acres would be needed for coal mining and waste disposal to support a 1,000-MWe plant during its operational life (NRC 1996, Section 8.3.9). Therefore, for a 1,200-MWe SCPC plant alternative, approximately 26,400 acres could be needed to support the plant for its lifetime. However, more recent impacts analysis for coal mining, based on limited case studies, indicates much less land would be transformed to support mining. An NETL (2010) study of the life-cycle cost of coal mining found the required feedstock of coal would result in land use impacts of approximately 3,720 acres (Entergy 2015q). Much of this land is assumed to already experience some level of disturbance, because the land use would likely occur in existing coal mining areas. The elimination of approximately 967 acres of uranium mining to supply fuel for RBS, estimated at approximately 1 acre per MWe (NRC 1996, Section 8.3.12), would offset some of these offsite land requirements. However, because the amount of land required for coal mining and processing could range from 3,720 to 26,400 acres, land use impacts during operations from the SCPC plant alternative are anticipated to range from SMALL to MODERATE.

Visual Resources

During construction, all clearing and excavation activities would not be visible off site because as discussed in Section 3.1.3, a significant tree buffer blocks any view of the RBS site from US- 61. Therefore, construction-related aesthetic impacts from the SCPC plant alternative would be SMALL.

The SCPC plant could be approximately 100 feet tall, with two to four exhaust stacks several hundred feet tall, and mechanical draft cooling towers. The associated condensate plumes from the mechanical draft cooling towers could potentially be visible off site. However, none of the SCPC plant structures are anticipated to be visible off site due to the presence of a significant tree buffer around the site. Therefore, operations-related aesthetic impacts from the SCPC plant alternative would be SMALL.

7.1.3.2.2 Air Quality

Construction of the SCPC plant would result in the release of various criteria pollutants and GHGs from the operation of internal combustion engines in construction vehicles, equipment, delivery vehicles, and vehicles used by the commuting construction workforce. VOC releases would also result from the onsite storage and dispensing of vehicle and equipment fuels.

Onsite activities would also generate fugitive dust. These impacts would be intermittent and short-lived, however, and adherence to well-developed and well-understood construction BMPs (e.g., development and execution of an appropriate fugitive dust control plan) would mitigate such impacts.

Construction lead times for coal plants are around 5 years (NRC 2015b, Section 4.3.4.1). Given that construction-related impacts on air quality from a coal-fired alternative would be of relatively short duration, impacts on air quality from the SCPC plant alternative are anticipated to be SMALL.

Air quality impacts associated with the operation of coal-fired generation are considerably different from those of nuclear power. SCPC plants emit $SO_x$, $NO_x$, particulate matter, and CO, all of which are regulated pollutants. The facility would consume approximately 6.7 million tons of coal annually (Table 7.1-2). Emission estimates for the SCPC plant alternative are provided in Table 7.1-2. Emission control technology and percent control assumptions were based on alternatives the EPA has identified as being available for minimizing emissions.

A new SCPC plant would qualify as a major emitter and would be subject to a new source review under requirements of the CAA to ensure air emissions are minimized and the local air quality is not substantially degraded. The SCPC plant would need to comply with the standards of performance for electric utility steam generating units set forth in 40 CFR Part 60, Subpart Da. (NRC 2015b, Section 4.3.4.1)

Subpart P of 40 CFR 51.307 contains the visibility protection regulatory requirements, including review of the new sources that may affect visibility in any federal Class I area. If the SCPC alternative were located near a mandatory Class I area, additional air pollution control would be required. (NRC 2015b, Section 4.3.4.1) However, because the nearest federal Class 1 area is 154 miles east-southeast of the RBS site, as discussed in Section 3.2.4, RBS is beyond the 62-mile requirement to contact federal land managers for the operation of any new major stationary source, and these regulatory requirements would not apply to the SCPC plant.

A new SCPC plant would also have to comply with CAA [42 USC 7651] Title IV reduction requirements for $SO_x$ and $NO_x$, which are the main precursors of acid rain and the major causes of reduced visibility. Title IV establishes maximum $SO_x$ and $NO_x$ emission rates from existing plants and a system of $SO_x$ emission allowances that can be used, sold, or saved for future use by new plants. (NRC 2015b, Section 4.3.4.1)

More recently, the EPA has promulgated additional rules and requirements that apply to certain fossil-fuel-based power plants, such as SCPC generation. The Clean Air Interstate Rule, the mercury and air toxics standards, and the Title V GHG Tailoring Rule impose several additional standards to limit ozone, particulate, mercury, $SO_x$, and GHG emissions from fossil-fuel-based power plants. (NRC 2015b, Section 4.3.4.1) Furthermore, the SCPC alternative would be subject to $CO_2$ emission performance rate standards set forth in the Clean Power Plan aimed at reducing carbon pollution from power plants (80 FR 64662).

$CO_2$ emissions are a major contributor to anthropogenic GHG emissions, which have 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. 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 electricity generation. As mentioned in Section 7.1.1.2, the SCPC plant alternative provides for carbon sequestration as proposed by EPA regulations (80 FR 64510). The proposed regulations require partial carbon capture sequestration technology operating to a level of 1,100 pounds $CO_2$/MWh.

As noted above, a new SCPC plant would be subject to several EPA regulations designed to minimize air quality impacts from operations. Nevertheless, a new SCPC plant would be a major source of criteria pollutants and GHGs, and the overall operational air quality impacts from the SCPC plant alternative would be MODERATE.

#### 7.1.3.2.3 Noise

During construction, noise would increase with the operation of vehicles, earthmoving equipment, materials-handling equipment, impact equipment, other stationary equipment (such as pumps and compressors), and the increase in human activity. The site on which the SCPC plant alternative would be constructed has been zoned for industrial use, as discussed in Section

3.1.1. As discussed in Section 3.0.3, the sensitive receptor closest to RBS is a residence located approximately 0.8 miles to the northwest, and as shown in Table 3.0-1, the parks nearest to RBS are approximately 3 miles north-northeast, west-northwest, and northwest. Because noise activities associated with construction are intermittent and last only through the duration of construction, construction-related noise impacts from the SCPC plant alternative are anticipated to be effectively managed and kept SMALL.

During operations, the SCPC plant alternative would introduce mechanical sources of noise. Sources contributing to the noise produced by plant operation are classified as continuous or intermittent. Continuous sources include the mechanical equipment associated with normal plant operations and mechanical draft cooling towers. Intermittent sources include the equipment related to coal and ash handling which, although intermittent, occur daily both during daylight and nighttime hours; use of outside loudspeakers; and the commuting of plant employees. However, Entergy does not expect noise impacts from the operation of the SCPC plant alternative to be any greater than those currently associated with RBS, because the site is zoned for industrial use, the closest residence is approximately 0.8 miles northwest, and the parks nearest to RBS are approximately 3 miles north-northeast, west-northwest, and northwest. Therefore, operations-related noise impacts from the SCPC plant alternative are anticipated to be SMALL.

#### 7.1.3.2.4 Geology and Soils

During construction, sources of aggregate material, such as crushed stone, sand, and gravel would be required to construct buildings, foundations, roads, and parking lots. It is presumed that these resources would likely be obtained from commercial suppliers using local or regional sources. Land clearing during construction and the installation of power plant structures and impervious surfaces would expose soils to erosion and alter surface drainage. However, any ground disturbance of one or more acres would require that a construction stormwater permit be obtained from the LDEQ. The construction stormwater permit specifies BMPs to reduce erosion caused by stormwater runoff, thereby minimizing the risk of pollution from soil erosion, sediment, and potentially from other pollutants that the stormwater may contact. Removed soils and any excavated materials would be stored on site for redistribution as backfill at the end of construction. Construction activities would be temporary and localized. Therefore, construction-related impacts from the SCPC plant alternative on geology and soils would be minimized and SMALL.

Land disturbance during operations would be conducted in accordance with applicable permits and site procedures and plans. The SCPC plant alternative would also have to comply with stormwater permitting requirements to develop and maintain a SWPPP. The SWPPP would identify potential sources of pollution reasonably expected to affect the quality of stormwater, such as erosion, and identify BMPs to prevent or reduce the pollutants in stormwater discharges. Therefore, operations-related impacts on geology and soils from the SCPC plant alternative would also be SMALL.

#### 7.1.3.2.5 Hydrology (Surface Water and Groundwater)

Surface Water

Entergy assumes that there would be no direct use of surface water during construction.

For the SCPC alternative, Entergy assumes that RBS's existing intake and discharge infrastructure at the RBS property would be modified to maximize use of existing facilities. This would reduce construction-related impacts on surface water quality. Dredge-and-fill operations, if needed, would be conducted under a USACE permit and equivalent state permits requiring the implementation of BMPs to minimize impacts. Construction activities associated with this alternative would alter onsite surface water drainage features. Some temporary impacts on surface water quality may result from increased sediment loading and from any pollutants in stormwater runoff from disturbed areas, excavation, and dredge-and-fill activities. Stormwater runoff from construction areas, as well as spills and leaks from construction equipment, could potentially affect downstream surface water quality. Nevertheless, for this alternative, appropriate soil erosion and sediment control measures would be observed. Application of BMPs in accordance with an LDEQ stormwater construction permit, including appropriate waste management, a SWPPP, and spill prevention practices, would prevent or minimize surface water quality impacts during construction. Therefore, construction-related impacts on surface water use and quality from the SCPC plant alternative are anticipated to be SMALL.

During operations, the SCPC plant alternative would use mechanical draft cooling towers with makeup water supplied by the Mississippi River. Water withdrawals would be similar to those required by RBS's closed-cycle cooling system and therefore constitute impacts similar to the continued operation of RBS, as discussed in Section 4.5.1.1.3. Cooling water treatment additives and effluent discharges would also essentially be the same as those for RBS and would be regulated under an LPDES permit to protect water quality. Therefore, operations-related impacts on surface water use and quality from the SCPC plant alternative would be SMALL.

Groundwater

Entergy assumes that water for potable and sanitary uses during construction would be provided by the West Feliciana Parish Consolidated Water District No. 13 water supply system, whose source is groundwater. Water for concrete production, equipment washdown, dust suppression, and soil compaction is assumed to be provided by RBS's onsite wells described in Section 3.5.3.2.

Groundwater could be affected by runoff that could contain contaminants; however, compliance with appropriate waste management practices, construction stormwater permit and pollution prevention requirements, and spill prevention practices would prevent or minimize such adverse impacts. Therefore, construction-related impacts on groundwater use and quality under the SCPC plant alternative would be SMALL.

During operations, it is assumed that the West Feliciana Parish Consolidated Water District No. 13 water supply system would continue to supply potable water. Although minor amounts of domestic water for plant operations may be provided by RBS's onsite wells described in Section 3.5.3.2, the majority of water for plant operations would be provided by the Mississippi River. Impacts to groundwater quality are anticipated to be prevented or minimized through appropriate waste management, stormwater management, and spill prevention practices. Therefore, operations-related impacts on groundwater use and quality from the SCPC plant alternative would be SMALL.

#### 7.1.3.2.6 Ecological Resources (Aquatic and Terrestrial)

Aquatic

Impacts on aquatic ecosystems during construction would be minimal, due to the relatively small amount of water required and controls on the quality of surface water discharges imposed by a construction stormwater permit and USACE permit. The construction stormwater permit would contain control measures to minimize the flow of disturbed soils into aquatic features while the USACE permit would require BMPs for in-water work to minimize sedimentation and erosion. Therefore, construction-related impacts on aquatic ecological resources from the SCPC plant alternative are anticipated to be SMALL.

During operations, water withdrawals from the Mississippi River for the SCPC plant alternative would be similar to RBS (Section 3.5.3.1). Therefore, the number of fish and other aquatic resources affected by cooling water intake and discharge operations (i.e., affected by entrainment, impingement, and thermal stress) would be minimal. In addition, the cooling system for the SCPC plant alternative would also have similar chemical discharges as RBS, which would be regulated by an LPDES permit (Section 3.5.1.1.1). Therefore, operations-related impacts on aquatic ecological resources under the SCPC plant alternative are anticipated to be SMALL.

Terrestrial

Terrestrial ecology impacts from construction of the SCPC plant alternative would primarily occur from land disturbance. As discussed in Section 7.1.3.2.1, the SCPC plant alternative would require approximately 60 acres of land on site. The site has available acreage that is already disturbed and would not encroach on the wetlands of the site. Furthermore, the site is zoned for industrial use (M2—General Industry District) by West Feliciana Parish.

Plant communities in the proposed construction footprint would be cleared to accommodate the new plant site, and wildlife would be displaced. Erosion and sedimentation, fugitive dust, and construction debris impacts would be minor with implementation of appropriate BMPs. Disturbed areas would be revegetated with native and non-invasive flora species, as appropriate. Therefore, construction-related impacts on terrestrial resources under the SCPC plant alternative are anticipated to be SMALL.

During operations, onsite temporary storage of coal, coal combustion residue, spent catalysts, and scrubber sludge, as well as any offsite waste disposal by landfilling of coal combustion residue, would also affect the terrestrial ecology by requiring conversion of existing habitat. Deposition of acid rain resulting from $NO_x$ or $SO_x$ emissions, and deposition of other pollutants could also affect terrestrial ecology. In addition, operation of the mechanical draft cooling towers would cause some deposition of dissolved solids on surrounding vegetation and soil from cooling tower drift. Cooling tower operational noise could also impact terrestrial wildlife, and there is the potential for bird collisions. However, these impacts would be similar to existing nuclear plants with cooling towers, which the NRC determined in the GEIS to be SMALL (NRC 2013b, Table 2.1-1). However, because it is assumed that the SCPC plant alternative would be located on previously disturbed land, as discussed in Section 7.1.3.2.1, these impacts are anticipated to be SMALL.

As discussed in Section 7.1.3.2.1, the amount of land required for coal mining could range from 3,720 to 26,400 acres to support a coal-fired plant during its operational life. The elimination of approximately 967 acres of uranium mining to supply fuel for RBS, estimated at approximately 1 acre per MWe (NRC 1996, Section 8.3.12), would offset some of these offsite land requirements. However, because of the potentially large area of undisturbed habitat that could be affected by mining activities, the operations-related impacts on terrestrial resources from the SCPC plant alternative could range from SMALL to MODERATE.

Special Status Species

Unlike the proposed action, no-action alternative, and new nuclear alternative, the NRC does not license SCPC facilities, and the NRC would not be responsible for initiating Section 7 consultation if listed species or habitats might be adversely affected under this alternative. The facilities themselves would be responsible for protecting listed species because the ESA forbids the taking of a listed species.

However, as discussed in Section 7.1.3.2.1, the site has available acreage already disturbed to support construction of the SCPC plant alternative. Operational impacts to special status species are anticipated to be similar to that of RBS, which were determined to have no effect as discussed in Section 4.6.3. Therefore, construction- and operations-related impacts on special status species from the SCPC plant alternative would have no effect.

7.1.3.2.7 Historic and Cultural Resources

As discussed in Section 7.1.3.2.1, the SCPC plant alternative would require approximately 60 acres of land on the RBS property, and the site has available acreage that is already disturbed.

The cultural resources on site and in the vicinity are detailed in Section 3.7. As discussed in Section 3.7, none of the properties on the RBS site are listed on the NRHP, nor have any been determined to be eligible for inclusion on the NRHP. Only three of the sites have been examined sufficiently to determine their NRHP eligibility, with at least two of these sites likely containing *in situ* archaeological deposits: the Magnolia Plantation Sugarhouse (16WF36) and Cottonmouth Mound (16WF61). However, because portions of the RBS site have already been previously identified as not containing significant historic and cultural resources, use of these areas for an SCPC plant alternative would have no adverse effect on historic and cultural resources.

The SCPC plant alternative could also require from 3,720 to 26,400 acres for land mining. These areas would be surveyed to identify and record historic and cultural resources. Any resources found would be recorded and evaluated for eligibility for listing on the NRHP. Mitigation of adverse effects would be considered if eligible properties were encountered. Areas with the most significant cultural resources would be avoided.

Given that the preference is to use previously surveyed and/or disturbed areas, avoidance of significant historic and cultural resources should be possible and effectively managed under current laws and regulations. Therefore, the construction and operational impacts on historic and cultural resources from the SCPC plant alternative are projected to have no adverse effect.

#### 7.1.3.2.8 Socioeconomics

Socioeconomic Issues Other than Transportation

In the GEIS, the NRC estimated the peak workforce required to construct a 1,000-MWe coal-fired plant at 1,200 to 2,500 (NRC 1996, Table 8.1). Therefore, for the 1,200-MWe SCPC plant, the peak workforce could range from approximately 1,440 to 3,000. Given the proximity of New Orleans and Baton Rouge, the majority of a construction workforce would be expected to reside within the region. It is expected that the remainder of the construction-related workforce would in-migrate from outside the region in the same residential distribution as the current RBS workforce. It is not expected that many in-migrating construction workers would permanently relocate to the region, so any socioeconomic effect induced by the in-migrating workers would be temporary. Therefore, construction-related socioeconomic impacts from the SCPC plant alternative are anticipated to be SMALL.

In the GEIS, the NRC estimated the operations workforce for a 1,000-MWe coal-fired plant at 250 (NRC 1996, Table 8.2). Therefore, the operations workforce for the SCPC plant alternative would be approximately 300, significantly smaller than the RBS operations workforce. The SCPC plant alternative workforce would continue to contribute beneficial socioeconomic impacts in the area, albeit on a smaller scale compared to RBS's current contribution. As a smaller workforce, it would have less of a demand for community services.

This alternative would also result in a loss of approximately 680 relatively high-paying jobs at RBS and a corresponding reduction in purchasing activity and revenue contributions to the regional economy. Should RBS cease operations, there would be an immediate socioeconomic impact to local communities and businesses from the loss of jobs (some, but not all, of the 680 employees would begin to leave), and tax payments may be reduced. In addition, the housing market could experience increased vacancies and decreased prices if operations workers and their families move out of the region. The impact of the job loss, however, may not be noticeable in local communities given the amount of time required for decommissioning the existing RBS facilities. Based on this information and given the number of operations workers, socioeconomic impacts during SCPC power plant operations on local communities could range from SMALL to MODERATE.

Transportation

Transportation impacts associated with construction and operation of the SCPC plant alternative would consist of commuting workers and truck deliveries of construction materials to the RBS site. During periods of peak construction activity, the number of workers commuting daily to the construction site could range from 1,440 to 3,000. In addition to commuting workers, trucks would be transporting construction materials and equipment to the work site, thus increasing the amount of traffic on local roads. The increase in vehicular traffic would peak during shift changes, resulting in temporary levels of service impacts and delays at intersections. Larger components for the SCPC plant would most likely arrive by barge, which would avoid potential traffic congestion and stoppages for transport of large components. The traffic capacity of these roads and the ability to stagger workforce shifts, if needed, would minimize traffic congestion; however, the construction-related impacts from the SCPC plant alternative could still be MODERATE.

Traffic-related transportation impacts would be greatly reduced after construction of the SCPC plant alternative. Transportation impacts would include daily commuting by the operating workforce, equipment and materials deliveries, and the removal of commercial waste material to offsite disposal or recycling facilities by truck. The operations workforce of approximately 300 likely would not be noticeable relative to total traffic volumes on local roadways. Because coal is assumed to be transported by barge, the transportation infrastructure would experience little to no increased traffic from plant operations. Overall, given the relatively small operations workforce, operations-related transportation impacts from the SCPC plant alternative would be SMALL.

#### 7.1.3.2.9 Human Health

Impacts on human health from construction of the SCPC plant alternative would be similar to effects associated with the construction of any major industrial facility. Compliance with OSHA worker protection rules would control those impacts on workers at acceptable levels. The radiological human health impact on construction workers due to the proximity of RBS still operating at that time would also be SMALL due to compliance with NRC regulations and adherence to ALARA principles. The NRC reviewed radiation exposures to workers in its license renewal GEIS and found the impacts to be SMALL (NRC 2013b, Table 2.1-1). Impacts from construction on the general public would be minimal because crews would limit access to active construction areas to authorized individuals. Therefore, construction-related impacts on human health from the SCPC plant alternative would be SMALL.

Coal-fired power generation introduces worker risks from coal and limestone mining; worker and public risk from coal, lime, and limestone transportation; worker and public risk from disposal of coal-combustion waste; and public risk from inhalation of stack emissions. In addition, human health risks are associated with the management and disposal of coal combustion waste. Coal combustion generates waste in the form of ash, and equipment for controlling air pollution generates additional ash and scrubber sludge. Human health risks may extend beyond the facility workforce to the public, depending on proximity to the coal combustion waste disposal facility. The character and the constituents of coal combustion waste depend on both the chemical composition of the source coal and the technology used to combust it. Generally, the primary sources of adverse consequences from coal combustion waste are from exposure to $SO_x$ and $NO_x$ in air emissions, and radioactive elements such as uranium and thorium, as well as the heavy metals and hydrocarbon compounds contained in fly ash, bottom ash, and scrubber sludge. (NRC 2015b, Section 4.11.4.2)

Regulatory agencies, including the EPA and state agencies, base air emission standards and requirements on human health impacts. These agencies also impose site-specific emission limits as needed to protect human health. Given the regulatory oversight exercised by the EPA and state agencies, Entergy concludes that the operational human health impacts from inhaled toxins and particulates generated from the SCPC plant alternative would be SMALL.

#### 7.1.3.2.10 Environmental Justice

Potential impacts on minority and low-income populations from the construction of the SCPC plant alternative would mostly consist of environmental and socioeconomic effects (e.g., noise, dust, traffic, employment, and housing impacts). Noise and dust impacts during construction would be short term and managed to limit offsite impacts. Minority and low-income populations residing along site access roads would be directly affected by increased commuter vehicle and truck traffic. However, because of the temporary nature of construction, these effects are not likely to be high and adverse, and would be contained to a limited time period during certain hours of the day.

Increased demand for rental housing during construction could cause rental costs to rise disproportionately, affecting low-income populations residing in the vicinity of the RBS site who rely on inexpensive housing. However, given the proximity of the New Orleans and Baton Rouge metropolitan areas, and their volume of temporary and permanent housing, any upward pressure on housing expenses would not be expected to be disproportionately felt within minority or low-income populations.

Minority and low-income populations living in close proximity to the SCPC power generating facility could be disproportionately affected by emissions associated with plant operations. However, because emissions are expected to remain within regulatory standards, impacts from emissions are not expected to be high and adverse.

Based on this information and the analysis of human health and environmental impacts presented in Section 7.1.3.2 of this ER, the construction and operation of the SCPC plant alternative would not have disproportionately high and adverse human health and environmental effects on minority and low-income populations residing in the vicinity of the RBS site.

#### 7.1.3.2.11 Waste Management

Sanitary wastes resulting from both the support of the construction crew and industrial wastes (some hazardous) would be generated during construction, such as clearing the construction site of vegetation, excavating and preparing the site surface before other crews begin actual construction of the plant, modifying existing infrastructure, and constructing any additional required infrastructure. Minor amounts of industrial wastes would result from the onsite maintenance of construction vehicles and equipment, the use of cleaning solvents, and the application of corrosion control coatings. Construction-related wastes are expected to be properly characterized and initially managed on site, and eventually removed to permitted offsite treatment, disposal, or recycling facilities. Construction-related waste impacts from the SCPC plant alternative are expected to be SMALL.

Coal combustion generates waste in the form of fly ash and bottom ash. In addition, equipment for controlling air pollution generates additional ash, spent SCR catalyst, and scrubber sludge. The management and disposal of the large amounts of coal combustion waste are a significant part of the operation of a coal-fired power generating facility. (NRC 2015b, Section 4.13.4.2) The estimated annual volumes of these wastes are presented in Table 7.1-3. Recycling and waste minimization programs applicable to these waste streams and other plant waste streams would be implemented as appropriate.

Although a coal-fired power generating facility is likely to use offsite disposal of coal combustion waste, some short-term storage of coal combustion waste (either in open piles or in surface impoundments) may take place on site, thus establishing the potential for toxic chemicals leaching into the local environment. (NRC 2015b, Section 4.13.4.2)

The impacts from waste generated during operation of the SCPC plant alternative would be dependent on the ability to recycle the solid wastes and dispose of the wastes that could not be recycled in dry ash piles in compliance with regulatory requirements. Based on the waste quantities requiring disposal as presented in Table 7.1-3, 40 years of operation could require from 143 to 334 acres to hold the ash and dry sludge wastes piled 30 feet high.

Therefore, based on the large volume of waste, the toxicity of the waste generated by coal combustion, and the uncertainty of recycling percentages of the waste, it is concluded that operations-related waste impacts would be MODERATE.

### 7.1.3.3 New Nuclear Generation

As discussed in Section 7.1.1.3, Entergy chose a 1,200-MWe (gross) plant. Based on a capacity factor of 90 percent (EIA 2015a, Table 1), the net capacity of the plant would be 1,080 MWe. The environmental impacts associated with constructing and operating the new nuclear plant alternative based on the assumptions described in Section 7.1.1.3 are discussed below.

#### 7.1.3.3.1 Land Use and Visual Resources

Land Use

The entire RBS site is zoned for industrial use (M2—General Industry District) by West Feliciana Parish, as discussed in Section 3.1.1. Based on previous acreage estimated for RBS3, Entergy is assuming that approximately 43 acres would be needed for permanent plant structures for this alternative (EOI 2008a, Section 4.1.1.1). The new nuclear plant alternative would be located on previously disturbed land so that encroachment on wetlands could be avoided; therefore, there would be no associated impacts. In addition, the new nuclear plant alternative would make use of existing infrastructure, which would reduce the amount of land needed to support the new unit. Therefore, construction-related impacts on land use from the new nuclear plant alternative would be SMALL.

During operations, there would be no net change in offsite land use impacts from the mining of uranium fuel, if supplies destined to be used during the RBS license renewal period were redirected for use at a new nuclear facility. Therefore, operations-related impacts on land use from the new nuclear plant alternative would be SMALL.

Visual Resources

During construction, all clearing and excavation activities would not be visible off site because, as discussed in Section 3.1.3, a significant tree buffer blocks any view of the RBS site from US-61. Therefore, construction-related aesthetic impacts from the new nuclear plant alternative would be SMALL.

During operations, Entergy does not expect visual impacts from the new nuclear alternative to be any greater than those associated with RBS, because a significant tree buffer blocks any view of the RBS site from US-61. Therefore, operations-related impacts on visual resources from the new nuclear plant alternative are anticipated to be SMALL.

#### 7.1.3.3.2 Air Quality

Construction of the new nuclear plant alternative would result in temporary impacts on local air quality. Ground-clearing, grading, and excavation activities would raise dust, as would the movement of materials and machinery. Fugitive dust may also arise from cleared areas during windy periods. In addition, emissions from these activities would contain various air pollutants, including CO, $NO_x$, $SO_x$, particulate matter, and VOCs, as well as various GHGs. Air emissions would be intermittent and vary based on the level and duration of a specific activity throughout the construction phase. Exhaust from the vehicles required to transport the construction workforce could also decrease air quality somewhat. Various mitigation techniques could be utilized to minimize air emissions and reduce fugitive dust. Because air emissions from construction activities would be limited, local, and temporary, construction-related impacts on air quality from the new nuclear plant alternative are anticipated to be SMALL.

Sources of air emissions during the operations phase include equipment such as emergency diesel generators and other minor emission sources that would be operated within federal and state air quality limits, and some would only be operated intermittently. Similar to RBS, the new nuclear plant alternative would be considered a minor source of air emissions and subject to conditions established in an LDEQ-issued air permit that would be protective of Louisiana's ambient air quality to ensure that impacts are maintained at acceptable levels.

As discussed in Section 7.1.1.3, the new nuclear plant alternative would utilize a closed-cycle cooling system with mechanical draft cooling towers. Particulate emissions from the cooling towers would be subject to conditions established in the LDEQ-issued air permit. The NRC evaluated impacts from cooling tower particulate emissions in the GEIS, and considered these impacts to be SMALL (NRC 2013b, Table 2.1-1). Therefore, the overall operations-related impacts on air quality from the new nuclear plant alternative would be SMALL.

In addition, as the NRC discussed in the GEIS, GHG emissions associated with nuclear are lower than fossil fuel-based energy sources, and similar to the lifecycle GHG emissions from renewable energy sources (NRC 2013b, Tables 4.12-4, 4.12-5, 4.12-6). Therefore, air quality impacts associated with the new nuclear plant alternative would avoid millions of tons of GHGs that otherwise would be produced by fossil fuel-fired generation, thereby resulting in a beneficial air quality impact.

#### 7.1.3.3.3 Noise

The site on which the new nuclear plant alternative would be constructed has been zoned for industrial use, as discussed in Section 3.1.1. Sources of noise during construction would include bulldozers, draglines, scrapers, haulers to excavate earth and grade, cranes, front loaders, graders, forklifts, man lifts, compressors, backhoes, dump trucks, a pier driller, and portable welding machines. These impacts would be intermittent and last only through the duration of plant construction. As discussed in Section 3.0.3, the sensitive receptor closest to RBS is a residence located approximately 0.8 miles to the northwest, and as shown in Table 3.0-1, the parks nearest to RBS are approximately 3 miles north-northeast, west-northwest, and northwest. Because noise activities associated with construction are intermittent and last only through the duration of construction, construction-related noise impacts from the new nuclear plant alternative are anticipated to be effectively managed and kept SMALL.

Noise associated with the operation of a new nuclear plant would include sources such as cooling towers, switchyard, motors, generators, pumps, trucks, and cars typical of an operating industrial facility. The permanent workforce would also produce traffic noise during their commute to and from work. However, Entergy does not expect noise impacts from the operation of the new nuclear plant alternative to be any greater than those currently associated with RBS, because the site is zoned for industrial use, the closest residence is approximately 0.8 miles northwest, and the parks nearest to RBS are approximately 3 miles north-northeast, west-northwest, and northwest. Therefore, operations-related noise impacts from the new nuclear plant alternative are anticipated to be SMALL.

#### 7.1.3.3.4 Geology and Soils

During construction, sources of aggregate material, such as crushed stone, sand, and gravel would be required to construct buildings, foundations, roads, and parking lots. It is presumed that these resources would likely be obtained from commercial suppliers using local or regional sources. Land clearing during construction and the installation of power plant structures and impervious surfaces would expose soils to erosion and alter surface drainage. Any ground disturbance of one or more acres would require that a construction stormwater permit be obtained from the LDEQ. The construction stormwater permit specifies BMPs to reduce erosion caused by stormwater runoff, thereby minimizing the risk of pollution from soil erosion and sediment, and potentially from other pollutants that the stormwater may contact. Removed soils and any excavated materials would be stored on site for redistribution as backfill at the end of construction. Construction activities would be temporary and localized. Therefore, construction-related impacts from the new nuclear plant alternative on geology and soils would be SMALL.

Land disturbance during operations would have to comply with applicable permits and site procedures and plans. The new nuclear plant alternative would have to comply with stormwater permitting requirements to develop and maintain a SWPPP. The SWPPP would identify potential sources of pollution expected to affect the quality of stormwater, such as erosion, and would contain BMPs to prevent or reduce the pollutants in stormwater discharges. Therefore, operations-related impacts on geology and soils from the new nuclear plant alternative would also be SMALL.

#### 7.1.3.3.5 Hydrology (Surface Water and Groundwater)

<u>Surface Water</u>

Entergy assumes that there would be no direct use of surface water during construction.

For the new nuclear plant alternative, Entergy also assumes that the existing intake and discharge infrastructure on the RBS property would be modified to maximize use of existing facilities. This would reduce construction-related impacts on surface water quality. Dredge-and-fill operations, if needed, would be conducted under a permit from the USACE and equivalent state permits requiring the implementation of BMPs to minimize impacts.

Construction activities associated with this alternative would alter onsite surface water drainage features. Some temporary impacts on surface water quality may result from increased sediment loading and from any pollutants in stormwater runoff from disturbed areas, excavation, and dredge-and-fill activities. Stormwater runoff from construction areas and spills and leaks from construction equipment could potentially affect downstream surface water quality. Nevertheless, for this alternative, it is anticipated that appropriate soil erosion and sediment control measures would be observed. Application of BMPs in accordance with an LDEQ stormwater construction permit, including appropriate waste management, a SWPPP, and spill prevention practices, would prevent or minimize surface water quality impacts during construction. Therefore, construction-related impacts on surface water use and quality from the new nuclear plant alternative are anticipated to be SMALL.

During operations, the new nuclear plant alternative would use mechanical draft cooling towers with makeup water supplied by the Mississippi River. Water withdrawals would be similar to those required by RBS's closed-cycle cooling system and therefore constitute impacts similar to the continued operation of RBS, as discussed in Section 4.5.1.1.3. Cooling water treatment additives and effluent discharges would also essentially be the same as those for RBS and would be regulated under an LPDES permit to protect water quality. Therefore, operations-related impacts on surface water use and quality under the new nuclear plant alternative would be SMALL.

Groundwater

Entergy assumes that water for potable and sanitary uses during construction would be provided by the West Feliciana Parish Consolidated Water District No. 13 water supply system, whose source is groundwater. Water for concrete production, equipment washdown, dust suppression, and soil compaction is assumed to be provided by RBS's onsite wells described in Section 3.5.3.2.

Foundation excavations may intrude on groundwater zones and require dewatering during construction. Discharge of water removed by dewatering activities would require an LPDES permit and compliance with any conditions, minimizing impacts on receiving waters and soils. The potential impacts on groundwater from dewatering activities could stem from reductions in quantity and quality. Groundwater could also be affected by runoff that could contain contaminants; however, compliance with appropriate waste management practices, construction stormwater permit and pollution prevention requirements, and spill prevention practices, would prevent or minimize such adverse impacts. Therefore, construction-related impacts on groundwater use and quality from the new nuclear plant alternative would be SMALL.

During operations, it is assumed that the West Feliciana Parish Consolidated Water District No. 13 water supply system would continue to supply potable water. Although minor amounts of domestic water for plant operations may be provided by RBS's onsite wells described in Section 3.5.3.2, the majority of water for plant operations would be provided by the Mississippi River. Impacts to groundwater quality are anticipated to be prevented or minimized through appropriate waste management, stormwater management, and spill prevention practices. Therefore, operations-related impacts on groundwater use and quality from the new nuclear plant alternative would be SMALL.

7.1.3.3.6 Ecological Resources (Aquatic and Terrestrial)

Aquatic

Impacts on aquatic ecosystems during construction would be minimal, due to the relatively small amount of water required and controls on the quality of surface water discharges imposed by a construction stormwater permit and USACE permit. The construction stormwater permit would contain control measures to minimize the flow of disturbed soils into aquatic features while the USACE permit would require BMPs for in-water work to minimize sedimentation and erosion. Therefore, construction-related impacts on aquatic ecological resources from the new nuclear plant alternative are anticipated to be SMALL.

During operations, water withdrawals from the Mississippi River for the new nuclear plant alternative would be similar to RBS (Section 3.5.3.1). Therefore, the number of fish and other aquatic resources affected by cooling-water intake and discharge operations (i.e., affected by entrainment, impingement, and thermal stress) would be minimal. In addition, the cooling system for the new nuclear plant alternative would also have chemical discharges similar to those of RBS, which would be regulated by an LPDES permit (Section 3.5.1.1.1). Therefore, operations-related impacts on aquatic ecological resources from the new nuclear plant alternative are anticipated to be SMALL.

Terrestrial

Terrestrial ecology impacts from construction of the new nuclear plant alternative would primarily occur from land disturbance. As discussed in Section 7.1.3.3.1, the new nuclear plant alternative would require approximately 43 acres of land for permanent plant structures. The RBS site has available acreage that is already disturbed, and new construction would not encroach on the wetlands of the site. Furthermore, the site is zoned for industrial use (M2—General Industry District) by West Feliciana Parish.

Plant communities in the proposed construction footprint would be cleared to accommodate the new plant site, and wildlife would be displaced. Erosion and sedimentation, fugitive dust, and construction debris impacts would be minor with implementation of appropriate BMPs. Disturbed areas would be revegetated with native and non-invasive flora species, as appropriate. Therefore, construction-related impacts on terrestrial resources from the new nuclear plant alternative are anticipated to be SMALL.

The impacts on terrestrial resources from operation of the new nuclear plant alternative would be similar to continued operation of RBS. Operation of the cooling towers would cause some deposition of dissolved solids on surrounding vegetation and soil from cooling tower drift. Other impacts such as fogging and shadowing, etc. would also occur. Operational noise from the mechanical draft cooling towers could also impact terrestrial wildlife, and there is the potential for bird collisions. However, these impacts would be similar to those at existing nuclear plants with cooling towers, which the NRC determined in the GEIS to be SMALL (NRC 2013b, Table 2.1-1). Therefore, it is concluded that overall operations-related impacts on terrestrial resources from the new nuclear plant alternative would be SMALL.

Special Status Species

The NRC would remain the licensing agency under this alternative, and thus the ESA would require the NRC to initiate consultation with the USFWS and NMFS, as applicable, prior to construction to ensure that the construction and operation of the new nuclear plant would not adversely affect any federally listed species or adversely modify or destroy designated critical habitat.

As previously discussed, the site has available acreage already disturbed to support construction of the new nuclear plant alternative. Operational impacts to special status species are not anticipated to be greater than those of RBS, which were determined to have no effect as discussed in Section 4.6.3. Therefore, construction- and operations-related impacts on special status species from the new nuclear plant alternative would have no effect.

#### 7.1.3.3.7 Historic and Cultural Resources

As discussed in Section 7.1.3.3.1, a new nuclear plant would require approximately 43 acres of land on site for permanent plant structures and, as previously discussed, the RBS site has available acreage that is already disturbed.

The cultural resources on site and in the vicinity are detailed in Section 3.7. As discussed in Section 3.7, none of the properties on the RBS site are listed on the NRHP, nor have any been determined to be eligible for inclusion on the NRHP. Only three of the sites have been examined sufficiently to determine their NRHP eligibility, with at least two of these sites likely containing *in situ* archaeological deposits: the Magnolia Plantation Sugarhouse (16WF36) and Cottonmouth Mound (16WF61). However, because portions of the RBS site have already been previously identified as not containing significant historic and cultural resources, use of these areas for the new nuclear plant alternative would have no adverse effect on historic and cultural resources.

Given that the preference is to use previously surveyed and/or disturbed areas, avoidance of significant historic and cultural resources should be possible and effectively managed under current laws and regulations. Therefore, the construction and operation of the new nuclear plant alternative is projected to have no adverse effect on historic and cultural resources.

#### 7.1.3.3.8 Socioeconomics

<u>Socioeconomic Issues Other than Transportation</u>

Using actual workforce numbers for constructing a single nuclear unit, Watts Bar 2, a workforce size of approximately 2,100 was assumed for construction of the new nuclear plant alternative (TVA 2012). Given the proximity of New Orleans and Baton Rouge, the majority of a construction workforce would be expected to reside within the region. It is expected that the remainder of the construction-related workforce would in-migrate from outside the region in the same residential distribution as the current RBS workforce. It is not expected that many in-migrating construction workers would permanently relocate to the region, so any socioeconomic effect induced by the in-migrating workers would be temporary. Therefore, construction-related socioeconomic impacts from the new nuclear plant alternative are anticipated to be SMALL.

Entergy assumes that the number of operations workers at the new nuclear plant alternative would be similar to the number of operations workers at RBS, but there could be a temporary increase in employment at the site from decommissioning activities at RBS. Therefore, operations-related socioeconomic impacts from the new nuclear plant alternative could range from SMALL to MODERATE.

Transportation

Transportation impacts associated with construction and operation of the new nuclear plant alternative would consist of commuting workers and truck deliveries of construction materials to the RBS site. During periods of peak construction activity, the number of workers commuting daily to the construction site could be 2,100. In addition to commuting workers, trucks would be transporting construction materials and equipment to the work site, thus increasing the amount of traffic on local roads. The increase in vehicular traffic would peak during shift changes, resulting in temporary levels of service impacts and delays at intersections. Larger components for the new nuclear plant alternative would most likely arrive by barge, which would avoid potential traffic congestion and stoppages for transport of large components. The traffic capacity of these roads and the ability to stagger workforce shifts, if needed, would minimize traffic congestion; however, the construction-related impacts from the new nuclear plant alternative could still be MODERATE.

Traffic-related transportation impacts would be greatly reduced after construction of the new nuclear plant alternative. Transportation impacts would include daily commuting by the operations workforce, equipment and materials deliveries, and the removal of commercial waste material to offsite disposal or recycling facilities by truck. Therefore, operations-related transportation impacts from the new nuclear plant alternative are anticipated to be SMALL.

#### 7.1.3.3.9 Human Health

Impacts on human health from construction of the new nuclear plant alternative would be similar to effects associated with the construction of any major industrial facility. Compliance with OSHA worker protection rules would control those impacts on workers at acceptable levels. The radiological human health impact on construction workers due to the proximity of RBS still operating at that time would also be SMALL due to compliance with NRC regulations and adherence to ALARA principles. The NRC reviewed radiation exposures to workers in its license renewal GEIS and found the impacts to be SMALL (NRC 2013b, Table 2.1-1). Impacts from construction on the general public would be minimal, because crews would limit access to active construction area to authorized individuals. Based on the above, the construction-related impacts on human health from the new nuclear plant alternative would be SMALL.

The human health effects from the operation of the new nuclear plant alternative would be similar to those of the existing RBS plant. As presented in Section 4.9, impacts on human health from the operation of RBS would be SMALL. In addition, the NRC determined in the GEIS that impacts from radiation exposures to the public and plant workers would be SMALL (NRC 2013b,

Table 2.1-1). Therefore, overall operations-related impacts on human health from the new nuclear plant alternative would be SMALL.

7.1.3.3.10 Environmental Justice

Potential impacts on minority and low-income populations from the construction of the new nuclear plant alternative on the RBS property would consist of mostly environmental and socioeconomic effects (e.g., noise, dust, traffic, employment, and housing impacts). Noise and dust impacts during construction would be short term, though longer than for the NGCC or SCPC plant alternatives, and primarily limited to the site. Minority and low-income populations residing along site access roads would be directly affected by increased commuter vehicle and truck traffic. However, because of the temporary nature of construction, these effects are not likely to be high and adverse, and would be contained to a limited time period during certain hours of the day.

Increased demand for rental housing during construction could cause rental costs to rise disproportionately, affecting low-income populations residing in the vicinity of the RBS site who rely on inexpensive housing. However, given the proximity of New Orleans and Baton Rouge metropolitan areas and their volume of temporary and permanent housing, any upward pressure on housing expenses would not be expected to be disproportionately felt within minority or low-income populations.

Based on this information and the analysis of human health and environmental impacts presented in Section 7.1.3.3 of this ER, the construction and operation of a new nuclear plant would not have disproportionately high and adverse human health and environmental effects on minority and low-income populations living near the RBS property.

7.1.3.3.11 Waste Management

Sanitary wastes resulting from both the support of the construction crew and industrial wastes (some hazardous) would be generated during construction. Construction-related wastes are expected to be properly characterized and initially managed on site and eventually removed to properly permitted offsite treatment or disposal facilities. Waste impacts from construction of the new nuclear plant alternative are expected to be SMALL.

During operation, the new nuclear plant alternative would generate nonhazardous, hazardous, and radioactive wastes and spent nuclear fuel. The nonhazardous and hazardous wastes would be managed in compliance with state regulations and disposed of in permitted offsite facilities. Entergy has internal recycling and waste minimization programs that would reduce waste volumes. Radioactive waste would be managed on site in accordance with NRC and state regulations and disposed of in permitted offsite facilities. Spent nuclear fuel would be managed on site per NRC regulations and the nuclear plant's NRC OL. The NRC reviewed the impacts from nonradioactive and radioactive wastes in the GEIS and determined the impacts to be SMALL (NRC 2013b, Table 2.1-1). Therefore, waste management impacts during operations from the new nuclear plant alternative would be SMALL.

### 7.1.3.4 Combination of Alternatives

As discussed in Section 7.1.1.4 and shown below, the combination alternative involves the construction and operation of NGCC and biomass plants at the RBS site, and implementation of DSM programs for an annual reduction in demand. A combination alternative that included an NGCC plant, biomass plants, and DSM was also selected by the NRC as a reasonable alternative to replace the base-load power generated by the Grand Gulf Nuclear Station, Unit 1 plant, which is also located in the southeastern United States. (NRC 2014b, Section 8.4)

A combination of hypothetical alternatives for replacing the generating capacity of RBS consists of the following:

- Two 400-MWe (gross) NGCC units operating at an 87-percent capacity factor (EIA 2015a, Table 1) for a total net capacity of 696 MWe.
- Four 50-MWe (gross) biomass units operating at an 83-percent capacity factor (EIA 2015a, Table 1) for a total net capacity of 166 MWe.
- DSM programs providing 105 MWe.

The biomass plants would be capable of using a variety of biomass fuels such as wood waste, crop residue, energy crops, and MSW to take advantage of the feedstock options available in the area, as well as for greater assurance of reliable feedstock.

Based on the projected supply for 2025 stemming from DSM programs, as discussed in Section 7.1.2.1.3, it is assumed that the potential for an annual savings of 105 MWe from implementation of a variety of energy efficiency and demand reduction programs can be achieved.

The environmental impacts associated with the combination alternatives based on the assumptions described in Section 7.1.1.4 are described below.

#### 7.1.3.4.1 Land Use and Visual Resources

Land Use

The entire RBS site is zoned for industrial use (M2—General Industry District) by West Feliciana Parish, as discussed in Section 3.1.1. Approximately 16 acres of land would be required to construct the NGCC plant components based on NETL's scaling factor of 0.02 acres/MW (Entergy 2015q). As previously discussed, there is ample availability of disturbed land on the RBS property to avoid encroachment into wetlands as a result of construction activities; therefore, there would be no associated impacts.

The natural gas pipeline closest to the RBS site that has adequate supply to operate the NGCC plants is the Texas Eastern Transmission Corporation/Spectra Energy pipeline, approximately 2 miles east of RBS on the same side of the Mississippi River (EOI 2008a, Section 2.2.1.7).

Therefore, a new pipeline segment with an associated 100-foot-wide ROW connecting the site to the existing natural gas distribution infrastructure would be needed. The 1996 GEIS estimated that up to approximately 3,600 acres would be needed for wells, collection stations, and associated pipelines to support a 1,000-MWe gas-fired plant (NRC 1996, Section 8.3.10). Therefore, for the 800-MWe NGCC plant, up to approximately 2,880 acres could be needed for gas extraction and collection. Partially offsetting some, but not all, of these offsite land requirements is the elimination of approximately 967 acres of uranium mining to supply fuel for RBS, estimated at approximately 1 acre per MWe (NRC 1996, Section 8.3.12). Locating a new pipeline within an existing ROW would minimize land use impacts.

The biomass plants would require an estimated 60 acres based on NRC's previous use of 15 acres per unit (NRC 2014b, Section 8.4.7). The biomass plants' fuel mix is assumed to include energy crops, but based on the NREL profile for energy crop supplies in the area, as discussed in Section 7.1.2.2.7, additional conversion of land to cultivate the energy crops is not anticipated. Forest residue and wood waste are byproducts of the timber industry, and thus activities associated with the production of this feedstock would occur regardless of whether a biomass-fired power plant is available to use the feedstock. Accordingly, the land use impacts associated with the production of this feedstock would be the same regardless whether the feedstock is used for electricity generation or not. However, additional land would be required for storing, loading, and transporting forest-residue and wood-waste power plant feedstock. Ultimately, land use impacts would depend on the characteristics of the affected forested lands and the effects of storing, loading, and transporting the biomass feedstock. (NRC 2014b, Section 8.4.7)

DSM would have little to no direct land use impacts. However, quickly replacing old inefficient appliances and other equipment could generate waste material and potentially increase the size of landfills. Given time for program development and implementation, the cost of replacements, and the average life of an appliance, the replacement process likely would be gradual. For example, older appliances would be replaced by more efficient appliances as they fail (especially in the case of frequently replaced items, such as light bulbs). In addition, many appliances and industrial equipment have substantial recycling value and would not be disposed of in landfills. (NRC 2014b, Section 8.4.7)

Overall land use impacts from the combination alternative could range from SMALL to MODERATE.

<u>Visual Resources</u>

Aesthetic impacts during construction of the NGCC and biomass plants would be essentially the same as those described for the discrete NGCC alternative in Section 7.1.3.1.1. During construction, all clearing and excavation activities would not be visible off site because, as discussed in Section 3.1.3, a significant tree buffer blocks any view of the RBS site from US-61.

During operations, plant infrastructure generally would be smaller and less noticeable than the RBS plant structures. The tallest structures associated with the NGCC plants would include the exhaust stacks and mechanical draft cooling towers. The biomass plants would look similar to other fossil-fuel power plants with a boiler stack and mechanical draft cooling towers. In addition, they would have feedstock storage, handling, and processing facilities. Combustion exhaust and cooling steam plumes may be visible in close proximity to the plant depending on atmospheric conditions. However, as previously discussed, a significant tree buffer blocks sight of the RBS plant structures from US-61. No aesthetic impacts would be expected for the DSM component of this alternative.

Overall aesthetic impacts from the combination alternative would be SMALL.

7.1.3.4.2 Air Quality

Construction activities associated with the NGCC and biomass plants would be similar to the discrete NGCC, SCPC, and new nuclear alternatives. Activities would result in the release of various criteria pollutants such as CO, $NO_x$, $SO_x$, particulate matter, and VOCs, as well as various GHGs from the operation of internal combustion engines in construction vehicles, equipment, delivery vehicles, and vehicles used by the commuting construction workforce.

Onsite activities would also generate fugitive dust. These impacts would be intermittent and short-lived, however, and adherence to well-developed and well-understood construction BMPs, such as development and execution of a fugitive dust control plan, would mitigate such impacts. Air emissions would be intermittent and vary based on the level and duration of a specific activity throughout the construction phase.

During operations, the NGCC plants would consume approximately 54.3 billion cubic feet of natural gas annually (Table 7.1-4). Emission estimates for the NGCC component, based on EPA emission factors, are shown in Table 7.1-4. The biomass plants would also emit air pollutants that would be dependent on the feedstock, but nevertheless in compliance with the maximum achievable control technology standards as discussed in Section 7.1.2.2.6. The biomass plants' annual $SO_2$ and $NO_x$ emissions based on a feedstock of MSW would be approximately 1,051 tons and 5,869 tons, respectively (Entergy 2015q). The biomass plants' annual $CO_2$ generation, based on MSW, would be approximately 890,016 tons (Entergy 2015q). As discussed in Section 7.1.3.1.2 and Section 7.1.2.2.6, the NGCC and biomass plants would be subject to several EPA regulations designed to minimize air quality impacts from operations. Nevertheless, the NGCC and biomass plants would be a major source of criteria pollutants and GHGs. Air quality impacts from the DSM component of the combination alternative would be negligible.

Overall air quality impacts from the combination alternative could range from SMALL to MODERATE.

7.1.3.4.3 Noise

The construction of the NGCC and biomass plants would have noise impacts similar to that of the discrete NGCC plant alternative discussed in Section 7.1.3.1.3. During construction, noise would increase with the operation of vehicles, earthmoving equipment, materials-handling equipment, impact equipment, other stationary equipment (such as pumps and compressors), and the increase in human activity. The site on which the NGCC and biomass plants would be constructed has been zoned for industrial use. As discussed in Section 3.0.3, the sensitive receptor closest to RBS is a residence located approximately 0.8 miles to the northwest, and as shown in Table 3.0-1, the parks nearest to RBS are approximately 3 miles north-northeast, west-northwest, and northwest. However, noise activities associated with construction are intermittent and last only through the duration of construction.

Most noise generated during the plants' operation would be limited to industrial processes and communications. Pipelines delivering natural gas fuel could be audible off site near gas compressor stations. The biomass plants would have feedstock storage, handling, and processing facilities. Noise may be detectable off site during the delivery and onsite handling operations of the feedstock, but given the location of the site, the noise impact is anticipated to be minor. No noise impacts would be expected for the DSM component of this alternative.

Overall noise impacts from the combination alternative would be SMALL.

#### 7.1.3.4.4 Geology and Soils

The impact on geology and soils due to constructing and operating the NGCC plants, the associated gas pipeline, and biomass plants at the RBS site would be similar to that of the discrete NGCC plant alternative discussed in Section 7.1.3.1.4. Any ground disturbance of one or more acres would require a construction stormwater permit from the LDEQ, which specifies BMPs to reduce erosion caused by stormwater runoff, thereby minimizing the risk of pollution from soil erosion and sediment, and potentially from other pollutants that the stormwater may contact. Construction activities would be temporary and localized.

During operations, the NGCC and biomass plants would have to comply with stormwater permitting requirements to develop and maintain a SWPPP that identifies potential sources of pollution expected to affect the quality of stormwater, such as erosion, and identifies BMPs to prevent or reduce the pollutants in stormwater discharges. No geology and soil impacts would be expected for the DSM component of this alternative.

Overall geology and soils impacts from the combination alternative would be SMALL.

#### 7.1.3.4.5 Hydrology (Surface Water and Groundwater)

Surface Water

The impact on surface water use and quality due to constructing and operating the NGCC and biomass plants at the RBS site would be similar to that of the discrete NGCC plant alternative as discussed in Section 7.1.3.1.5. Entergy assumes that there would be no direct use of surface water during construction.

RBS's existing intake and discharge infrastructure would be modified to maximize use of existing facilities, reducing construction-related impacts on surface water quality. Dredge-and-fill operations, if necessary, would be conducted under a permit from the USACE and equivalent state permits requiring the implementation of BMPs. Stormwater runoff from construction areas and spills and leaks from construction equipment could potentially affect downstream surface water quality. However, application of BMPs in accordance with an LDEQ stormwater construction permit, including appropriate waste management, a SWPPP, and spill prevention practices, would prevent or minimize surface water quality impacts during construction.

Depending on the path of any required new gas pipelines to service the NGCC plants, some stream crossings could be necessary. However, because of the short-term nature of any required dredge-and-fill and stream-crossing activities, the hydrologic alterations and sedimentation would be localized, and water-quality impacts would be temporary. In addition, modern pipeline construction techniques, such as horizontal directional drilling, would further minimize the potential for water quality impacts on the affected streams. Such activities, including any dredge-and-fill operations, would be conducted under a permit from the USACE or equivalent state permits for dredge-and-fill and stream encroachment, requiring the implementation of BMPs to minimize impacts.

During operations, the NGCC and biomass plants would use mechanical draft cooling towers with makeup water supplied by the Mississippi River. Water withdrawals and cooling water treatment additives would essentially be the same as RBS. Effluent discharges from the NGCC plant and biomass plants would be regulated under an LPDES permit to protect water quality. No surface water use and quality impacts would be expected for the DSM component of this alternative.

Overall, impacts on surface water use and quality from the combination alternative would be SMALL.

Groundwater

The impact on groundwater use and quality due to constructing and operating the NGCC and biomass plants on the RBS property would be similar to that of the discrete NGCC plant alternative as discussed in Section 7.1.3.1.5. Entergy assumes that water for potable and sanitary uses during construction would be provided by the West Feliciana Parish Consolidated Water District No. 13 water supply system, whose source is groundwater. Water for concrete production, equipment washdown, dust suppression, and soil compaction is assumed to be provided by RBS's onsite wells described in Section 3.5.3.2.

Groundwater could be affected by runoff that could contain contaminants; however, compliance with appropriate waste management practices, construction stormwater permit and pollution prevention requirements, and spill prevention practices would prevent or minimize such adverse impacts.

During the operations period, Entergy assumes that the West Feliciana Parish Consolidated Water District No. 13 water supply system would continue to supply potable water. Although minor amounts of domestic water for plant operations may be provided by RBS's onsite wells described in Section 3.5.3.2, the majority of water for plant operations would be provided by the Mississippi River. Impacts to groundwater quality are anticipated to be prevented or minimized through appropriate waste management, stormwater management, and spill prevention practices. No groundwater use and quality impacts would be expected for the DSM component of this alternative.

Overall, the impacts on groundwater use and quality from the combination alternative would be SMALL.

#### 7.1.3.4.6 Ecological Resources (Aquatic and Terrestrial)

Aquatic

The impact on aquatic resources due to constructing and operating the NGCC and biomass plants at the RBS site would be similar to that of the discrete NGCC plant alternative, as discussed in Section 7.1.3.1.6. Impacts on aquatic ecosystems during construction would be minimal, due to the relatively small amount of water required and controls on the quality of surface water discharges imposed by a construction stormwater permit and USACE permit. The construction stormwater permit would contain control measures to minimize the flow of disturbed soils into aquatic features, while the USACE permit would require BMPs for in-water work to minimize sedimentation and erosion.

During operations, water withdrawals from the Mississippi River for the NGCC and biomass plants would be similar to RBS (Section 3.5.3.1). Therefore, the number of fish and other aquatic resources affected by cooling-water intake and discharge operations (i.e., affected by entrainment, impingement, and thermal stress) would be minimal. In addition, the cooling system for the NGCC and biomass plants would have similar chemical discharges as RBS, which would be regulated by an LPDES permit (Section 3.5.1.1.1). The DSM component of this alternative would have no impact on aquatic resources.

Overall, impacts on aquatic resources from the combination alternative would be SMALL.

Terrestrial

The impact on terrestrial resources due to constructing and operating the NGCC (and associated gas pipeline) and biomass plants at the RBS site would be similar to that of the discrete NGCC plant alternative discussed in Section 7.1.3.1.6.

Terrestrial ecology impacts from construction of the NGCC and biomass plants would primarily occur from land disturbance. As discussed in Section 7.1.3.4.1, the NGCC and biomass plants would require approximately 16 and 60 acres of land on site, respectively. The site has available acreage that is already disturbed and would not encroach on the wetlands of the site.

Furthermore, the site is zoned for industrial use (M2—General Industry District) by West Feliciana Parish.

As discussed in Section 7.1.3.4.1, up to approximately 2,880 acres could be needed for wells, collection stations, and associated pipelines to support an 800-MWe gas-fired plant. This construction would likely occur on land where gas extraction is occurring already. Siting any new gas pipelines along existing utility corridors would minimize impacts. Erosion and sedimentation, fugitive dust, and construction debris impacts would be minor with implementation of appropriate BMPs.

Plant communities in the proposed construction footprint would be cleared, and wildlife would relocate by their own means. Erosion and sedimentation, fugitive dust, and construction debris impacts would be minor with implementation of appropriate BMPs. Disturbed areas would be revegetated with native and non-invasive flora species, as appropriate.

During operations, it is not anticipated that wildlife species would be displaced, because the site is already zoned for industrial use with an existing power plant located on it; therefore, wildlife have most likely acclimated to noise activities associated with this area. Operation of the mechanical draft cooling towers could cause some deposition of dissolved solids on surrounding vegetation and soil from cooling tower drift. Operational noise from the cooling towers could also impact terrestrial wildlife, and there is the potential for bird collisions with the cooling towers. However, these impacts would be similar to existing nuclear plants with cooling towers, which the NRC determined in the GEIS to be SMALL (NRC 2013b, Table 2.1-1). The DSM component of the combination alternative would have no impact on terrestrial resources.

Overall, impacts on terrestrial resources from the combination alternative are anticipated to be SMALL.

Special Status Species

Unlike the proposed action, no-action alternative, and new nuclear alternative, the NRC does not license NGCC or biomass facilities, and the NRC would not be responsible for initiating Section 7 consultation if listed species or habitats might be adversely affected under this alternative. The facilities themselves would be responsible for protecting listed species because the ESA forbids the taking of a listed species.

However, as previously discussed, the site has available acreage already disturbed to support construction of the NGCC and biomass plants. In addition, construction activities associated with the new gas pipeline would be subject to LDEQ construction stormwater permitting requirements, which would consider protection of special status species and associated designated habitats. Operational impacts to special status species are anticipated to be similar to those of RBS, which were determined to have no effect as discussed in Section 4.6.3. Therefore, construction- and operations-related impacts on special status species from the NGCC and biomass plants would have no effect. The DSM component of this alternative would have no impacts on special status species.

Overall, impacts on special status species from the combination alternative would have no effect.

7.1.3.4.7 Historic and Cultural Resources

The impact on historic and cultural resources due to constructing and operating the NGCC and biomass plants at the RBS site would be similar to that of the discrete NGCC plant alternative as discussed in Section 7.1.3.1.7. No direct impacts on historic and cultural resources are expected from DSM.

As discussed in Section 7.1.3.4.1, the NGCC and biomass plants would require approximately 16 and 60 acres of land, respectively, and as previously discussed, the site has available acreage that is already disturbed. The cultural resources on site and in the vicinity are detailed in Section 3.7. As discussed in Section 3.7, none of the properties on the RBS site are listed on the NRHP, nor have any been determined to be eligible for inclusion on the NRHP. Only three of the sites have been examined sufficiently to determine their NRHP eligibility, with at least two of these sites likely containing *in situ* archaeological deposits: the Magnolia Plantation Sugarhouse (16WF36) and Cottonmouth Mound (16WF61). However, because portions of the RBS site have already been previously identified as not containing significant historic and cultural resources, use of these areas for the NGCC and biomass plants would have no adverse effect on historic and cultural resources.

The NGCC component could also require up to approximately 2,880 acres for wells, collection stations, and associated pipelines as discussed in Section 7.1.3.4.1. The new gas pipeline to connect the NGCC component to the gas infrastructure could be located within an existing ROW or, if not located within an existing ROW, the area could be surveyed to identify and record historic and cultural resources.

Given that the preference is to use previously surveyed and/or disturbed areas, avoidance of significant historic and cultural resources should be possible and effectively managed under current laws and regulations. Therefore, impacts on historic and cultural resources from the combination alternative are projected to have no adverse effect.

7.1.3.4.8 Socioeconomics

Socioeconomic Issues Other than Transportation

Scaling from the NRC's 1996 GEIS (NRC 1996, Table 8.1) estimate of 1,200 workers needed to construct a 1,000-MWe natural gas plant, the NGCC plant combination component would have a peak construction workforce of approximately 960. Fifty construction workers are required for each of the four biomass plants, totaling 200 construction workers if all four units were constructed at the same time (NRC 2014b, Section 8.4.8). Given the proximity of New Orleans and Baton Rouge, the majority of a construction workforce would be expected to reside within the region. It is expected that the remainder of the construction-related workforce would in-migrate from outside the region in the same residential distribution as the current RBS workforce. It is not expected that many in-migrating construction workers would permanently relocate to the region, so any socioeconomic effect induced by the in-migrating workers would be temporary.

Scaling from the NRC's 1996 GEIS (NRC 1996, Table 8.2) estimate of 150 workers needed to operate a 1,000-MWe natural gas plant, the NGCC plant combination component would have an operations workforce of 120. Each biomass unit is assumed to require 22 operations workers for a total of 88 operations workers for this component of the combination alternative (NRC 2014b, Section 8.4.8). Therefore, the operations workforce for the NGCC and biomass plants would be significantly smaller than the RBS operations workforce. The NGCC and biomass plants would continue to contribute beneficial socioeconomic impacts in the area, albeit on a smaller scale as compared to RBS's current contribution and, as a smaller workforce, would have less of a demand for community services.

The DSM component could generate additional employment, depending on the nature of the conservation programs and the need for direct measure installations in homes and office buildings. Jobs would likely be few and scattered throughout the region, and would not have a noticeable effect on the local economy.

This combination alternative would also result in a loss of approximately 680 relatively high-paying jobs at RBS and a corresponding reduction in purchasing activity and revenue contributions to the regional economy. Should RBS cease operations, there would be an immediate socioeconomic impact to local communities and businesses from the loss of jobs (some, but not all, of the 680 employees would begin to leave), and tax payments may be reduced. In addition, the housing market could experience increased vacancies and decreased prices if operations workers and their families move out of the region. The impact of the job loss, however, may not be noticeable in local communities given the amount of time required for decommissioning the existing RBS facilities.

Overall, the socioeconomic impacts from the combination alternative could range from SMALL to MODERATE.

Transportation

Transportation impacts during the construction and operation of the NGCC and biomass plants would be less than the impacts for any of the previous alternatives discussed, because the construction workforce for each component and the volume of materials and equipment to be transported to each respective construction site would be smaller than each of the other alternatives.

During construction, commuting workers and trucks transporting construction materials and equipment to the work site would increase the amount of traffic on local roads. The increase in vehicular traffic would peak during shift changes, resulting in temporary levels of service impacts and delays at intersections. Transporting heavy and oversized components on local roads could have a noticeable impact over a large area. Some components and materials also could be delivered by barge. During operations, transportation impacts from the NGCC and biomass plants would be less noticeable than during construction. No incremental operations impacts would be expected for the DSM component of this alternative.

Overall, transportation impacts from the combination alternative could range from SMALL to MODERATE.

#### 7.1.3.4.9 Human Health

Impacts on human health from construction of the NGCC (including the construction of a new gas pipeline) and biomass plants would be similar to impacts associated with the construction of any major industrial facility. Compliance with OSHA worker protection rules would control those impacts on workers at acceptable levels. Impacts on the general public from construction would be minimal, because crews would limit access to active construction areas to authorized individuals. The radiological human health impact on construction workers, operations workers, and the surrounding public due to the proximity of RBS still operating at that time would also be SMALL due to compliance with NRC regulations and adherence to ALARA principles. The NRC reviewed radiation exposures to workers in its license renewal GEIS and found the impacts to be SMALL (NRC 2013b, Table 2.1-1).

Construction and operations impacts for the DSM component of the combination alternative would be minimal and localized to activities such as weatherization efficiency of an end-user's home or facility. The GEIS notes that the environmental impacts are likely to be centered on indoor air quality due to increased weatherization of the home in the form of extra insulation and reduced air turnover rates from the reduction in air leaks. However, the actual impact is highly site specific and not yet well established. (NRC 2014b, Section 8.4.6).

Human health effects of gas-fired generation are generally low, although in Table 8.2 of the GEIS (NRC 1996), the NRC identified cancer and emphysema as potential health risks from gas-fired plants. $NO_x$ emissions contribute to ozone formation, which in turn contributes to human health risks. Emission controls on the NGCC plant component of the combination alternative can be expected to maintain $NO_x$ emissions well below air quality standards established to protect human health, and emissions trading or offset requirements mean that overall $NO_x$ releases in the region would not increase. Health risks for workers may also result from handling spent catalysts used for $NO_x$ control that may contain heavy metals.

Using biomass for energy consists of the direct burning of MSW, crop residue, and/or forest residue/wood waste. Given this source of fuel for power generation, the health impacts would be similar to those found in a fossil fuel-fired electricity generating facility. As discussed in the discrete NGCC and the SCPC plant alternatives in Section 7.1.3.1.2 and Section 7.1.3.2.2, respectively, regulations restricting emissions enforced by either the EPA or delegated state agencies have reduced the potential health effects from plant emissions, but have not entirely eliminated them. These agencies also impose site-specific emission limits, as needed, to protect human health. Proper emissions controls would protect workers and the public from the harmful effects of burning the biomass fuel.

Overall, human health risks to occupational workers and members of the public from the combination alternative would be SMALL.

7.1.3.4.10 Environmental Justice

Potential impacts to minority and low-income populations from the construction and operation of the NGCC and biomass plants would consist mostly of environmental and socioeconomic effects (e.g., noise, dust, traffic, employment, and housing impacts). Noise and dust impacts during construction would be short term and primarily limited to onsite activities. Minority and low-income populations residing along site access roads would be directly affected by increased commuter vehicle traffic during shift changes and truck traffic. However, because of the temporary nature of construction, these impacts are not likely to be high and would be contained to a limited time period during certain hours of the day.

Increased demand for rental housing during construction could cause rental costs to rise, disproportionately affecting low-income populations residing in the vicinity of the RBS site who rely on inexpensive housing. However, given the small number of construction workers and the possibility that workers could commute to the construction site due to the proximity of the Baton Rouge and New Orleans metropolitan areas, and their volume of temporary and permanent housing, any upward pressure on housing expenses would not be expected to be disproportionately felt within minority or low-income populations. No incremental human health or environmental impacts related to construction would be expected from the DSM component of this alternative.

Minority and low-income populations living in close proximity to the power generating facilities could be disproportionately affected by emissions associated with the NGCC and biomass plants operations. However, because emissions are expected to remain within regulatory standards, impacts from emissions are not expected to be high and adverse.

Low-income populations could benefit from weatherization and insulation programs in a DSM energy conservation program. This could have a greater effect on low-income populations than the general population, as low-income households generally experience greater home energy burdens than the average household.

Based on this information and the analysis of human health and environmental impacts presented in Section 7.1.3.4 of this ER, the construction and operation of the combination alternative would not have disproportionately high and adverse human health and environmental effects on minority and low-income populations residing in the vicinity of the RBS site.

7.1.3.4.11 Waste Management

During the construction stage for the NGCC combination component, land clearing and other construction activities would generate wastes that could be recycled, disposed of on site, or shipped to a permitted offsite waste disposal facility. During the operations period, spent SCR catalysts, which control $NO_X$ emissions from the NGCC plants, would make up the majority of waste generated by this alternative. (NRC 2014b, Section 8.4.13) These wastes would be properly managed and disposed of as hazardous or nonhazardous wastes in permitted offsite facilities.

During construction of the biomass plants, land clearing and other construction activities would generate waste that could be recycled, disposed of on site, or shipped to a permitted offsite waste disposal facility (NRC 2014b, Section 8.4.13). A biomass plant may use as fuel the residue from forest clear cut and thinning operations and timber mill operations, crop residue, and MSW from nearby metropolitan areas. In addition to the gaseous emissions, ash would be generated. Wastes would be handled in accordance with appropriate LDEQ regulations.

For the DSM component, there may be an increase in wastes generated during installation or implementation of energy conservation measures, such as appropriate disposal of old appliances, installation of control devices, and building modifications. New and existing recycling programs would help minimize the amount of generated waste. (NRC 2014b, Section 8.4.13)

Overall, waste management impacts from the combination alternative would be SMALL.

**Table 7.1-1**
**Air Emissions from NGCC Plant Alternative**

| Emission | Annual Amount |
|---|---|
| Gas consumption | 81.4 billion $ft^3$ |
| Sulfur dioxide | 142 tons |
| Nitrogen oxides[a] | 543 tons |
| Carbon monoxide | 1,253 tons |
| Particulate matter | 276 tons |
| Nitrous oxide | 125 tons |
| Volatile organic compounds | 88 tons |
| Carbon dioxide | 4.6 million tons |

(Entergy 2015q)

a. Assumes 90-percent conversion in SCR equipment.

**Table 7.1-2**
**Air Emissions from SCPC Plant Alternative**

| Parameter | Tons/Year |
|---|---|
| Annual coal consumption | 6.7 million |
| Sulfur oxides | 2,287 |
| Nitrogen oxides | 1,207 |
| Carbon monoxide | 1,676 |
| Filterable particulate matter | 448 |
| Particulates less than 10 microns in diameter | 103 |
| Carbon dioxide | 11.8 million |

(Entergy 2015q)

**Table 7.1-3**
**Solid Waste from SCPC Plant Alternative**

| Parameter | Amount |
|---|---|
| Annual $SO_2$ generated | 52,203 tons per year |
| Annual $SO_2$ captured | 49,593 tons per year |
| Annual scrubber waste | 142,361 tons per year |
| Annual scrubber waste disposed based on 90-percent recycling | 14,236 tons per year |
| Annual ash generated | 447,544 tons per year |
| Annual ash disposed based on 50-percent recycling | 223,772 tons per year |
| Annual total waste disposed assuming no recycling | 589,905 tons per year |
| Annual total waste disposed assuming recycling | 238,008 tons per year |
| Waste pile area (40-year period) assuming no recycling | 334 acres, 30 feet high |
| Waste pile area (40-year period) assuming recycling | 143 acres, 30 feet high |

(Entergy 2015q)

## Table 7.1-4
## Air Emissions from NGCC Plant Combination Alternative

| Emission | Annual Amount |
|---|---|
| Gas consumption | 54.3 billion $ft^3$ |
| Sulfur dioxide | 95 tons |
| Nitrogen oxides[a] | 362 tons |
| Carbon monoxide | 835 tons |
| Particulate matter | 184 tons |
| Nitrous oxide | 84 tons |
| Volatile organic compounds | 58 tons |
| Carbon dioxide | 3.1 million tons |

(Entergy 2015q)

a. Assumes 90-percent conversion in SCR equipment.

## 7.2 Alternatives for Reducing Adverse Impacts

### 7.2.1 Alternatives Considered

As noted in 10 CFR 51.53(c)(3)(iii), "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" (NRC 2013a, Section 7.2). The review of the environmental impacts associated with the Category 2 issues required by 10 CFR 51.53(c)(3)(ii) provided in Chapter 4 identified no significant adverse effects that would warrant consideration of additional alternatives to reduce or avoid those impacts. Based on the Chapter 4 analysis, Entergy concludes that the impacts of renewal of the RBS OL do not warrant additional consideration of alternatives for reducing adverse impacts, as specified in NRC Regulatory Guide 4.2, Revision 1 (NRC 2013a, Section 7.2), and existing mitigation measures discussed in Section 6.2 and listed in Table 6.1-1 to avoid, reduce the severity of, or eliminate adverse impacts are adequate for minimizing adverse impacts.

### 7.2.2 Environmental Impacts of Alternatives for Reducing Adverse Impacts

As discussed in Section 7.2.1 above, there were no alternatives identified by Entergy to further warrant additional consideration for reducing adverse impacts associated with the renewal of the RBS OL.

## 7.3 No-Action Alternative

### 7.3.1 Proposed Action

The proposed action is to renew the RBS OL, which would preserve the option for Entergy to continue to operate RBS to provide reliable base-load power and meet future system generating needs throughout the 20-year license renewal period. The analysis of the environmental impacts required by 10 CFR 51.53(c)(3)(ii) and presented in Chapter 4 identified no significant adverse effects from the continued operation of RBS during the license renewal period.

### 7.3.2 No-Action Alternative

The "no-action alternative" to the proposed action is to not renew the RBS OL. In this alternative, it is expected that RBS would continue to operate up through the end of the existing OL, at which time plant operations would cease and decommissioning would begin (Section 7.3.3). 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, such as those identified in Section 7.1.1 of this ER. In effect, the net environmental impacts would be transferred from the continued operation of RBS to the environmental impacts associated with the construction and operation of a new generating facility or a combination of facilities. Therefore, the no-action alternative would have no net environmental benefits.

The environmental impacts associated with the proposed action (continued operation of RBS) were compared to the environmental impacts from the no-action alternative (decommissioning of RBS) and the construction and operation of other reasonable sources of electricity generation. Entergy believes this comparison shows that the continued operation of RBS would produce no significant environmental impacts, while the no-action alternative would have greater impacts than the proposed action on certain environmental resources as described in Section 7.1.3.

In addition, $CO_2$ emissions are suspected to be a major contributor to anthropogenic GHG emissions, which some scientists believe contribute to climate change. The burning of fossil fuels (coal, natural gas, and petroleum) is the largest energy-related contributor to $CO_2$ emissions in the world. Table 7.3-1 shows the amount of $CO_2$ released by the consumption of various fuel sources to produce electricity. This table illustrates that all fossil fuel-based energy sources produce GHG emissions, whereas nuclear power produces none. In addition, as discussed in Section 7.1.3.3.2, GHG emissions associated with nuclear power are similar to the life-cycle GHG emissions from renewable energy sources. Therefore, under the proposed action, millions of tons of GHGs would be avoided, thereby resulting in a beneficial air quality impact.

### 7.3.3 Decommissioning Impacts

The NRC defines decommissioning as the safe removal of a nuclear facility from service and the reduction of residual radioactivity to a level that permits (1) release of the property for unrestricted use and termination of the license, or (2) release of the property under restricted conditions and termination of the license [10 CFR 20.1003]. NRC-evaluated decommissioning options include (1) immediate dismantling soon after the facility closes and prompt decontamination (DECON); (2) safe storage and monitoring of the facility for a period of time that allows the radioactivity to decay, followed by dismantling and additional decontamination (SAFSTOR); and (3) permanent entombment on site in structurally sound material, such as concrete, appropriately maintained and monitored (ENTOMB). Regardless of the option chosen, decommissioning must be completed within the 60-year period following permanent cessation of operations and permanent removal of fuel.

Under the no-action alternative, Entergy would continue operating RBS until the existing OL expires, and then initiate decommissioning activities in accordance with NRC requirements. As the GEIS notes, the NRC has evaluated environmental impacts from decommissioning. NRC-evaluated impacts include those associated with land use, visual resources, air quality, noise, geology and soils, hydrology, ecology, historic and cultural resources, socioeconomics, human health, environmental justice, and waste management and pollution prevention. Entergy considers NRC's evaluation of these impacts in the GEIS to be reasonably representative of actions that Entergy would perform for decommissioning of RBS. Therefore, Entergy relies on the NRC conclusions regarding environmental impacts of decommissioning RBS.

Entergy notes that decommissioning activities and their impacts are not discriminators between the proposed action and the no-action alternative. RBS will have to be decommissioned eventually, regardless of the NRC decision on license renewal; license renewal would only postpone decommissioning for another 20 years. The NRC has established in the GEIS that the timing of decommissioning operations does not substantially influence the environmental impacts of decommissioning.

Entergy relies on NRC findings [10 CFR Part 51, Subpart A, Appendix B, Table B-1] to the effect that delaying decommissioning until after the renewal term would have SMALL environmental impacts. The discriminators between the proposed action and the no-action alternative lie within the choice of power generation replacement options to be part of the no-action alternative. Section 7.1.3 analyzes the impacts from these options.

Entergy concludes that the decommissioning impacts under the no-action alternative would not be substantially different from those following license renewal as identified in the GEIS and in the decommissioning generic environmental impact statement. Decommissioning impacts under the no-action alternative would be temporary and could overlap with operation of an RBS replacement.

## Table 7.3-1
## Carbon Dioxide Emissions from Electricity Generation

| Fuel | Pounds $CO_2$ per Million Btu |
|---|---|
| Bituminous coal[a] | 205 |
| Sub-bituminous coal[a] | 213 |
| Lignite coal[a] | 215 |
| Natural gas[a] | 117 |
| Distillate oil (No. 2)[a] | 161 |
| Residual oil (No. 6)[a] | 174 |
| Nuclear | 0 |
| Renewable sources | 0 |

a. (EIA 2015b)

# 8.0 COMPARISON OF THE ENVIRONMENTAL IMPACT OF LICENSE RENEWAL WITH THE ALTERNATIVES

> To the extent practicable, the environmental impacts of the proposal and the alternatives should be presented in comparative form . . . . [10 CFR 51.45(b)(3)]

The proposed action is renewal of the RBS OL, which would preserve the option to continue to operate RBS to provide reliable base-load power and meet Entergy's future system generating needs throughout the 20-year license renewal period. Chapter 4 analyzes environmental impacts of the proposed action, and Chapter 7 describes potential energy alternatives to the proposed action, and analyzes impacts from the alternatives deemed to be reasonable.

Table 8.0-1 summarizes the environmental impacts of the proposed action and the alternatives deemed reasonable, for comparison purposes. Table 8.0-2 provides a more detailed comparison. The environmental impacts compared in Tables 8.0-1 and 8.0-2 are either Category 2 issues that apply to the proposed action or issues that the GEIS identified as major considerations in an alternatives analysis.

As shown in Tables 8.0-1 and 8.0-2, there are no reasonable alternatives superior to that of the continued operation of RBS, providing approximately 967 net MWe of reliable base-load power generation. The continued operation of RBS would create significantly less environmental impact than the construction and operation of new alternative generating capacity. In addition, the continued operation of RBS will have a significant positive economic impact on the communities surrounding the station, such as reduced local unemployment, economic support of surrounding communities, and lower energy costs.

**Table 8.0-1**
**Environmental Impacts Comparison Summary**

| | | No-Action Alternative | | | | |
|---|---|---|---|---|---|---|
| **Impact Area[a]** | **Proposed Action** | **Decommissioning** | **NGCC Plant Alternative** | **SCPC Plant Alternative** | **New Nuclear Plant Alternative** | **Combination of Alternatives** |
| Land Use | SMALL | SMALL | SMALL | SMALL to MODERATE | SMALL | SMALL to MODERATE |
| Visual Resources | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL |
| Air Quality | SMALL | SMALL | SMALL to MODERATE | SMALL to MODERATE | SMALL | SMALL to MODERATE |
| Noise | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL |
| Geology and Soils | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL |
| Surface Water | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL |
| Groundwater | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL |
| Aquatic | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL |
| Terrestrial | SMALL | SMALL | SMALL | SMALL to MODERATE | SMALL | SMALL |
| Special Status Species | NO EFFECT | NO EFFECT | NO EFFECT | NO EFFECT | NO EFFECT | NO EFFECT |
| Historic and Cultural | NO ADVERSE EFFECT | NO ADVERSE EFFECT | NO ADVERSE EFFECT | NO ADVERSE EFFECT | NO ADVERSE EFFECT | NO ADVERSE EFFECT |
| Socioeconomics | SMALL | SMALL | SMALL to MODERATE | SMALL to MODERATE | SMALL to MODERATE | SMALL to MODERATE |

**Table 8.0-1 (Continued)**
**Environmental Impacts Comparison Summary**

| | | No-Action Alternative | | | | |
|---|---|---|---|---|---|---|
| **Impact Area[a]** | **Proposed Action** | **Decommissioning** | **NGCC Plant Alternative** | **SCPC Plant Alternative** | **New Nuclear Plant Alternative** | **Combination of Alternatives** |
| Human Health | SMALL | SMALL | SMALL | SMALL | SMALL | SMALL |
| Environmental Justice | (b) | (b) | (b) | (b) | (b) | (b) |
| Waste Management | SMALL | SMALL | SMALL | SMALL to MODERATE | SMALL | SMALL |

a. As defined in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, Footnote 3,
SMALL: Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
MODERATE: Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.
LARGE: Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

b. This alternative would not have disproportionately high and adverse human health and environmental effects on minority and low-income populations in the vicinity of RBS.

**Table 8.0-2 (Sheet 1 of 16)**
**Environmental Impacts Comparison Detail**

| Summary of Replacement Power Alternatives and Key Characteristics | | | | |
|---|---|---|---|---|
| | **NGCC Alternative** | **SCPC Alternative** | **New Nuclear Alternative** | **Combination Alternative** |
| **Summary of Alternative** | Multiple combustion turbines for a total of 1,044 net MWe. | SCPC plant with CCS for a total of 1,020 net MWe. | One-unit nuclear plant for a total of 1,080 net MWe. | Multiple NGCC combustion turbines for a total of 696 net MWe; four biomass plants for a total of 166 net MWe; and 105 MWe from DSM. |
| **Location** | At RBS site. | At RBS site. | At RBS site. | At RBS site. |
| **Cooling System** | Closed-cycle cooling with mechanical draft cooling towers; some infrastructure upgrades may be required. | Closed-cycle cooling with mechanical draft cooling towers; some infrastructure upgrades may be required. | Closed-cycle cooling with mechanical draft cooling towers; some infrastructure upgrades may be required. | Closed-cycle cooling with mechanical draft cooling towers; some infrastructure upgrades may be required. |
| **Land Requirements** | 24 acres for the plant; 4,320 acres needed for gas extraction and collection, offset by elimination of approximately 967 acres for uranium mining for RBS. | 60 acres for the plant; 3,720 to 26,400 acres for coal mining; 143 to 334 acres for waste disposal, offset by elimination of approximately 967 acres for uranium mining for RBS. | 43 acres for the plant; no net change in offsite land use for uranium mining and processing. | 16 acres for the NGCC plant and 2,880 acres needed for gas extraction and collection, offset by elimination of approximately 967 acres for uranium mining for RBS; 60 acres needed for the biomass plants. |
| **Workforce** | 1,440 during peak construction; 180 during operations. | 1,440 to 3,000 during peak construction; 300 during operations. | 2,100 during peak construction; workforce similar to RBS during operations. | 960 during peak construction of NGCC plant and 120 during operations; 200 during peak construction of the biomass plants and 88 during operations. |

**Table 8.0-2 (Sheet 2 of 16)**
**Environmental Impacts Comparison Detail**

| Land Use | |
|---|---|
| Proposed action | **SMALL**: Adopting by reference the Category 1 issue findings in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 for the following:<br>Onsite land use<br>Offsite land use |
| Decommissioning | **SMALL**: Adopting by reference the Category 1 issue finding for termination of plant operations and decommissioning in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. |
| NGCC plant alternative | **SMALL**: Plant to be constructed on previously disturbed land; no encroachment into wetlands; new gas pipeline may be collocated within existing ROW. |
| SCPC plant alternative | **SMALL to MODERATE**: Plant to be constructed on previously disturbed land; no encroachment into wetlands; land required for coal mining and processing to support SCPC plant operations could range from 3,720 to 26,400 acres. |
| New nuclear plant alternative | **SMALL**: Plant to be constructed on previously disturbed land; no encroachment into wetlands; during operations, no net change in offsite land use impacts as a result of uranium mining. |
| Combination of alternatives | **SMALL to MODERATE**: NGCC and biomass plants to be constructed on previously disturbed land; no encroachment into wetlands; new gas pipeline may be collocated within existing ROW; impacts from biomass plants depend on characteristics of affected forested lands and effects of storing, loading, and transporting biomass feedstock; DSM would have little to no direct land use impacts. |

## Table 8.0-2 (Sheet 3 of 16)
## Environmental Impacts Comparison Detail

| Visual Resources | |
|---|---|
| Proposed action | **SMALL**: Adopting by reference the Category 1 issue finding for aesthetic impacts in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. |
| Decommissioning | **SMALL**: Adopting by reference the Category 1 issue finding for termination of plant operations and decommissioning in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. |
| NGCC plant alternative | **SMALL**: Construction activities and permanent plant structures are not anticipated to be visible off site due to presence of a significant tree buffer around the site; condensate plumes from mechanical draft cooling towers could potentially be visible off site. |
| SCPC plant alternative | **SMALL**: Construction activities and permanent plant structures are not anticipated to be visible off site due to presence of a significant tree buffer around the site; condensate plumes from mechanical draft cooling towers could potentially be visible off site. |
| New nuclear plant alternative | **SMALL**: Construction activities and permanent plant structures are not anticipated to be visible off site due to presence of a significant tree buffer around the site; condensate plumes from mechanical draft cooling towers could potentially be visible off site. |
| Combination of alternatives | **SMALL**: Construction activities and permanent plant structures are not anticipated to be visible off site due to presence of a significant tree buffer around the site; condensate plumes from mechanical draft cooling towers could potentially be visible off site; no impacts would be expected from the DSM component. |

**Table 8.0-2 (Sheet 4 of 16)**
**Environmental Impacts Comparison Detail**

| Air Quality | |
|---|---|
| Proposed action | **SMALL**: Adopting by reference the Category 1 issue findings in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 for the following:<br>Air quality impacts (all plants)<br>Air quality effects of transmission lines |
| Decommissioning | **SMALL**: Adopting by reference the Category 1 issue finding for termination of plant operations and decommissioning in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. |
| NGCC plant alternative | **SMALL to MODERATE**: Construction impacts would be temporary; emission estimates during the operations period are as follows:<br>Sulfur dioxide = 142 tons per year<br>Nitrogen oxides = 543 tons per year<br>Carbon monoxide = 1,253 tons per year<br>Particulate matter = 276 tons per year<br>Nitrous oxide = 125 tons per year<br>Volatile organic compounds = 88 tons per year<br>Carbon dioxide = 4.6 million tons per year |
| SCPC plant alternative | **SMALL to MODERATE**: Construction impacts would be temporary; emission estimates during the operations period are as follows:<br>Sulfur dioxide = 2,287 tons per year<br>Nitrogen oxides = 1,207 tons per year<br>Carbon monoxide = 1,676 tons per year<br>Filterable particulate matter = 448 tons per year<br>Particulates less than 10 microns in diameter = 103 tons per year<br>Carbon dioxide = 11.8 million tons per year |
| New nuclear plant alternative | **SMALL**: Construction impacts would be temporary; operations impacts would be minor with emissions from combustion sources and cooling towers being maintained within federal and state regulatory limits. |
| Combination of alternatives | **SMALL to MODERATE**: Construction impacts would be temporary; emission estimates during the operations period are as follows:<br>*NGCC Plant*<br>Sulfur dioxide = 95 tons per year<br>Nitrogen oxides = 362 tons per year<br>Carbon monoxide = 835 tons per year<br>Particulate matter = 184 tons per year<br>Nitrous oxide = 84 tons per year<br>Volatile organic compounds = 58 tons per year<br>Carbon dioxide = 3.1 million tons per year<br>*Biomass Plants*<br>Sulfur dioxide = 1,051 tons<br>Nitrogen oxide = 5,869 tons<br>Carbon dioxide = 890,016 tons<br>Air quality impacts associated with DSM would be negligible. |

**Table 8.0-2 (Sheet 5 of 16)**
**Environmental Impacts Comparison Detail**

| Noise | |
|---|---|
| Proposed action | **SMALL**: Adopting by reference the Category 1 issue finding for noise impacts in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. |
| Decommissioning | **SMALL**: Adopting by reference the Category 1 issue finding for termination of plant operations and decommissioning in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. |
| NGCC plant alternative | **SMALL**: Noise impacts from construction activities would be intermittent and last only through the duration of construction; noise impacts during operations are not anticipated to be greater than those currently associated with RBS. |
| SCPC plant alternative | **SMALL**: Noise impacts from construction activities would be intermittent and last only through the duration of construction; noise impacts during operations are not anticipated to be greater than those currently associated with RBS. |
| New nuclear plant alternative | **SMALL**: Noise impacts from construction activities would be intermittent and last only through the duration of construction; noise impacts during operations are not anticipated to be greater than those currently associated with RBS. |
| Combination of alternatives | **SMALL**: Noise impacts from construction activities would be intermittent and last only through the duration of construction; noise impacts during operations are not anticipated to be greater than those currently associated with RBS; no impacts would be expected from the DSM component. |

**Table 8.0-2 (Sheet 6 of 16)**
**Environmental Impacts Comparison Detail**

| Geology and Soils | |
|---|---|
| Proposed action | **SMALL**: Adopting by reference the Category 1 issue finding for geology and soils in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. |
| Decommissioning | **SMALL**: Adopting by reference the Category 1 issue finding for termination of plant operations and decommissioning in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. |
| NGCC plant alternative | **SMALL**: Construction activities would be localized and reduced with implementation of BMPs; land disturbance activities during operations would be conducted in compliance with a stormwater permit and associated BMPs. |
| SCPC plant alternative | **SMALL**: Construction activities would be localized and reduced with implementation of BMPs; land disturbance activities during operations would be conducted in compliance with a stormwater permit and associated BMPs. |
| New nuclear plant alternative | **SMALL**: Construction activities would be localized and reduced with implementation of BMPs; land disturbance activities during operations would be conducted in compliance with a stormwater permit and associated BMPs. |
| Combination of alternatives | **SMALL**: Construction activities would be localized and reduced with implementation of BMPs; land disturbance activities during operations would be conducted in compliance with a stormwater permit and associated BMPs; no impacts would be expected from the DSM component. |

## Table 8.0-2 (Sheet 7 of 16)
## Environmental Impacts Comparison Detail

| Surface Water | |
|---|---|
| Proposed action | **SMALL**: Adopting by reference the Category 1 issue findings in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 for the following:<br>Surface water use and quality (non-cooling system impacts)<br>Altered current patterns at intake and discharge structures<br>Scouring caused by discharged cooling water<br>Discharge of metals in cooling system effluent<br>Discharge of biocides, sanitary wastes, and minor chemical spills<br>Effects of dredging on surface water quality<br>Temperature effects on sediment transport capacity<br>**SMALL**[(a)] (Surface water use conflicts—plants with cooling ponds or cooling towers using makeup water from a river): Water withdrawals represent 0.04 percent of Mississippi River flow; water consumption represents 0.03 percent of river flow; withdrawals and consumption expected to remain at current rates. |
| Decommissioning | **SMALL**: Adopting by reference the Category 1 issue finding for termination of plant operations and decommissioning in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. |
| NGCC plant alternative | **SMALL**: No direct usage of surface water during construction; construction impacts would be minimized through implementation of BMPs; during operations, cooling tower water consumption would be insignificant compared to the volume of water flowing in the Mississippi River; cooling water discharges would be regulated under an LPDES permit. |
| SCPC plant alternative | **SMALL**: No direct usage of surface water during construction; construction impacts would be minimized through implementation of BMPs; during operations, cooling tower water consumption would be insignificant compared to the volume of water flowing in the Mississippi River; cooling water discharges would be regulated under an LPDES permit. |
| New nuclear plant alternative | **SMALL**: No direct usage of surface water during construction; construction impacts would be minimized through implementation of BMPs; during operations, cooling tower water consumption would be insignificant compared to the volume of water flowing in the Mississippi River; cooling water discharges would be regulated under an LPDES permit. |
| Combination of alternatives | **SMALL**: No direct usage of surface water during construction; construction impacts would be minimized through implementation of BMPs; during operations, cooling tower water consumption would be insignificant compared to the volume of water flowing in the Mississippi River; cooling water discharges would be regulated under an LPDES permit; no impacts would be expected from the DSM component. |

a. Category 2 issue requiring site-specific evaluation.

## Table 8.0-2 (Sheet 8 of 16)
## Environmental Impacts Comparison Detail

| Groundwater | |
|---|---|
| Proposed action | **SMALL**: Adopting by reference the Category 1 issue findings in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 for the following:<br>Groundwater contamination and use (non-cooling system impacts)<br>Groundwater use conflicts (plants that withdraw less than 100 gpm)<br>**SMALL**[(a)] (Groundwater use conflicts—plants with closed-cycle cooling systems that withdraw makeup water from a river): Onsite groundwater withdrawals less than 100 gpm; surface water withdrawals represent 0.04 percent of Mississippi River flow; surface water consumption represents 0.03 percent of river flow; water withdrawals and consumption expected to remain at current rates.<br>**SMALL**[(a)] (Radionuclides released to groundwater): Tritium-contaminated groundwater confined within the RBS property; groundwater flow at the site is in a southwesterly direction toward the Mississippi River; no offsite wells will be affected; no tritium has been detected in groundwater wells used for plant industrial purposes. |
| Decommissioning | **SMALL**: Adopting by reference the Category 1 issue finding for termination of plant operations and decommissioning in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. |
| NGCC plant alternative | **SMALL**: During construction and operations, potable water would be supplied by West Feliciana Parish Consolidated Water District No. 13; BMPs would minimize impacts to groundwater quality as a result of stormwater runoff during construction and operation. |
| SCPC plant alternative | **SMALL**: During construction and operations, potable water would be supplied by West Feliciana Parish Consolidated Water District No. 13; BMPs would minimize impacts to groundwater quality as a result of stormwater runoff during construction and operation. |
| New nuclear plant alternative | **SMALL**: During construction and operations, potable water would be supplied by West Feliciana Parish Consolidated Water District No. 13; BMPs would minimize impacts to groundwater quality as a result of stormwater runoff during construction and operation. |
| Combination of alternatives | **SMALL**: During construction and operations, potable water would be supplied by West Feliciana Parish Consolidated Water District No. 13; BMPs would minimize impacts to groundwater quality as a result of stormwater runoff during construction and operation; no impacts would be expected from the DSM component. |

a. Category 2 issue requiring site-specific evaluation.

**Table 8.0-2 (Sheet 9 of 16)**
**Environmental Impacts Comparison Detail**

| Aquatic | |
|---|---|
| Proposed action | **SMALL**: Adopting by reference the Category 1 issue findings in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 for the following:<br>Impingement and entrainment of aquatic organisms (plants with cooling towers)<br>Entrainment of phytoplankton and zooplankton (all plants)<br>Thermal impacts on aquatic organisms (plants with cooling towers)<br>Infrequently reported thermal impacts (all plants)<br>Effects of cooling water discharge on dissolved oxygen, gas supersaturation, and eutrophication<br>Effects of nonradiological contaminants on aquatic organisms<br>Exposure of aquatic organisms to radionuclides<br>Effects of dredging on aquatic organisms<br>Effects on aquatic resources (non-cooling system impacts)<br>Impacts of transmission line right-of-way management on aquatic resources<br>Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses<br>**SMALL**[a] (Water use conflicts with aquatic resources—plants with cooling ponds or cooling towers using makeup water from a river): Water withdrawals represent 0.04 percent of Mississippi River flow; water consumption represents 0.03 percent of river flow; withdrawals and consumption expected to remain at current rates. |
| Decommissioning | **SMALL**: Adopting by reference the Category 1 issue finding for termination of plant operations and decommissioning in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. |
| NGCC plant alternative | **SMALL**: Implementation of BMPs would minimize impacts on aquatic ecosystems during construction; during operations, water withdrawals and discharges would be similar to RBS and would be governed under an LPDES permit. |
| SCPC plant alternative | **SMALL**: Implementation of BMPs would minimize impacts on aquatic ecosystems during construction; during operations, water withdrawals and discharges would be similar to RBS and would be governed under an LPDES permit. |
| New nuclear plant alternative | **SMALL**: Implementation of BMPs would minimize impacts on aquatic ecosystems during construction; during operations, water withdrawals and discharges would be similar to RBS and would be governed under an LPDES permit. |
| Combination of alternatives | **SMALL**: Implementation of BMPs would minimize impacts on aquatic ecosystems during construction; during operations, water withdrawals and discharges would be similar to RBS and would be governed under an LPDES permit; no impacts would be expected from the DSM component. |

a. Category 2 issue requiring site-specific evaluation.

## Table 8.0-2 (Sheet 10 of 16)
## Environmental Impacts Comparison Detail

| Terrestrial | |
|---|---|
| Proposed action | **SMALL**: Adopting by reference the Category 1 issue findings in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 for the following:<br>Exposure of terrestrial organisms to radionuclides<br>Cooling tower impacts on vegetation (plants with cooling towers)<br>Bird collisions with plant structures and transmission lines<br>Transmission line ROW management impacts on terrestrial resources<br>Electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock)<br>**SMALL**[a] (Effects on terrestrial resources—non-cooling system impacts): No license-renewal-related refurbishment or construction activities identified; adequate management programs and regulatory controls in place to ensure that important plant and animal habitats are protected.<br>**SMALL**[a] (Water use conflicts with terrestrial resources—plants with cooling ponds or cooling towers using makeup water from a river): Water withdrawals represent 0.04 percent of Mississippi River flow; water consumption represents 0.03 percent of river flow; withdrawals and consumption expected to remain at current rates. |
| Decommissioning | **SMALL**: Adopting by reference the Category 1 issue finding for termination of plant operations and decommissioning in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. |
| NGCC plant alternative | **SMALL**: Impacts would be limited to previously disturbed areas during construction with appropriate BMPs implemented; wetlands would be unaffected; siting gas pipeline along existing ROWs would minimize impacts; cooling tower impacts similar to other nuclear plants with cooling towers; all other operations impacts would be similar to that of the continued operation of RBS. |
| SCPC plant alternative | **SMALL to MODERATE**: Impacts limited to previously disturbed areas during construction with appropriate BMPs implemented; wetlands would be unaffected; land required for coal mining and processing to support plant operations could range from 3,720 to 26,400 acres; onsite temporary storage of coal, CCR, spent catalysts, and scrubber sludge would occur on previously disturbed land. |
| New nuclear plant alternative | **SMALL**: Impacts would be limited to previously disturbed areas during construction with appropriate BMPs implemented; wetlands would be unaffected; cooling tower impacts would be similar to other nuclear plants with cooling towers; all other operations impacts would be similar to that of the continued operation of RBS. |
| Combination of alternatives | **SMALL**: Impacts would be limited to previously disturbed areas during construction with appropriate BMPs implemented; wetlands would be unaffected; cooling tower impacts would be similar to other nuclear plants with cooling towers; all other operations impacts would be similar to that of the continued operation of RBS; no impacts would be expected from the DSM component. |

a. Category 2 issue requiring site-specific evaluation.

## Table 8.0-2 (Sheet 11 of 16)
## Environmental Impacts Comparison Detail

| Special Status Species | |
|---|---|
| Proposed action | **NO EFFECT**: No license-renewal-related refurbishment or construction activities identified; no species or habitats under NMFS's jurisdiction occur within the action area; management and regulatory programs in place to protect special status species. |
| Decommissioning | **NO EFFECT**: Adopting by reference the Category 1 issue finding for termination of plant operations and decommissioning in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. |
| NGCC plant alternative | **NO EFFECT**: Construction activities to occur on already disturbed land; operational impacts are anticipated to be similar to that of RBS; construction of gas pipeline subject to LDEQ construction stormwater permitting requirements. |
| SCPC plant alternative | **NO EFFECT**: Construction activities to occur on already disturbed land; operational impacts are anticipated to be similar to that of RBS. |
| New nuclear plant alternative | **NO EFFECT**: Construction activities to occur on already disturbed land; operational impacts are anticipated to be similar to that of RBS. |
| Combination of alternatives | **NO EFFECT**: Construction activities to occur on already disturbed land; operational impacts are anticipated to be similar to that of RBS; no impacts would be expected from the DSM component. |

**Table 8.0-2 (Sheet 12 of 16)**
**Environmental Impacts Comparison Detail**

| Historic and Cultural Resources | |
|---|---|
| Proposed action | **NO ADVERSE EFFECT**: No license-renewal-related refurbishment or construction activities identified; administrative controls ensure protection of cultural resources in the event of excavation activities. |
| Decommissioning | **NO ADVERSE EFFECT**: Adopting by reference the Category 1 issue finding for termination of plant operations and decommissioning in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. |
| NGCC plant alternative | **NO ADVERSE EFFECT**: Previously surveyed and/or disturbed areas to be utilized during construction; avoidance of significant historic and archaeological resources during operations can be effectively managed under current laws and regulations. |
| SCPC plant alternative | **NO ADVERSE EFFECT**: Previously surveyed and/or disturbed areas to be utilized during construction; avoidance of significant historic and archaeological resources during operations can be effectively managed under current laws and regulations. |
| New nuclear plant alternative | **NO ADVERSE EFFECT**: Previously surveyed and/or disturbed areas to be utilized during construction; avoidance of significant historic and archaeological resources during operations can be effectively managed under current laws and regulations. |
| Combination of alternatives | **NO ADVERSE EFFECT**: Previously surveyed and/or disturbed areas to be utilized during construction; avoidance of significant historic and archaeological resources during operations can be effectively managed under current laws and regulations; no impacts would be expected from the DSM component. |

**Table 8.0-2 (Sheet 13 of 16)**
**Environmental Impacts Comparison Detail**

| Socioeconomics | |
|---|---|
| Proposed action | **SMALL**: Adopting by reference the Category 1 issue findings in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 for the following:<br>Employment and income, recreation and tourism<br>Tax revenues<br>Community services and education<br>Population and housing<br>Transportation |
| Decommissioning | **SMALL**: Adopting by reference the Category 1 issue finding for termination of plant operations and decommissioning in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. |
| NGCC plant alternative | **SMALL to MODERATE**: Majority of construction workers would reside within the region; in-migrating workers would be temporary; traffic congestion during construction could be minimized but would still be noticeable; smaller operations workforce and loss of jobs at RBS on the area economy could be noticeable; traffic-related transportation impacts would be reduced after construction. |
| SCPC plant alternative | **SMALL to MODERATE**: Majority of construction workers would reside within the region; in-migrating workers would be temporary; traffic congestion during construction could be minimized but would still be noticeable; smaller operations workforce and loss of jobs at RBS on the area economy could be noticeable; traffic-related transportation impacts would be reduced after construction. |
| New nuclear plant alternative | **SMALL to MODERATE**: Majority of construction workers would reside within the region; in-migrating workers would be temporary; traffic congestion during construction could be minimized but would still be noticeable; number of operations workforce would be similar to that of RBS; economic contributions locally and regionally would remain generally the same; could be a temporary increase in employment from decommissioning activities; traffic-related transportation impacts would be reduced after construction. |
| Combination of alternatives | **SMALL to MODERATE**: Majority of construction workers would reside within the region; in-migrating workers would be temporary; traffic congestion during construction could be minimized but would still be noticeable; smaller operations workforce and loss of jobs at RBS on the area economy could be noticeable; traffic-related transportation impacts would be reduced after construction; DSM component would not have a noticeable effect on the local economy. |

## Table 8.0-2 (Sheet 14 of 16)
## Environmental Impacts Comparison Detail

| Human Health | |
|---|---|
| Proposed action | **SMALL**: Adopting by reference the Category 1 issue findings in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 for the following:<br>Radiation exposures to the public<br>Radiation exposures to plant workers<br>Human health impact from chemicals<br>Microbiological hazards to plant workers<br>Physical occupational hazards<br>**SMALL**[a] (Public health—plants using lakes or canals, or cooling towers or cooling ponds that discharge to a river): Conditions necessary for optimal growth are limited at discharge area; discharge flow rate minor when compared with Mississippi River flows; point of discharge of heated effluent not typically utilized for primary contact recreation; and from 2005 to 2013, no reported cases of *Naegleria* infection attributable to Mississippi River.<br>**SMALL**[a] (Electric shock hazards): Transmission lines constructed to meet NESC 5-mA Rule; transmission lines located entirely within RBS property; occupational safety and health measures in place to protect plant workers from shock hazards associated with overhead lines.<br>**SMALL**[a] (SAMA): Potentially cost-effective SAMAs are not related to adequately managing the effects of aging during the period of extended operation. |
| Decommissioning | **SMALL**: Adopting by reference the Category 1 issue finding for termination of plant operations and decommissioning in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. |
| NGCC plant alternative | **SMALL**: Compliance with OSHA worker protection rules would control impacts on workers at acceptable levels during construction and operations; air emissions would be subject to regulatory standards that are protective of human health. |
| SCPC plant alternative | **SMALL**: Compliance with OSHA worker protection rules would control impacts on workers at acceptable levels during construction and operations; air emissions would be subject to regulatory standards that are protective of human health. |
| New nuclear plant alternative | **SMALL**: Compliance with OSHA worker protection rules would control impacts on workers at acceptable levels during construction; human health impacts during operation would be similar to RBS. |
| Combination of alternatives | **SMALL**: Compliance with OSHA worker protection rules would control impacts on workers at acceptable levels during construction and operations; air emissions would be subject to regulatory standards that are protective of human health; impacts from DSM component would be minimal and localized. |

a. Category 2 issue requiring site-specific evaluation.

**Table 8.0-2 (Sheet 15 of 16)**
**Environmental Impacts Comparison Detail**

| Environmental Justice | |
|---|---|
| Proposed action | There are no known pathways by which disproportionately high and adverse impacts could be imposed on minority or low-income populations from the proposed action of renewing the RBS OL. |
| Decommissioning | Adopting by reference the Category 1 issue finding for termination of plant operations and decommissioning in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. |
| NGCC plant alternative | There are no known pathways by which disproportionately high and adverse impacts could be imposed on minority or low-income populations from the construction and operation of an NGCC plant alternative. |
| SCPC plant alternative | There are no known pathways by which disproportionately high and adverse impacts could be imposed on minority or low-income populations from the construction and operation of an SCPC plant alternative. |
| New nuclear plant alternative | There are no known pathways by which disproportionately high and adverse impacts could be imposed on minority or low-income populations from the construction and operation of a new nuclear plant alternative. |
| Combination of alternatives | There are no known pathways by which disproportionately high and adverse impacts could be imposed on minority or low-income populations from the construction and operation of the combination alternative. |

## Table 8.0-2 (Sheet 16 of 16)
## Environmental Impacts Comparison Detail

| Waste Management | |
|---|---|
| Proposed action | **SMALL**: Adopting by reference the Category 1 issue findings in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 for the following:<br>Low-level waste storage and disposal<br>Onsite storage of spent nuclear fuel<br>Offsite radiological impacts of spent nuclear fuel and high-level waste disposal<br>Mixed-waste storage and disposal<br>Nonradioactive waste storage and disposal |
| Decommissioning | **SMALL**: Adopting by reference the Category 1 issue finding for termination of plant operations and decommissioning in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. |
| NGCC plant alternative | **SMALL**: Construction-related wastes would be properly characterized and disposed of at permitted offsite facilities; spent SCR catalysts would make up the majority of the waste during operations; operations-related wastes would be managed and recycled or disposed of at permitted offsite facilities. |
| SCPC plant alternative | **SMALL to MODERATE**: Construction-related wastes would be properly characterized and disposed of at permitted offsite facilities; scrubber and ash wastes disposed of annually would total 238,008 tons per year if recycling options are available; without recycling, scrubber and ash wastes disposed of annually would be 589,905 tons per year. |
| New nuclear plant alternative | **SMALL**: Construction-related wastes would be properly characterized and disposed of at permitted offsite facilities; during operations, nonhazardous, hazardous, and radioactive wastes would be managed in compliance with federal and state regulations and disposed of at permitted offsite facilities. |
| Combination of alternatives | **SMALL**: Construction-related wastes would be properly characterized and disposed of at permitted offsite facilities; during operations, spent SCR catalysts would make up the majority of the NGCC plant waste while ash would make up the majority of the biomass plants' waste; operations-related wastes would be managed and recycled or disposed of at permitted offsite facilities; recycling programs would minimize DSM-generated waste. |

# 9.0 STATUS OF COMPLIANCE

In accordance with 10 CFR 51.45(d), the ER 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 ER 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 RBS Authorizations

Table 9.1-1 provides a summary of authorizations held by RBS for current plant operations. Authorizations in this context include any permits, licenses, approvals, or other entitlements that would continue to be in place as appropriate throughout the period of extended operation given their respective renewal schedules as applicable. Table 9.1-2 lists additional environmental authorizations and consultations related to the renewal of the RBS OL.

**Table 9.1-1**
**Environmental Authorizations for Current RBS Operations**

| Agency | Authority | Requirement | Number | Expiration Date | Authorized Activity |
|---|---|---|---|---|---|
| CILLRWC | Omnibus Low-Level Radioactive Waste Interstate Compact Consent Act (1980 and amended in 1985) | Authorization to export waste | None | Updated annually | Export of LLRW outside the region. |
| LDEQ | Federal Water Pollution Control Act Section 402 | LPDES permit | LA0042731 | October 1, 2016[a] | Discharge of wastewaters to waters of the State. |
| LDEQ | LAC 33:III.503 | Air permit | 3160-00009-04 | [b] | Operation of air emission sources (diesel generators, diesel pumps, portable auxiliary boiler, and portable gas/diesel generators). |
| LDEQ | LAC 33:V.1105 | Hazardous waste generator identification | LAD070664818 | None | Hazardous waste generation. |
| LDEQ | LAC 33:VII.501 | Industrial solid waste site identification | G-2104-125 | None | Industrial solid waste generation. |
| LDHH | Title 51, Louisiana State Sanitary Code, Section 701 | Onsite wastewater treatment system | 1030185 | None | MO-DAD sanitary wastewater treatment. |
| LDHH | Title 51, Louisiana State Sanitary Code, Section 701 | Onsite wastewater treatment system | 1089509 | None | MO-DAD sanitary wastewater treatment. |
| MEMA | Chapter 432, Laws of 1982, Mississippi Radioactive Waste Transportation Act | Radioactive waste transport permit | 1511 | Updated annually | Transportation of radioactive waste into, within, or through the state of Mississippi. |

**Table 9.1-1 (Continued)**
**Environmental Authorizations for Current RBS Operations**

| Agency | Authority | Requirement | Number | Expiration Date | Authorized Activity |
|---|---|---|---|---|---|
| NRC | Atomic Energy Act, 10 CFR Part 50 | RBS license to operate | NPF-47 | August 29, 2025 | Operation of RBS. |
| TDEC | Tennessee Department of Environment and Conservation Rule 1200-2-10-32 | Radioactive waste license for delivery | TLA002-LI6 | Updated annually | Shipment of radioactive material into Tennessee to a disposal/processing facility. |
| TLLRWDCC | Texas Low-Level Radioactive Waste Disposal Compact, Section 3.05(6) | Authorization to import waste | TLLRWDCC #2-0103-00 | Updated annually | Import LLRW to a Texas LLRW disposal compact facility. |
| UDEQ | Utah Radiation Control Rules R313-26 | Generator site access permit | 1110007082 | Updated annually | Site access permit for disposal of Class A wastes. |
| USACE | Federal Water Pollution Control Act Section 404 | General permit | NOD-23 | August 10, 2017 | Dredging activities at the intake structure. |
| USDOT | 49 CFR Part 107, Subpart G | Hazardous materials certificate of registration | 061616550010Y | Updated annually | Radioactive and hazardous materials shipments. |
| USFWS | 16 USC 703-712 | Depredation permit | MBS8598A-0 | Updated annually | Taking of migratory birds. |

CILLRWC: Central Interstate Low-Level Radioactive Waste Commission

LAC: Louisiana Administrative Code

LDEQ: Louisiana Department of Environmental Quality

LDHH: Louisiana Department of Health and Hospitals

MEMA: Mississippi Emergency Management Agency

NRC: U.S. Nuclear Regulatory Commission

TDEC: Tennessee Department of Environment and Conservation

**Table 9.1-1 (Continued)**
**Environmental Authorizations for Current RBS Operations**

TLLRWDCC: Texas Low-Level Radioactive Waste Disposal Compact Commission

UDEQ: Utah Department of Environmental Quality

USACE: U.S. Army Corps of Engineers

USDOT: U.S. Department of Transportation

USFWS: U.S. Fish and Wildlife Service

a. Renewal application submitted and was determined by the LDEQ to be administratively complete (Entergy 2016a).

b. Current air permit does not contain an expiration date. However, in 2015, the LDEQ promulgated amendments to LAC 33:III.503 to establish a regulatory framework setting forth renewal procedures and maximum terms for minor source air permits of not more than 10 years. Therefore, RBS's air permit will expire on July 8, 2019.

**Table 9.1-2**
**Environmental Authorizations for RBS License Renewal**

| Agency | Authority | Requirement | Remarks |
|---|---|---|---|
| U.S. Nuclear Regulatory Commission | Atomic Energy Act [42 USC 2011 et seq.] | License renewal | Applicant for federal license must submit an ER in support of license renewal application. |
| U.S. Fish and Wildlife Service | Endangered Species Act Section 7 [16 USC 1636] | Consultation | Requires federal agency issuing a license to consult with the USFWS and NMFS, if applicable, regarding federally protected species. |
| Louisiana Department of Culture, Recreation and Tourism | National Historic Preservation Act Section 106 | Consultation | Requires federal agency issuing a license to consider cultural impacts and consult with SHPO and/or THPO. |
| Louisiana Department of Environmental Quality | Clean Water Act Section 401 [33 USC 1341] | Certification | Applicant seeking federal license for a project with discharge to state waters must obtain either state certification that proposed action would comply with applicable state water quality standards, or a waiver. |

## 9.2 Status of Compliance

RBS 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. RBS 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.

## 9.3 Notice of Violations

Based on a review of records over the previous 5 years (2011–2015) of various environmental programs and permits that RBS is subject to and complies with, there have been no federal (i.e., agencies other than NRC) or state regulatory notices of violations issued to the facility.

## 9.4 Remediation Activities

There are no surface or subsurface areas on site that are contaminated with nonradiological industrial constituents. Therefore, there are no current or ongoing remediation activities or investigations at the RBS site for these constituents.

However, RBS is currently remediating tritium-contaminated groundwater to lower tritium levels in the groundwater. In addition to the installation of monitoring wells, increased groundwater sampling frequency, and natural monitored attenuation, groundwater is periodically pumped from an existing onsite monitoring well (MW-125) into temporary storage tanks. Prior to discharging, the water in the tanks is recirculated to obtain a representative sample and examined for radioactivity in accordance with the site's ODCM. Once the water in the tanks has been found to be within acceptable LDEQ and NRC regulatory limits, the contents are discharged to the Mississippi River via Outfall 101 (low-volume waste treatment system).

## 9.5 Federal, State, and Local Regulatory Standards—Discussion of Compliance

### 9.5.1 Clean Water Act

#### 9.5.1.1 Water Quality (401) Certification

Federal CWA, Section 401, requires an applicant for a federal license to conduct an activity that might result in a discharge into navigable waters to provide the licensing agency a certification, or a waiver of certification, from the state where the discharge would originate that the discharge will not violate state water quality standards [33 USC 1341].

On December 2, 1974, RBS requested a Section 401 certification, covering the operational discharge of the RBS facility into the Mississippi River. On December 13, 1974, the Louisiana Stream Control Commission indicated it did not intend to take any action on this request. Because no action was taken by the state within a year of the site's request, the inaction constituted a waiver of the Section 401 requirements under the provisions of the CWA. (NRC 1985, Section 1.2)

The EPA has granted Louisiana the authority to issue NPDES permits under a fully delegated NPDES program. Based on communication with the LDEQ regarding the 401 water quality certification as it relates to RBS license renewal, the LDEQ deemed the current LPDES permit to be a certification obtained pursuant to paragraph (1) of 33 U.S.C. Section 1341(a) with respect to the operation of RBS. Therefore, RBS is providing a copy of its LPDES permit and the record of communication with the LDEQ as demonstration of the existing state water quality (401) certification (Attachment A).

#### 9.5.1.2 LPDES Permit

The release of pollutants in wastewaters at the RBS facility is regulated and controlled through LPDES Permit No. LA0042731 issued by the LDEQ. As discussed in Section 3.5.1.1.1, there are 14 outfalls (6 external and 8 internal) identified in the LPDES permit. Monitoring results associated with these outfalls are submitted in discharge monitoring reports to the LDEQ at the frequency specified in the permit. RBS's compliance with the LPDES permit over the previous 5 years (2012–2016) has been excellent. For example, as shown in Table 9.5-1, over the previous 5 years, there have been only two noncompliances associated with the permitted parameters shown in Table 3.5-1.

#### 9.5.1.3 Stormwater Permit

Stormwater discharges associated with industrial activities at the RBS site are regulated and controlled through LPDES Permit No. LA0042731 issued by the LDEQ. RBS samples stormwater runoff at LPDES Outfalls 002, 003, 004, and 005 on a quarterly basis, and analyzes for pollutants as specified in the permit. RBS is also required to develop, maintain, and implement a SWPPP for the facility that identifies potential sources of pollution reasonably expected to affect the quality of stormwater and identify the practices that will be used to prevent or reduce the pollutants in stormwater discharges (RBS 2013a). RBS is in compliance with the terms and conditions of the LPDES permit as they relate to the stormwater program.

#### 9.5.1.4 Sanitary Wastewaters

As discussed in Section 3.5.1.1.3, sanitary wastewater from all plant locations is transferred to the onsite sanitary sewage treatment system where it is managed appropriately. Discharges of sanitary wastewaters (Outfall 201) are regulated by RBS's LPDES Permit No. LA0042731 prior to discharging either to the Mississippi River via LPDES Outfall 001 (cooling tower blowdown) or Grant's Bayou via Outfall 002 (stormwater runoff) when discharging a mixture of sanitary and maintenance wastewaters. RBS is in compliance with the conditions specified in LPDES Permit No. LA0042731.

RBS also utilizes MO-DAD sanitary wastewater treatment systems at the small structure located at the unmanned checkpoint facility leading to the plant and the auxiliary control room located in the Unit 2 excavation area. These leach-field systems generate no surface wastewater discharges and are regulated under LDHH Permit No. 1030185 and Permit No. 1089509. (Entergy 2016a, Section 4.7) RBS is in compliance with LDHH regulatory requirements as they relate to these sanitary treatment systems.

Because sanitary wastewaters are managed on site, RBS is also required to have personnel certified in accordance with LDHH Louisiana Administrative Code (LAC) 48:V.7303 (Certification Requirements). RBS maintains onsite certified wastewater operators; therefore, the site is in compliance with this program.

#### 9.5.1.5 Spill Prevention, Control and Countermeasures

The EPA'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 an SPCC plan to prevent any discharge of oil into or upon navigable waters of the United States or adjoining shorelines. RBS 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 to meet the requirements of this rule (RBS 2013d).

Reportable Spills [40 CFR Part 110]

RBS is subject to the reporting provisions of 40 CFR Part 110 as they relate 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. Based on a review of records over the previous 5 years (2011–2015), there have been no releases at RBS that have triggered this notification requirement.

Reportable Spills [LAC 33.I Chapter 39]

RBS is also subject to the reporting provisions of Louisiana Environmental Regulatory Code, LAC 33.I Chapter 39. This reporting provision requires that any release of oil in a quantity of 42 gallons (1 barrel) or greater to the environment be reported to the Louisiana Department of Public Safety and the LDEQ.

Based on a review of records over the previous 5 years (2012–2016), there has been only one spill at RBS that triggered this notification requirement. In October 2016, an estimated 60 gallons of hydraulic fluid from a service truck's hydraulic oil reservoir leaked onto the ground. Sorbents were used to absorb visible puddles, and the area was cleaned up and the fluid placed in drums for disposal. No oil entered any waterway. (Entergy 2016k)

Facility Response Plan

RBS is not subject to the facility response plan risk requirements described in 40 CFR 112.20 because the facility does not transfer oil over water to or from vessels and does not store oil in quantities greater than 1 million gallons.

9.5.1.6 Section 404 Permit

As discussed in Section 3.5.1.1.4, RBS performs annual maintenance dredging for the removal of no more than 125,000 cubic yards of silt accumulation around the intake screens in the Mississippi River, in accordance with a USACE NOD-23 general permit (Table 9.1-1). The dredging material is deposited back into deeper portions of the Mississippi River in accordance with the permit. RBS is in compliance with this permit.

### 9.5.2 Safe Drinking Water Act

As discussed in Section 2.2.2.7, potable water for RBS is supplied by the West Feliciana Parish Consolidated Water District No. 13. No further treatment for potable water usage is performed on site. In addition, RBS does not engage in underground injections or other actions that could endanger drinking water sources. Therefore, RBS is not subject to the Safe Drinking Water Act.

### 9.5.3 Clean Air Act

9.5.3.1 Air Permit

RBS has a permit to operate emergency diesel generators, emergency diesel fire water pumps, a liquid propane gas generator, a diesel air compressor, and portable diesel engines (RBS 2009). Operation of these air emission sources is maintained within the emission limitations, opacity, fuel sulfur content, fuel usage, and operational run time (as applicable) limits established in the station air permit issued by the LDEQ. No reports are required to be submitted to the LDEQ in association with this air permit. For purposes of the CAA, RBS is considered a minor air emission source and is in compliance with this permit.

9.5.3.2 Chemical Accident Prevention Provisions [40 CFR Part 68]

RBS is not subject to the risk management plan requirements described in 40 CFR Part 68 because the amount of regulated chemicals present on site do not exceed the threshold quantities specified in 40 CFR 68.130.

9.5.3.3 Stratospheric Ozone [40 CFR Part 82]

Under Title VI of the CAA, the EPA is responsible for several programs that protect the stratospheric ozone layer. Regulations promulgated by the EPA 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. RBS is in compliance with Section 608 of the CAA as amended in 1990 and the implementing regulations codified in 40 CFR Part 82. The program to manage stationary refrigeration appliances at RBS is described in Entergy's fleet procedure (Entergy 2014e). Because motor vehicle air conditioners are not serviced on site, Section 609 of the CAA is not applicable.

### 9.5.4 Atomic Energy Act

#### 9.5.4.1 Radioactive Waste

As a generator of both LLRW and spent fuel, RBS 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.

RBS also complies with permits issued by (1) the Central Interstate Low-Level Radioactive Waste Commission for exporting radioactive waste, (2) the Mississippi Emergency Management Agency for transportation of radioactive material through the state of Mississippi, (3) the Tennessee Department of Environment and Conservation for shipping radioactive material to a licensed disposal/processing facility within the state of Tennessee, (4) the Texas Low-Level Radioactive Waste Disposal Compact Commission agreement for importing LLRW to a Texas LLRW disposal compact facility, and (5) the Utah Department of Environmental Quality for site access permit for disposal of Class A wastes.

### 9.5.5 Resource Conservation and Recovery Act

#### 9.5.5.1 Nonradioactive Wastes

As a generator of hazardous and nonhazardous wastes, RBS is subject to and complies with RCRA and specific LDEQ regulations contained in LAC 33:V (Hazardous Waste and Hazardous Materials) and LAC 33:VII Part VII (Solid Waste). As discussed in Section 2.2.4, RBS is classified as a small quantity generator of hazardous wastes; therefore hazardous wastes routinely make up only a small percentage of the total wastes generated. As a generator of hazardous wastes, RBS also maintains a hazardous waste generator identification number (Table 9.1-1). Because RBS is classified as a small quantity generator of hazardous waste, LDEQ regulation LAC 33:V.1111.E exempts the facility from annual hazardous waste reporting requirements.

<u>Reportable Spills [40 CFR Part 262]</u>

RBS is subject to the reporting provisions of 40 CFR 262.34(d)(5)(iv)(C) as they relate 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. Based on a review of records over the previous 5 years (2011–2015), there have been no releases at RBS that have triggered this notification requirement.

#### 9.5.5.2 Low-Level Mixed Waste

Radioactive materials are regulated by the NRC under the Atomic Energy Act of 1954, and hazardous wastes are regulated by the EPA under RCRA (enacted in 1976). As discussed in Section 2.2.3.5, LLMW is generated on an infrequent basis and in small quantities. These materials are appropriately managed in accordance with Entergy's waste management program fleet procedure (Entergy 2015d) that specifies EPA and NRC requirements for managing this type of waste. RBS is in compliance with the regulatory requirements as they relate to the management of LLMW.

#### 9.5.5.3 Underground Storage Tanks (LAC 33:XI)

RBS has no underground storage tanks on site as defined in LAC 33:XI (Underground Storage Tanks). Therefore, RBS is not subject to the underground storage requirements of LAC 33:XI.

### 9.5.6 Louisiana Public Health Sanitary Code

#### 9.5.6.1 Medical Waste

Because RBS generates small quantities of medical waste from the onsite medical clinic, the facility is subject to and complies with the requirements of Louisiana Sanitary Code, Chapter XXVII (Management of Refuse, Infectious Waste, Medical Waste, and Potentially Infectious Biomedical Waste).

### 9.5.7 Pollution Prevention Act

In accordance with RCRA Section 3002(b) and 40 CFR 262.27(a), a small or large quantity generator must certify that there is a waste minimization program in place to reduce the volume and toxicity of the waste generated to the degree determined to be economically practical. As discussed in Section 2.2.4, RBS is meeting this requirement as procedural measures are in place to minimize hazardous waste generated to the maximum extent practical.

### 9.5.8 Federal Insecticide, Fungicide and Rodenticide Act

Commercially approved herbicides are applied by a licensed contractor on an as-needed basis to control weeds and vegetation. Pesticides are also applied inside buildings by a licensed contractor, but are not exposed to stormwater. Fertilizers or soil conditioners are typically not used at RBS. (Entergy 2016a, Section 4.4) Because only contractors who have obtained a license as specified in Louisiana Department of Agriculture and Animals LAC 7:XXIX.107 conduct pesticide/herbicide applications on site, RBS is in compliance with the requirements of this act.

### 9.5.9 Toxic Substances Control Act

The Toxic Substances Control Act of 1976 regulates PCBs [40 CFR Part 761] and asbestos [40 CFR Part 763], both of which are present at RBS. PCBs are present in some lighting ballasts, while asbestos is present in specific types of insulation and gaskets. RBS is in compliance with the PCB and asbestos regulations applicable to the facility.

### 9.5.10 Hazardous Materials Transportation Act

Because RBS ships hazardous materials off site that are regulated by the U.S. Department of Transportation, the facility is subject to and complies with the applicable requirements of the Hazardous Materials Transportation Act described in 49 CFR, including the requirement to possess a current hazardous materials certificate of registration (Table 9.1-1).

### 9.5.11 Emergency Planning and Community Right-to-Know Act

#### 9.5.11.1 Section 312 Reporting [40 CFR Part 370]

RBS is subject to and complies with Section 312 of the Emergency Planning and Community Right-to-Know Act 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, chemicals such as carbon dioxide, diesel fuel, gasoline, hydrogen (liquid and gas), liquid nitrogen, liquid oxygen, liquid propane, lube oils, Nalco water treatment chemicals, sodium hydroxide, sodium hypochlorite, and sulfuric acid, is submitted to these agencies annually.

#### 9.5.11.2 Section 313 Reporting [40 CFR Part 372]

RBS is not subject to Section 313 of the Emergency Planning and Community Right-to-Know Act because the station does not combust coal or oil for the purpose of generating power for distribution in commerce.

### 9.5.12 Comprehensive Environmental Response, Compensation, and Liability Act

RBS is subject to the hazardous substance release and reporting provisions of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as subsequently amended. Any release of reportable quantities of listed hazardous substances to the environment requires a notification to the National Response Center, the Louisiana Department of Public Safety, and the LDEQ, and a subsequent written follow-up. Based on a review of records over the previous 5 years (2011–2015), no releases at RBS have triggered this notification requirement.

### 9.5.13 Migratory Bird Treaty Act

As discussed in Section 3.6.11.4, RBS maintains a federal migratory bird depredation permit (Table 9.1-1) to manage primarily two species that transit the site: swallows (barn and cliff), and vultures (black and turkey). This permit authorizes RBS to take 25 swallow nests, 15 black vultures, and 10 turkey vultures. To minimize the lethal taking of these species, non-lethal control measures utilized by RBS include nest removal and harassment. A report is submitted to the USFWS annually regarding depredation activities that occur at the site. RBS is in compliance with this permit.

### 9.5.14 Endangered Species Act

Potential impacts on federally listed species were considered in Entergy's review and analysis in Section 4.6.3, and it was concluded that the renewal of RBS's OL would have no effect on any federally listed species.

Section 7 of the ESA requires federal agencies to ensure that their actions are not likely to jeopardize the continued existence of species that are listed, or proposed for listing, as endangered or threatened. Depending on the action involved, the ESA requires consultation with the USFWS and with the NMFS if marine and anadromous species could be affected. Although Entergy invited comment from the USFWS (Attachment B) during the development of this ER, a more structured consultation process with these agencies may be initiated by the NRC per Section 7 of the ESA. As discussed in Section 3.6.11.3, no species or habitats under the NMFS's jurisdiction occur within the action area because RBS is located beyond tidal influence. Therefore, there are no EFH considerations or consultation requirements associated with RBS operations.

### 9.5.15 Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act prohibits the take, transport, sale, barter, trade, import and export, and possession of eagles, making it illegal for anyone to collect eagles and eagle parts, nests, or eggs without a USFWS permit. There are currently no Bald and Golden Eagle Protection Act permitting requirements associated with RBS operations.

### 9.5.16 Coastal Zone Management Act

RBS 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.

### 9.5.17 Magnuson-Stevens Fishery Conservation and Management Act

RBS is not subject to the Magnuson-Stevens Fishery Conservation and Management Act because RBS is located upstream beyond tidal influence.

### 9.5.18 Marine Mammal Protection Act

RBS is not subject to the Marine Mammal Protection Act because the facility is located on a freshwater body.

### 9.5.19 Farmland Protection Policy Act

The FPPA applies only 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, because license renewal is considered a federal licensing activity and RBS is located on non-federal lands, the FPPA is not applicable.

### 9.5.20 National Historic Preservation Act

Potential impacts on historic properties were considered in Entergy's review and analysis in Section 4.7, and it was concluded that although historic properties are present within the vicinity of RBS, they will not be adversely affected as a result of license renewal. As discussed in Section 3.7.5, administrative controls are in place for management of cultural resources ahead of any future ground-disturbing activities at the plant. These controls consist of a cultural resources protection plan fleet procedure that requires reviews, investigations, and consultations as needed (Entergy 2015n). These controls ensure that existing or potentially existing cultural resources are adequately protected, and assist RBS in meeting state and federal expectations.

Section 106 of the NHPA requires federal agencies having the authority to license any undertaking to take into account the effect of the undertaking on historic properties and to afford the Advisory Council on Historic Preservation an opportunity to comment on the undertaking, prior to the agency issuing the license. Although Entergy invited comment from the LDHP (Attachment C) during development of this ER, a more structured consultation process with this agency may be initiated by the NRC per Section 106 of the NHPA.

### 9.5.21 Federal Aviation Act

Coordination with the Federal Aviation Administration (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 approximately 270-foot-high reactor building (RBS 2015, Figure 1.2-12). There are no license-renewal-related activities planned at this time to build any new structures; therefore, no new notifications to the FAA are required.

### 9.5.22 Occupational Safety and Health Act

OSHA governs the occupational safety and health of the construction workers and the operational staffs. RBS and its contractors comply with OSHA's substantive requirements, as these are incorporated in the site's occupational health and safety practices.

### 9.5.23 West Feliciana Parish Zoning Requirements

#### 9.5.23.1 Land Use

As discussed in Section 3.1.1, land on the RBS site is zoned as an industrial area by West Feliciana Parish. Therefore, because the site is on land already zoned and planned for industrial development, RBS is complying with West Feliciana Parish land use plans and zoning requirements.

## Table 9.5-1
## RBS LPDES Permit Noncompliances, 2012–2016

| LPDES Outfall | Noncompliance | Date |
|---|---|---|
| 003 (stormwater runoff) | **Unauthorized discharge**: Due to a loss of power at a sewage lift station, wastewater back-flowed into the general services building drain system with some of the wastewater eventually entering the plant storm drain system, which discharges to Outfall 003. | May 2013 |
| 003 (stormwater runoff) | **Unauthorized discharge**: Due to a loss of power at a sewage lift station, wastewater back-flowed into the general services building drain system with some of the wastewater eventually entering the plant storm drain system, which discharges to Outfall 003. | September 2013 |
| 003 (stormwater runoff) | **Unauthorized discharge**: Sanitary wastewater leaked from a vacuum truck during a security inspection. | March 2014 |
| 003 (stormwater runoff) | **Missed sample**: Maintenance wastewater sample was not collected during the month of June. | June 2014 |
| Not applicable | **Unauthorized discharge**: Wastewater treatment plant Train 1 aeration and sedimentation ponds overflowed banks into a ditch after a heavy rainfall event due to pump failure and a clogged sand filter. Overflow discharged to Outfall 002, which is an approved alternate outfall for treated wastewater. | January 2015 |
| 501 (low-volume wastewater) | **Missed sample**: Sample was not collected during the month of March due to pump failure. | March 2015 |
| 001 (cooling tower blowdown) | **pH exceedance**: Limit exceeded due to failure of the acid injection pump metering instrumentation. | June 2015 |
| 001 (cooling tower blowdown) | **Zinc exceedance**: Limit exceeded due to low pH, which caused the zinc to go into solution. | June 2015 |
| 201 (treated sanitary wastewater) | **Unauthorized discharge**: Wastewater treatment sedimentation pond overflowed due to heavy rains. | October 2015 |
| 101 (low-volume waste treatment system) | **Sample analysis:** Hold time for total suspended solids sample exceeded. | February 2016 |

**Table 9.5-1 (Continued)**
**RBS LPDES Permit Noncompliances, 2012–2016**

| LPDES Outfall | Noncompliance | Date |
|---|---|---|
| Not applicable | **Unauthorized discharge**: Aeration and settling ponds overflowed due to obstruction of settling pond sluice gate during a heavy rainfall event. Overflow discharged to Outfall 002, which is an approved alternate outfall for treated wastewater. | February 2016 |
| 002<br>(stormwater runoff) | **Unauthorized discharge**: Sewage overflow due to excessive rainfall (24.28 inches) that exceeded the water processing ability and storage capacity of the sanitary treatment system | August 2016 |
| 003<br>(stormwater runoff) | **TSS exceedance**: Limit exceeded due to sand sloughing off from water being pumped from an excavation area containing treated wastewater from Outfall 201 as a result of piping break. | September 2016 |

## 9.6 Environmental Reviews

Entergy has fleet procedural controls in place to ensure that environmentally sensitive areas at RBS, if present, are adequately protected during site operations and project planning (Entergy 2013d). These controls, which encompass nonradiological environmental resource areas such as land use, air quality, surface water and groundwater, aquatic and terrestrial ecology, historic and cultural resources, and waste management and pollution prevention consist of the following:

- Appropriate local, state, and/or federal permits are obtained or modified as necessary.
- BMPs are implemented to protect wetlands, natural heritage areas, and sensitive ecosystems.
- Appropriate agencies are consulted on matters involving federally and state-listed threatened, endangered, and protected species, and to ensure that BMPs are implemented to minimize impacts to these species.
- Appropriate agencies are consulted on matters involving cultural resources and ensure that BMPs are implemented to minimize impact to this resource.

In summary, Entergy's administrative controls ensure that appropriate local, state, and/or federal permits are obtained or modified as necessary; cultural resources and threatened and endangered species are protected, if present; and other regulatory issues are adequately addressed as necessary.

## 9.7 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. [10 CFR 51.45(d)]

The natural gas, coal, new nuclear, and combination of alternatives discussed in Chapter 7 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.

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# Attachment A

# RBS Clean Water Act Documentation

## Attachment A

## RBS Clean Water Act Documentation

- Telephone Conversation Record re Section 401 Water Quality Certification. Conversation between Elizabeth Johnson, Louisiana Department of Environmental Quality, and Rick Buckley, Entergy Services, Inc. February 17, 2016.
- Louisiana Pollutant Discharge Elimination System (LPDES) Permit No. LA0042731. October 1, 2011.

**Entergy Services, Inc**
1340 Echelon Parkway
Jackson, Mississippi 39213

# TELEPHONE CONVERSATION RECORD

| | | |
|---|---|---|
| Date: | February 17, 2016 | |
| Subject: | River Bend Station Unit 1 License Renewal<br>401 Water Quality Certification | |
| Person Called:<br><br>Elizabeth Johnson | Company:<br><br>Louisiana Department of Environmental Quality<br>Water Permits Division<br>Phone: (225) 219-3225<br>Email: elizabeth.johnson@la.gov | CTC 2016-00001 |
| Person Calling:<br><br>Rick Buckley | Company:<br><br>Entergy<br>License Renewal<br>Phone: (601) 368-5823<br>Email: rbuckle@entergy.com | |

**INFORMATION DISCUSSED:**

In 2017, Entergy plans to apply to the Nuclear Regulatory Commission for renewal of the existing operating license for River Bend Station Unit 1 (RBS).

On December 2, 1974, RBS requested a Section 401 certification, covering the operational discharge of the RBS facility into the Mississippi River. On December 13, 1974, the Louisiana Stream Control Commission indicated it did not intend to take any action on this request. Because no action was taken by the state within a year of the site's request, the inaction constituted a waiver of the Section 401 requirements under the provisions of the Clean Water Act.

Based on correspondence dated January 30, 2015 related to the renewal of the Waterford Steam Electric Station, Unit 3 operating license, the Louisiana Department of Environmental Quality (LDEQ) deemed that the currently issued Louisiana Pollutant Discharge Elimination System (LPDES) permit to be a certification obtained pursuant to paragraph of 33 U.S.C. Section 134l(a) with respect to the operation of the facility.

| |
|---|
| As there will be no changes in the footprint of the RBS facility or an increase in water withdrawals or discharges as a result of license renewal, Entergy requests LDEQ to confirm that RBS's existing LPDES Permit LA0042731 constitutes issuance of a 401 Water Quality Certification in Louisiana. |
| **LDEQ RESPONSE:** |
| Based on the information discussed during the telephone call, Ms. Johnson confirmed that RBS's existing LPDES Permit LA0042731 constitutes issuance of a 401 Water Quality Certification in Louisiana. |

Rick Buckley

Rick Buckley, CHMM, REM
Sr. Project Manager, Environmental

RBC-50963

BOBBY JINDAL
GOVERNOR

PEGGY M. HATCH
SECRETARY

# State of Louisiana

**DEPARTMENT OF ENVIRONMENTAL QUALITY**
**ENVIRONMENTAL SERVICES**

SEP 01 2011

**CERTIFIED MAIL** 7005 1820 0002 2086 6520 **-RETURN RECEIPT REQUEST**

File No.: LA0042731
AI No.: 2889
Activity No.: PER20100002

RECEIVED
SEP 0 2011
ENVIRONMENTAL SERVICES

Mr. William H. Spell, HP/Chem Specialist
Entergy Operations, Inc.
River Bend Station
5485 U. S. Highway 61
St. Francisville, LA 70775

RE: Louisiana Pollutant Discharge Elimination System (LPDES) permit to discharge cooling tower blowdown, low volume wastewaters, maintenance wastewaters, clarifier underflow, treated sanitary wastewater, hydrostatic test wastewater, and metal cleaning wastewater to the Mississippi River (via Outfalls 001, 101, 201, 301, 401, 501, 601, 006, and 007) and stormwater runoff, vehicle washwater, air conditioning condensate, cooling tower drift, low volume wastewaters, hydrostatic test wastewater, and maintenance wastewaters to Grant's Bayou, thence to Alligator Bayou, thence to Thompson Creek (via Outfalls 002, 003, 004, 104, 005, and 007) from an existing steam electric generating facility located at 5485 U. S. Highway 61 in St. Francisville, West Feliciana Parish.

Dear Mr. Spell:

This Office has not received any comments from either the general public or from Entergy Operations, Inc. in response to the public notice published in the Office of Environmental Services Public Notice Mailing List on June 24, 2011, and the *St. Francisville Democrat* on June 29, 2011.

Please note that footnote (*4), Part I, Page 6 of 17 has been changed to clarify that discharge monitoring reports must be submitted for both Outfall 201 operational scenarios.

Pursuant to the Clean Water Act (33 U.S.C. 1251 et seq.), and the Louisiana Environmental Quality Act (La. R.S. 30:2001, et seq.), the attached LPDES permit has been issued. Provisions of this permit may be appealed in writing pursuant to La. R.S. 30: 2024(A) within 30 days from receipt of the permit. A request for hearing must be sent to the following:

> Louisiana Department of Environmental Quality
> Office of the Secretary
> Attention: Hearings Clerk, Legal Division
> Post Office Box 4302
> Baton Rouge, Louisiana 70821-4302

Upon the effective date this permit shall replace the previously effective LPDES permit, LA0042731.

Monitoring results should be reported on a Discharge Monitoring Report (DMR) form per the schedule specified. A copy of the form to be used is attached for your convenience.

Pursuant to LAC 33:IX.1309.I, LAC 33:IX.6509.A.1, and LAC 33:I.1701, you must pay any outstanding fees to the Department. Therefore, you are encouraged to verify your facility's fee status by contacting LDEQ's Office of Management and Finance, Financial Services Division at (225) 219-3863. **Any outstanding fees must be remitted via a check to the Louisiana Department of Environmental Quality within thirty (30) days after the effective date of your permit.** Failure to pay the full amount due in the manner and time prescribed could result in applicable enforcement actions as prescribed in the Environmental Quality Act, including, but not limited to revocation or suspension of the applicable permit, and/or a civil penalty against you.

Should you have any questions concerning any part of the permit, please feel free to contact Lisa Kemp of the Office of Environmental Services at the address on the first page or by telephone at (225) 219-3195. To ensure that all future correspondence regarding this facility is properly filed into the Department's Electronic Document Management System, please reference your Agency Interest (AI) number 2889 and LPDES permit number LA0042731 on all future correspondence to this Department.

Sincerely,

S L Phillips

Sam L. Phillips
Assistant Secretary

lwk

Attachment(s): final permit and DMR

c: IO-W File

ec: Lisa Kemp
Angela Marse
Bruce Fielding
Water Permits Division

Public Health Chief Engineer
Office of Public Health
Department of Health and Hospitals

Evelyn Rosborough (6WQ-CA)
U.S. EPA, Region VI

Permit Compliance Unit
Capital Regional Office
Office of Environmental Compliance

PERMITTEE NAME/ADDRESS (Include Facility Name/Location if Different)
NAME

ADDRESS

FACILITY
LOCATION

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
DISCHARGE MONITORING REPORT (DMR)

Form Approved
OMB No. 2040-0004

| PERMIT NUMBER | DISCHARGE NUMBER |
|---|---|
| | |

| | MONITORING PERIOD | | | | | |
|---|---|---|---|---|---|---|
| | YEAR | MO | DAY | | YEAR | MO | DAY |
| FROM | | | | TO | | | |

☐ Check here if No Discharge

NOTE: Read Instructions before completing this form

| PARAMETER | | QUANTITY OR LOADING | | | QUALITY OR CONCENTRATION | | | | NO. EX | FREQUENCY OF ANALYSIS | SAMPLE TYPE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | VALUE | VALUE | UNITS | VALUE | VALUE | VALUE | UNITS | | | |
| | SAMPLE MEASUREMENT | | | | | | | | | | |
| | PERMIT REQUIREMENT | | | | | | | | | | |
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| | SAMPLE MEASUREMENT | | | | | | | | | | |
| | PERMIT REQUIREMENT | | | | | | | | | | |

| NAME/TITLE PRINCIPAL EXECUTIVE OFFICER | I CERTIFY UNDER PENALTY OF LAW THAT THIS DOCUMENT AND ALL ATTACHMENTS WERE PREPARED UNDER MY DIRECTION OR SUPERVISION IN ACCORDANCE WITH A SYSTEM DESIGNED TO ASSURE THAT QUALIFIED PERSONNEL PROPERLY GATHER AND EVALUATE THE INFORMATION SUBMITTED. BASED ON MY INQUIRY OF THE PERSON OR PERSONS WHO MANAGE THE SYSTEM, OR THOSE PERSONS DIRECTLY RESPONSIBLE FOR GATHERING THE INFORMATION, THE INFORMATION SUBMITTED IS, TO THE BEST OF MY KNOWLEDGE AND BELIEF, TRUE, ACCURATE, AND COMPLETE. I AM AWARE THAT THERE ARE SIGNIFICANT PENALTIES FOR SUBMITTING FALSE INFORMATION, INCLUDING THE POSSIBILITY OF FINE AND IMPRISONMENT FOR KNOWING VIOLATIONS. | | TELEPHONE | | DATE | | |
|---|---|---|---|---|---|---|---|
| TYPED OR PRINTED | | SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT | AREA CODE | NUMBER | YEAR | MO | DAY |

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

PERMIT NUMBER
LA0042731
AI No.: 2889

LOUISIANA DEQ

**OFFICE OF ENVIRONMENTAL SERVICES**

# Water Discharge Permit

**Pursuant to the Clean Water Act, as amended (33 U.S.C. 1251 et seq.), and the Louisiana Environmental Quality Act, as amended (La. R. S. 30:2001 et seq.), rules and regulations effective or promulgated under the authority of said Acts, and in reliance on statements and representations heretofore made in the application, a Louisiana Pollutant Discharge Elimination System permit is issued authorizing**

Entergy Operations, Inc.
River Bend Station
5485 U. S. Highway 61
St. Francisville, LA 70775

**Type Facility:** steam electric generating facility

**Location:** 5485 U. S. Highway 61 in St. Francisville
West Feliciana Parish

**Receiving Waters:** Mississippi River (Outfalls 001, 101, 201, 301, 401, 501, 601, 006, 007) and Grant's Bayou (Outfalls 002, 003, 004, 104, 005, 007) (070201)

**to discharge in accordance with effluent limitations, monitoring requirements, and other conditions set forth in Parts I, II, and III attached hereto.**

**This permit shall become effective on** October 1, 2011

**This permit and the authorization to discharge shall expire five (5) years from the effective date of the permit.**

**Issued on** August 30, 2011

S L Phillips

**Sam L. Phillips**
**Assistant Secretary**

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Outfall 001, the continuous discharge of cooling tower blowdown, previously monitored effluent from Internal Outfalls 101, 201, 301, 401, 501, and 601, and previously monitored hydrostatic test wastewater from Outfall 007.

Such discharges shall be limited and monitored by the permittee as specified below:

| Effluent Characteristic | | Discharge Limitations | | Other Units | | Monitoring Requirements | |
|---|---|---|---|---|---|---|---|
| | | (lbs/day, UNLESS STATED) | | (mg/L, UNLESS STATED) | | | |
| | STORET Code | Monthly Average | Daily Maximum | Monthly Average | Daily Maximum | Measurement Frequency | Sample Type |
| Flow-MGD | 50050 | Report | Report | --- | --- | Continuous | Recorder |
| Temperature (°F) (*1) | 00011 | --- | --- | 105 | 110 | Continuous | Recorder |
| Free Available Chlorine (*2) | 50064 | 0.63 | 1.64 | 0.2 | 0.5 | 1/week | Grab |
| Total Chromium | 01034 | --- | --- | 0.2 | 0.2 | 1/year | Grab |
| Total Zinc | 01092 | --- | --- | 1.0 | 1.0 | 1/week | Grab |
| pH Minimum/Maximum Values (standard units) | 00400 | --- | --- | 6.0 (*3) (Min) | 9.0 (*3) (Max) | 1/week | Grab |

| WHOLE EFFLUENT (ACUTE) TOXICITY TESTING (*4) (*5) | STORET Code | (Percent %, UNLESS STATED) Monthly Avg Minimum | 48-Hour Minimum | Maximum | Measurement Frequency (*4) | Sample Type |
|---|---|---|---|---|---|---|
| NOEC, Pass/Fail [0/1], Lethality, Static Renewal, 48-Hour Acute, Pimephales promelas | TEM6C | Report | Report | --- | 1/year | 24-hr. Composite |
| NOEC, Value [%], Lethality, Static Renewal, 48-Hour Acute, Pimephales promelas | TOM6C | Report | Report | --- | 1/year | 24-hr. Composite |
| NOEC, Value [%], Coefficient of Variation, Static Renewal, 48-Hour Acute, Pimephales promelas | TQM6C | --- | --- | Report | 1/year | 24-hr. Composite |

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (Outfall 001 continued)

| Effluent Characteristic | | Discharge Limitations | | | Monitoring Requirements | |
|---|---|---|---|---|---|---|
| | | Other units (Percent %, UNLESS STATED) | | | | |
| WHOLE EFFLUENT (ACUTE) TOXICITY TESTING | STORET Code | Monthly Avg Minimum | 48-Hour Minimum | Maximum | Measurement Frequency (*4) | Sample Type |
| NOEC, Pass/Fail [0/1], Lethality, Static Renewal, 48-Hour Acute, Daphnia pulex | TEM3D | Report | Report | --- | 1/year | 24-hr. Composite |
| NOEC, Value [%], Lethality, Static Renewal, 48-Hour Acute Daphnia pulex | TOM3D | Report | Report | ---- | 1/year | 24-hr. Composite |
| NOEC, Value [%], Coefficient of Variation, Static Renewal, 48-Hour Acute Daphnia pulex | TQM3D | --- | --- | Report | 1/year | 24-hr. Composite |

There shall be no discharge of floating solids or visible foam in other than trace amounts, nor of free oil or other oil materials, nor of toxic materials in quantities such as to cause acute toxicity to aquatic organisms. Furthermore, there shall be no visible sheen or stains attributable to this discharge.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Outfall 001, at the exposed vacuum-break chamber of the buried 30-inch diameter discharge pipeline prior to discharge to the Mississippi River. As an alternative, the permittee may report temperature measurements based on the balance of plant computer points, and flow may be measured from the auxiliary control room flow recorder.

FOOTNOTE(S):

(*1) See Part II. N.

(*2) Samples shall be representative of any periodic episodes of chlorination, biocide usage, or other potentially toxic substances discharged on an intermittent basis.

(*3) The permittee shall report on the Discharge Monitoring Reports both the minimum and maximum instantaneous pH values measured.

(*4) Biomonitoring shall be conducted during periods of chlorination, biocide (s) usage or potentially toxic substances being discharged. However, if no biofouling agent or chlorine is used during the monitoring period, the permittee must still conduct the required annual testing.

(*5) See Part II. U.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Internal Outfall 101, the intermittent discharge of low level radioactive low volume wastewater from the liquid radwaste wastewater system (LWS) which includes equipment and building floor drain sumps, equipment washing, personnel decontamination, laboratory drains, filter press effluent, RO unit wastewater, other low volume wastewater sources as defined in 40 CFR 423 and maintenance wastewaters. During maintenance activities, Internal Outfall 101 may be discharged via the cooling tower flume rather than the common discharge header. (*2)

Such discharges shall be limited and monitored by the permittee as specified below:

| Effluent Characteristic | | Discharge Limitations | | | | Monitoring Requirements | |
|---|---|---|---|---|---|---|---|
| | | (lbs/day, UNLESS STATED) | | Other Units (mg/L, UNLESS STATED) | | | |
| | STORET Code | Monthly Average | Daily Maximum | Monthly Average | Daily Maximum | Measurement Frequency (*1) | Sample Type |
| Flow-MGD | 50050 | Report | Report | --- | --- | 1/month | Estimate |
| TSS | 00530 | --- | --- | 30 | 100 | 1/month | Grab |
| Oil & Grease | 03582 | --- | --- | 15 | 20 | 1/month | Grab |

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Internal Outfall 101, at the point of discharge from the Radwaste Building prior to combining with other wastestreams and the waters of Final Outfall 001.

FOOTNOTE(S):

(*1) When discharging.

(*2) The permittee shall monitor all low volume wastewater sources that contribute to Outfall 101 from various locations on the property once per month when discharging.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Internal Outfall 201, the intermittent discharge of treated sanitary wastewater; also, during maintenance activities, sanitary wastewater may be combined with previously monitored hydrostatic test wastewater, wastewater from floor drains of the control building and the diesel generator oil/water separator (and other low volume wastewaters as defined in 40 CFR 423), and maintenance wastewaters and may be routed to Outfall 002 (*4).

Such discharges shall be limited and monitored by the permittee as specified below:

| Effluent Characteristic | | Discharge Limitations | | | | Monitoring Requirements | |
|---|---|---|---|---|---|---|---|
| | | (lbs/day, UNLESS STATED) | | Other Units (mg/L, UNLESS STATED) | | | |
| | STORET Code | Monthly Average | Daily Maximum | Monthly Average | Daily Maximum | Measurement Frequency (*1) | Sample Type |
| Flow-MGD | 50050 | Report | Report | --- | --- | 1/quarter | Estimate |
| $BOD_5$ | 00310 | --- | --- | 30 | 45 | 1/quarter | Grab |
| TSS | 00530 | --- | --- | 30 | 45 | 1/quarter | Grab |
| Fecal Coliform colonies/100 ml (*2) | 74055 | --- | --- | 200 | 400 | 1/quarter | Grab |

In addition to the above monitoring requirements, the following limitations and monitoring frequencies are applicable during maintenance activities:

| Effluent Characteristic | | Discharge Limitations | | | | Monitoring Requirements | |
|---|---|---|---|---|---|---|---|
| | | (lbs/day, UNLESS STATED) | | Other Units (mg/L, UNLESS STATED) | | | |
| | STORET Code | Monthly Average | Daily Maximum | Monthly Average | Daily Maximum | Measurement Frequency (*3) | Sample Type |
| Flow-MGD | 50050 | Report | Report | --- | --- | 1/week | Estimate |
| TSS | 00530 | --- | --- | 30 | 45 | 1/week | Grab |
| Oil & Grease | 03582 | --- | --- | 15 | 20 | 1/week | Grab |

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Internal Outfall 201, at the point of discharge from the sewage treatment plant prior to combining with the waters of Final Outfall 001 or Final Outfall 002.

FOOTNOTE(S):

(*1) When discharging.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (Internal Outfall 201 continued)

(*2) Future water quality studies may indicate potential toxicity from the presence of residual chlorine in the treatment facility's effluent. Therefore, the permittee is hereby advised that a future Total Residual Chlorine Limit may be required if chlorine is used as a method of disinfection. In many cases, this becomes a NO MEASURABLE Total Residual Chlorine Limit.

(*3) Samples shall be representative of discharges occurring during maintenance activities.

(*4) Discharge Monitoring Reports must be submitted for BOTH Outfall 201 operational scenarios. If either scenario does not discharge within the monitoring period, mark "no discharge" on the top right hand corner of the DMR for that operational scenario.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Internal Outfall 301, the intermittent discharge of mobile metal cleaning wastewater generated from cleaning processes of internal components of plant equipment.

Such discharges shall be limited and monitored by the permittee as specified below:

| Effluent Characteristic | | Discharge Limitations | | | | Monitoring Requirements | |
|---|---|---|---|---|---|---|---|
| | | | | Other Units | | | |
| | | (lbs/day, UNLESS STATED) | | (mg/L, UNLESS STATED) | | | |
| | STORET Code | Monthly Average | Daily Maximum | Monthly Average | Daily Maximum | Measurement Frequency (*1) | Sample Type |
| Flow-MGD | 50050 | Report | Report | --- | --- | 1/week | Estimate |
| TSS | 00530 | --- | --- | 30 | 100 | 1/week | Grab |
| Oil & Grease | 03582 | --- | --- | 15 | 20 | 1/week | Grab |
| Total Copper | 01042 | --- | --- | 1.0 | 1.0 | 1/week | Grab |
| Total Iron | 01045 | --- | --- | 1.0 | 1.0 | 1/week | Grab |

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Internal Outfall 301, at the point of discharge of metal cleaning wastewaters prior to combining with other waters and the waters of Final Outfall 001.

FOOTNOTE(S):

(*1) When discharging.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning __the effective date__ and lasting through __the expiration date__ the permittee is authorized to discharge from:

Internal Outfall 401, the intermittent discharge of previously monitored hydrostatic test wastewater and low volume wastewater treatment systems to Final Outfall 001 via the common header. The low volume waste management systems receive effluent from the following sources, including but not limited to: ion exchange resin backwash and regeneration, auxiliary boiler blowdown, floor washdown, equipment washing, personnel decontamination, laboratory drains, filter press, and maintenance wastewaters and other low volume wastewater sources as defined in 40 CFR 423. During maintenance activities, Internal Outfall 401 may be discharged via the cooling tower flume rather than the common discharge header. During maintenance activities, reverse osmosis reject water from the makeup water polishing system may be discharged via Outfall 401 rather than Outfall 003.

Such discharges shall be limited and monitored by the permittee as specified below:

| Effluent Characteristic | | | Discharge Limitations | | | | Monitoring Requirements | |
|---|---|---|---|---|---|---|---|---|
| | | | (lbs/day, UNLESS STATED) | | Other Units (mg/L, UNLESS STATED) | | | |
| | STORET | Monthly Code | Daily Average | Monthly Maximum | Daily Average | Measurement Maximum | Sample Frequency (*1) | Type |
| Flow-MGD | | 50050 | Report | Report | --- | --- | 1/month | Estimate |
| TSS | | 00530 | --- | --- | 30 | 100 | 1/month | Grab |
| Oil & Grease | | 03582 | --- | --- | 15 | 20 | 1/month | Grab |

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Internal Outfall 401, at the makeup water pump house off one of the two discharge pumps, after filtration prior to combining with other wastestreams and the waters of Final Outfall 001.

FOOTNOTE(S):

(*1) When discharging.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Internal Outfall 501, the intermittent discharge of low volume wastewaters including but not limited to wastewaters from the mobile standby service water reverse osmosis filtration unit and standby cooling tower reject.

Such discharges shall be limited and monitored by the permittee as specified below:

| Effluent Characteristic | | Discharge Limitations | | | | Monitoring Requirements | |
|---|---|---|---|---|---|---|---|
| | | (lbs/day, UNLESS STATED) | | Other Units (mg/L, UNLESS STATED) | | | |
| | STORET Code | Monthly Average | Daily Maximum | Monthly Average | Daily Maximum | Measurement Frequency (*1) | Sample Type |
| Flow-MGD | 50050 | Report | Report | --- | --- | 1/month | Estimate |
| TSS | 00530 | --- | --- | 30 | 100 | 1/month | Grab |
| Oil & Grease | 03582 | --- | --- | 15 | 20 | 1/month | Grab |

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Internal Outfall 501, at the northwest end of the flume at the point of discharge of low volume wastewater prior to combining with other wastestreams and the waters of Final Outfall 001.

FOOTNOTE(S):

(*1) When discharging.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Internal Outfall 601, the intermittent discharge of low volume wastewater including but not limited to wastewaters from the filter backwash from service water polishing and feed-and-bleed from the service water system.

Such discharges shall be limited and monitored by the permittee as specified below:

| Effluent Characteristic | | Discharge Limitations | | | | Monitoring Requirements | |
|---|---|---|---|---|---|---|---|
| | | (lbs/day, UNLESS STATED) | | Other Units (mg/L, UNLESS STATED) | | | |
| | STORET Code | Monthly Average | Daily Maximum | Monthly Average | Daily Maximum | Measurement Frequency (*1) | Sample Type |
| Flow-MGD | 50050 | Report | Report | --- | --- | 1/month | Estimate |
| TSS | 00530 | --- | --- | 30 | 100 | 1/month | Grab |
| Oil & Grease | 03582 | --- | --- | 15 | 20 | 1/month | Grab |

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Internal Outfall 601, at the southeast end of the flume at the point of discharge of low volume wastewater prior to combining with other wastestreams and the waters of Final Outfall 001.

FOOTNOTE(S):

(*1) When discharging.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Outfall 002, the intermittent discharge of stormwater runoff from the industrial materials storage area, low-level storage building and sewage treatment plant area; air conditioning condensate, potable water, and previously monitored hydrostatic test wastewater. During periods of maintenance activities, previously monitored treated wastewater from Internal Outfall 201 may be discharged through Outfall 002.

Such discharges shall be limited and monitored by the permittee as specified below:

| Effluent Characteristic | | Discharge Limitations | | | | Monitoring Requirements | |
|---|---|---|---|---|---|---|---|
| | | (lbs/day, UNLESS STATED) | | Other Units (mg/L, UNLESS STATED) | | | |
| | STORET Code | Monthly Average | Daily Maximum | Monthly Average | Daily Maximum | Measurement Frequency (*1) | Sample Type |
| Flow-MGD | 50050 | --- | Report | --- | --- | 1/quarter | Estimate |
| TOC | 00680 | --- | --- | --- | 50 | 1/quarter | Grab |
| Oil & Grease | 03582 | --- | --- | --- | 15 | 1/quarter | Grab |
| pH Minimum/Maximum Values (standard units) | 00400 | --- | --- | 6.0 (*2) (Min) | 9.0 (*2) (Max) | 1/quarter | Grab |

There shall be no discharge of floating solids or visible foam in other than trace amounts, nor of free oil or other oil materials, nor of toxic materials in quantities such as to cause acute toxicity to aquatic organisms. Furthermore, there shall be no visible sheen or stains attributable to this discharge.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Outfall 002, at the point of discharge from the plant drainage ditch system where the stormwater runoff from the sewage treatment plant area converges with that from the industrial materials storage area and Low Level Waste Storage Building prior to combining with other waters.

FOOTNOTE(S):

(*1) When discharging.

(*2) The permittee shall report on the Discharge Monitoring Reports both the minimum and maximum instantaneous pH values measured.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Outfall 003, the intermittent discharge of stormwater runoff from the reactor building, turbine building, services building, clarifiers, main transformer yard and auxiliary transformer yard; maintenance wastewaters including but not limited to flushing of piping systems and vessels (including Fire Protection Water Supply System and Automatic Sprinkler System); low volume wastewaters including but not limited to reverse osmosis reject water from the standby service water polishing system, effluent from floor drains within power plant buildings (domestic potable water, well water, reject mobile reverse osmosis and fire suppression water treated in the fire pump house oil/water separator), air compressor condensate, and reverse osmosis reject water from makeup water polishing system; air conditioning condensate, previously monitored hydrostatic test wastewater, and de minimis quantities of cooling tower drift/mist (*5).

Such discharges shall be limited and monitored by the permittee as specified below:

| Effluent Characteristic | | Discharge Limitations | | | | Monitoring Requirements | |
|---|---|---|---|---|---|---|---|
| | | (lbs/day, UNLESS STATED) | | Other Units (mg/L, UNLESS STATED) | | | |
| | STORET Code | Monthly Average | Daily Maximum | Monthly Average | Daily Maximum | Measurement Frequency (*1) | Sample Type |
| Flow-MGD | 50050 | --- | Report | --- | --- | 1/quarter (*2) | Estimate |
| TOC | 00680 | --- | --- | --- | 50 | 1/quarter | Grab |
| Oil & Grease | 03582 | --- | --- | --- | 15 | 1/quarter (*2) | Grab |
| TSS | 00530 | --- | --- | --- | 100 | 1/month (*3) | Grab |
| pH Minimum/Maximum Values (standard units) | 00400 | --- | --- | 6.0 (*2) (Min) | 9.0 (*4) (Max) | 1/quarter (*2) | Grab |

There shall be no discharge of floating solids or visible foam in other than trace amounts, nor of free oil or other oil materials, nor of toxic materials in quantities such as to cause acute toxicity to aquatic organisms. Furthermore, there shall be no visible sheen or stains attributable to this discharge.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Outfall 003, at the point of discharge from the plant drainage ditch system along the East Creek prior to combining with other waters.

FOOTNOTE(S):

(*1) When discharging.

(*2) Sampling shall be monthly when discharging low volume wastewaters.

(*3) When discharging low volume wastewater, total suspended solids shall be monitored and reported as required above.

(*4) The permittee shall report on the Discharge Monitoring Reports both the minimum and maximum instantaneous pH values measured.

(*5) Discharge Monitoring Reports must be submitted for BOTH operational scenarios: (1) discharges which do not include low volume wastewaters; and (2) discharges which include low volume wastewaters. If either scenario does not discharge within the monitoring period, mark "no discharge" on the top right hand corner of the DMR for that operational scenario.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Outfall 004, the intermittent discharge of stormwater runoff from the office areas, warehouse areas, materials storage areas, and equipment/vehicle maintenance areas; maintenance wastewaters including but not limited to flushing of piping systems and vessels (fire protection water supply system and automatic sprinkler system, etc.); air conditioning condensate, potable water, previously monitored hydrostatic test wastewater, and previously monitored effluent from Internal Outfall 104

Such discharges shall be limited and monitored by the permittee as specified below:

| Effluent Characteristic | | Discharge Limitations | | | | Monitoring Requirements | |
|---|---|---|---|---|---|---|---|
| | | (lbs/day, UNLESS STATED) | | Other Units (mg/L, UNLESS STATED) | | | |
| | STORET Code | Monthly Average | Daily Maximum | Monthly Average | Daily Maximum | Measurement Frequency (*1) | Sample Type |
| Flow-MGD | 50050 | --- | Report | --- | --- | 1/quarter | Estimate |
| TOC | 00680 | --- | --- | --- | 50 | 1/quarter | Grab |
| Oil & Grease | 03582 | --- | --- | --- | 15 | 1/quarter | Grab |
| pH Minimum/Maximum Values (standard units) | 00400 | --- | --- | 6.0 (*2) (Min) | 9.0 (*2) (Max) | 1/quarter | Grab |

There shall be no discharge of floating solids or visible foam in other than trace amounts, nor of free oil or other oil materials, nor of toxic materials in quantities such as to cause acute toxicity to aquatic organisms. Furthermore, there shall be no visible sheen or stains attributable to this discharge.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Outfall 004, at the point of discharge from the plant drainage ditch system along the West Creek prior to combining with other waters.

FOOTNOTE(S):

(*1) When discharging.

(*2) The permittee shall report on the Discharge Monitoring Reports both the minimum and maximum instantaneous pH values measured.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Internal Outfall 104, the intermittent discharge of exterior vehicle washwater.

Such discharges shall be limited and monitored by the permittee as specified below:

| Effluent Characteristic | | Discharge Limitations | | | | Monitoring Requirements | |
|---|---|---|---|---|---|---|---|
| | | (lbs/day, UNLESS STATED) | | Other Units (mg/L, UNLESS STATED) | | | |
| | STORET Code | Monthly Average | Daily Maximum | Monthly Average | Daily Maximum | Measurement Frequency (*1) | Sample Type |
| Flow-MGD | 50050 | Report | Report | --- | --- | 1/quarter | Estimate |
| COD | 00340 | --- | --- | --- | 300 | 1/quarter | Grab |
| TSS | 00530 | --- | --- | --- | 45 | 1/quarter | Grab |
| Oil & Grease | 03582 | --- | --- | --- | 15 | 1/quarter | Grab |
| pH Minimum/Maximum Values (standard units) | 00400 | --- | --- | 6.0 (*2) (Min) | 9.0 (*2) (Max) | 1/quarter | Grab |
| Soaps and/or Detergents (*3) | --- | --- | --- | Report | --- | 1/quarter | Inventory Calculation |

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Internal Outfall 104, at the point of discharge from the area where vehicles will be washed prior to combining with the waters of Final Outfall 004.

FOOTNOTE(S):

(*1) When discharging.

(*2) The permittee shall report on the Discharge Monitoring Reports both the minimum and maximum instantaneous pH values measured.

(*3) Soaps/Detergents: Monitor by inventory records and calculations quarterly. Retain inventory records (quantity and type), and a Material Safety Data Sheet (MSDS) for each material used for three years. No DMR reporting shall be required.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Outfall 005, the intermittent discharge of stormwater runoff from the cooling tower yard, air conditioning condensate, previously monitored hydrostatic test wastewater, and de minimis quantities of cooling tower drift/mist.

Such discharges shall be limited and monitored by the permittee as specified below:

| Effluent Characteristic | | Discharge Limitations | | | | Monitoring Requirements | |
|---|---|---|---|---|---|---|---|
| | | (lbs/day, UNLESS STATED) | | Other Units (mg/L, UNLESS STATED) | | | |
| | STORET Code | Monthly Average | Daily Maximum | Monthly Average | Daily Maximum | Measurement Frequency (*1) | Sample Type |
| Flow-MGD | 50050 | --- | Report | --- | --- | 1/quarter | Estimate |
| TOC | 00680 | --- | --- | --- | 50 | 1/quarter | Grab |
| Oil & Grease | 03582 | --- | --- | --- | 15 | 1/quarter | Grab |
| pH Minimum/Maximum Values (standard units) | 00400 | --- | --- | 6.0 (*2) (Min) | 9.0 (*2) (Max) | 1/quarter | Grab |

There shall be no discharge of floating solids or visible foam in other than trace amounts, nor of free oil or other oil materials, nor of toxic materials in quantities such as to cause acute toxicity to aquatic organisms. Furthermore, there shall be no visible sheen or stains attributable to this discharge.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Outfall 005, at the point of discharge from the stormwater drainage ditch east of the cooling towers prior to combining with other waters.

FOOTNOTE(S):

(*1) When discharging.

(*2) The permittee shall report on the Discharge Monitoring Reports both the minimum and maximum instantaneous pH values measured.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Outfall 006, the intermittent discharge of clarifier underflow.

Such discharges shall be limited and monitored by the permittee as specified below:

| Effluent Characteristic | | Discharge Limitations | | | | Monitoring Requirements | |
|---|---|---|---|---|---|---|---|
| | | (lbs/day, UNLESS STATED) | | Other Units (mg/L, UNLESS STATED) | | | |
| | STORET Code | Monthly Average | Daily Maximum | Monthly Average | Daily Maximum | Measurement Frequency (*1) | Sample Type |
| Flow-MGD | 50050 | --- | Report | --- | --- | 1/day | Estimate |

COAGULANTS

The quantity and types of all coagulants (clarifying agents) used in the intake raw river water treatment clarification system during the sampling month shall be recorded. Records of the quantity and type of coagulants used shall be retained for three (3) years. No DMR reporting shall be required.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Outfall 006, at the point of discharge of the underflow from the raw river water intake clarifier.

FOOTNOTE(S):

(*1) When discharging.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Outfall 007, the discharge of hydrostatic test wastewater

Such discharges shall be limited and monitored by the permittee as specified below:

| Effluent Characteristic (*1) | | Discharge Limitations | | | | Monitoring Requirements | |
|---|---|---|---|---|---|---|---|
| | | (lbs/day, UNLESS STATED) | | Other Units (mg/L, UNLESS STATED) | | | |
| | STORET Code | Monthly Average(*2) | Daily Maximum(*3) | Monthly Average | Daily Maximum(*3) | Measurement Frequency(*4) | Sample Type |
| Flow-MGD | 50050 | Report | Report | --- | --- | 1/discharge | Estimate |
| TSS (*5) | 00530 | --- | --- | --- | 90 | 1/discharge | Grab |
| Oil & Grease | 03582 | --- | --- | --- | 15 | 1/discharge | Grab |
| TOC | 00680 | --- | --- | --- | 50 | 1/discharge | Grab |
| Benzene | 34030 | --- | --- | --- | 50 $\mu$g/L | 1/discharge | Grab |
| Total BTEX (*6) | 49491 | --- | --- | --- | 250 $\mu$g/L | 1/discharge | Grab |
| Total Lead | 01051 | --- | --- | --- | 50 $\mu$g/L | 1/discharge | Grab |

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Internal Outfall 007, at the point of discharge from the hydrostatic testing activity, prior to combining with other wastewaters (may be discharged through Outfalls 001, 002, 003, 004, 005, 201, and 401).

FOOTNOTE(S):

(*1) Flow, TSS, and Oil and Grease shall be measured on discharges from all new and existing pipelines, flowlines, vessels, or tanks. In addition, Total Organic Carbon (TOC) shall be measured on discharges from existing pipelines, flowlines, vessels, or tanks which have previously been in service; (i.e., those which are not new). Benzene, Total BTEX, and Total Lead shall be measured on discharges from existing pipelines, flowlines, vessels, or tanks which have been used for the storage or transportation of liquid or gaseous petroleum hydrocarbons.

(*2) The flow for the month with the highest monthly average flow shall be reported.

(*3) The highest result from any individual hydrostatic test must be reported.

(*4) Monitoring is required once prior to discharge.

(*5) Report the TSS concentration of the intake on the DMR along with the concentration of TSS in the effluent, if the effluent is being returned to the same water source from which the intake water was obtained. In these cases, concurrent sampling of the influent and the effluent is required, and the net value shall not exceed 90 mg/L.

(*6) BTEX shall be measured as the sum of benzene, toluene, ethylbenzene, ortho-xylene, and para-xylene as quantified using methods prescribed by the latest approved 40 CFR 136, Tables, A-G.

# PART II

## OTHER REQUIREMENTS

In addition to the standard conditions required in all permits and listed in Part III, the Office has established the following additional requirements in accordance with the Louisiana Water Quality Regulations.

A. This permit does not in any way authorize the permittee to discharge a pollutant not listed or quantified in the application or limited or monitored for in the permit.

B. Authorization to discharge pursuant to the conditions of this permit does not relieve the permittee of any liability for damages to state waters or private property. For discharges to private land, this permit does not relieve the permittee from obtaining proper approval from the landowner for appropriate easements and rights of way.

C. For definitions of monitoring and sampling terminology see STANDARD CONDITIONS FOR LPDES PERMITS, Section F.

D. <u>24-HOUR ORAL REPORTING: DAILY MAXIMUM LIMITATION VIOLATIONS</u>

Under the provisions of Part III.D.6.e.(3) of this permit, violations of daily maximum limitations for the following pollutants shall be reported orally to the Office of Environmental Compliance within 24 hours from the time the permittee became aware of the violation followed by a written report in five days.

Pollutant(s):

Benzene
Lead
Total BTEX
Total Chromium
Total Copper
Total Zinc

E. <u>COMPOSITE SAMPLING</u>

Unless otherwise specified in this permit, the term "24-hour composite sample" means a sample consisting of a minimum of four (4) aliquots of effluent collected at regular intervals over a normal 24-hour operating day and combined in proportion to flow or a sample continuously collected in proportion to flow over a normal 24-hour operating period.

F. <u>40 CFR PART 136 (See LAC 33:IX.4901) ANALYTICAL REQUIREMENTS</u>

Unless otherwise specified in this permit, monitoring shall be conducted according to analytical, apparatus and materials, sample collection, preservation, handling, etc., procedures listed at 40 CFR Part 136, and in particular, Appendices A, B, and C (See LAC 33:IX.4901).

OTHER REQUIREMENTS (continued)

G. FLOW MEASUREMENT "ESTIMATE" SAMPLE TYPE

If the flow measurement sample type in Part I is specified as "estimate", flow measurements shall not be subject to the accuracy provisions established at Part III.C.6 of this permit. The daily flow value may be estimated using best engineering judgement.

H. MINIMUM QUANTIFICATION LEVEL (MQL)

If any individual analytical test result is less than the minimum quantification level listed below, a value of zero (0) may be used for that individual result for the Discharge Monitoring Report (DMR) calculations and reporting requirements.

| NONCONVENTIONAL | MQL (μg/L) |
|---|---|
| Phenolics, Total Recoverable (4AAP) | 5 |
| Chlorine (Total Residual) | 33 |
| 3-Chlorophenol | 10 |
| 4-Chlorophenol | 10 |
| 2,3-Dichlorophenol | 10 |
| 2,5-Dichlorophenol | 10 |
| 2,6-Dichlorophenol | 10 |
| 3,4-Dichlorophenol | 10 |
| 2,4-D | 10 |
| 2,4,5-TP (Silvex) | 4 |

| METALS AND CYANIDE | MQL (μg/L) |
|---|---|
| Aluminum (Total) | 2.5 |
| Antimony (Total) | 60 |
| Arsenic (Total) | 5 |
| Beryllium (Total) | 0.5 |
| Cadmium (Total) | 1 |
| Chromium (Total) | 10 |
| Chromium (3+) | 10 |
| Chromium (6+) | 10 |
| Copper (Total) | 3 |
| Lead (Total) | 2 |
| Mercury (Total) | 0.005 |
| Molybdenum (Total) | 30 |
| Nickel (Total) Freshwater | 5 |
| Nickel (Total) Marine | 5 |
| Selenium (Total) | 5 |
| Silver (Total) | 0.5 |
| Thallium (Total) | 0.5 |
| Zinc (Total) | 20 |
| Cyanide (Total) | 10 |

| DIOXIN | MQL (μg/L) |
|---|---|
| 2,3,7,8-TCDD | 0.00001 |

OTHER REQUIREMENTS (continued)

| VOLATILE COMPOUNDS | MQL (μg/L) |
|---|---|
| Acrolein | 50 |
| Acrylonitrile | 20 |
| Benzene | 10 |
| Bromoform | 10 |
| Carbon Tetrachloride | 2 |
| Chlorobenzene | 10 |
| Chlorodibromomethane | 10 |
| Chloroethane | 50 |
| 2-Chloroethylvinylether | 10 |
| Chloroform | 10 |
| 1,2-Dichlorobenzene | 10 |
| 1,3-Dichlorobenzene | 10 |
| 1,4-Dichlorobenzene | 10 |
| Dichlorobromomethane | 10 |
| 1,1-Dichloroethane | 10 |
| 1,2-Dichloroethane | 10 |
| 1,1-Dichloroethylene | 10 |
| 1,2-Dichloropropane | 10 |
| 1,3-Dichloropropylene | 10 |
| Ethylbenzene | 10 |
| Methyl Bromide [Bromomethane] | 50 |
| Methyl Chloride [Chloromethane] | 50 |
| Methylene Chloride | 20 |
| 1,1,2,2-Tetrachloroethane | 10 |
| Tetrachloroethylene | 10 |
| Toluene | 10 |
| 1,2-trans-Dichloroethylene | 10 |
| 1,1,1-Trichloroethane | 10 |
| 1,1,2-Trichloroethane | 10 |
| Trichloroethylene | 10 |
| Vinyl Chloride | 10 |

| ACID COMPOUNDS | MQL (μg/L) |
|---|---|
| 2-Chlorophenol | 10 |
| 2,4-Dichlorophenol | 10 |
| 2,4-Dimethylphenol | 10 |
| 4,6-Dinitro-o-Cresol [2-Methyl-4,6-Dinitrophenol] | 50 |
| 2,4-Dinitrophenol | 50 |
| 2-Nitrophenol | 20 |
| 4-Nitrophenol | 50 |
| p-Chloro-m-Cresol [4-Chloro-3-Methylphenol] | 10 |
| Pentachlorophenol | 5 |
| Phenol | 10 |
| 2,4,6-Trichlorophenol | 10 |

| BASE/NEUTRAL COMPOUNDS | MQL (μg/L) |
|---|---|
| Acenaphthene | 10 |
| Acenaphthylene | 10 |
| Anthracene | 10 |

OTHER REQUIREMENTS (continued)

| | |
|---|---|
| Benzidine | 50 |
| Benzo(a)anthracene | 5 |
| Benzo(a)pyrene | 5 |
| 3,4-Benzofluoranthene | 10 |
| Benzo(ghi)perylene | 20 |
| Benzo(k)fluoranthene | 5 |
| Bis(2-chloroethoxy) Methane | 10 |
| Bis(2-chloroethyl) Ether | 10 |
| Bis(2-chloroisopropyl) Ether | 10 |
| Bis(2-ethylhexyl) Phthalate | 10 |
| 4-Bromophenyl Phenyl Ether | 10 |
| Butylbenzyl Phthalate | 10 |
| 2-Chloronapthalene | 10 |
| 4-Chlorophenyl Phenyl Ether | 10 |
| Chrysene | 5 |
| Dibenzo(a,h)anthracene | 5 |
| 3,3'-Dichlorobenzidine | 5 |
| Diethyl Phthalate | 10 |
| Dimethyl Phthalate | 10 |
| Di-n-Butyl Phthalate | 10 |
| 2,4-Dinitrotoluene | 10 |
| 2,6-Dinitrotoluene | 10 |
| Di-n-octyl Phthalate | 10 |
| 1,2-Diphenylhydrazine | 20 |
| Fluoranthene | 10 |
| Fluorene | 10 |
| Hexachlorobenzene | 5 |
| Hexachlorobutadiene | 10 |
| Hexachlorocyclopentadiene | 10 |
| Hexachloroethane | 20 |
| Indeno(1,2,3-cd)pyrene [2,3-o-Phenylene Pyrene] | 5 |
| Isophorone | 10 |
| Naphthalene | 10 |
| Nitrobenzene | 10 |
| n-Nitrosodimethylamine | 50 |
| n-Nitrosodi-n-Propylamine | 20 |
| n-Nitrosodiphenylamine | 20 |
| Phenanthrene | 10 |
| Pyrene | 10 |
| 1,2,4-Trichlorobenzene | 10 |

| PESTICIDES | MQL (µg/L) |
|---|---|
| Aldrin | 0.01 |
| Alpha-BHC | 0.05 |
| Beta-BHC | 0.05 |
| Gamma-BHC [Lindane] | 0.05 |
| Delta-BHC | 0.05 |
| Chlordane | 0.2 |
| 4,4'-DDT | 0.02 |
| 4,4'-DDE [p,p-DDX] | 0.1 |

OTHER REQUIREMENTS (continued)

| | |
|---|---|
| 4,4'-DDD [p,p-TDE] | 0.1 |
| Dieldrin | 0.02 |
| Alpha-Endosulfan | 0.01 |
| Beta-Endosulfan | 0.02 |
| Endosulfan Sulfate | 0.1 |
| Endrin | 0.02 |
| Endrin Aldehyde | 0.1 |
| Heptachlor | 0.01 |
| Heptachlor Epoxide [BHC-Hexachlorocyclohexane] | 0.01 |
| PCB-1242 | 0.2 |
| PCB-1254 | 0.2 |
| PCB-1221 | 0.2 |
| PCB-1232 | 0.2 |
| PCB-1248 | 0.2 |
| PCB-1260 | 0.2 |
| PCB-1016 | 0.2 |
| Toxaphene | 0.3 |

The permittee may develop an effluent specific method detection limit (MDL) in accordance with Appendix B to 40 CFR Part 136 (See LAC 33:IX.4901). For any pollutant for which the permittee determines an effluent specific MDL, the permittee shall send to this Office a report containing QA/QC documentation, analytical results, and calculations necessary to demonstrate that the effluent specific MDL was correctly calculated. An effluent specific minimum quantification level (MQL) shall be determined in accordance with the following calculation:

$$MQL = 3.3 \times MDL$$

Upon written approval by this Office, the effluent specific MQL may be utilized by the permittee for all future Discharge Monitoring Report (DMR) calculations and reporting requirements.

I. The permittee shall achieve compliance with the effluent limitations and monitoring requirements specified for discharges in accordance with the following schedule:

Effective date of the permit

J. PERMIT REOPENER CLAUSE

This permit may be modified, or alternatively, revoked and reissued, to comply with any applicable effluent standard or limitations issued or approved under sections 301(b)(2)(C) and (D); 304(b)(2); and 307(a)(2) of the Clean Water Act or more stringent discharge limitations and/or additional restrictions in the future to maintain the water quality integrity and the designated uses of the receiving water bodies based upon additional water quality studies and/or TMDL's, if the effluent standard, limitations, water quality studies or TMDL's so issued or approved:

1. Contains different conditions or is otherwise more stringent than any effluent limitation in the permit; or

OTHER REQUIREMENTS (continued)

2. Controls any pollutant not limited in the permit; or

3. Require reassessment due to change in 303(d) status of waterbody; or

4. Incorporates the results of any total maximum daily load allocation, which may be approved for the receiving water body.

The Louisiana Department of Environmental Quality (LDEQ) reserves the right to modify or revoke and reissue this permit based upon any changes to established TMDLs for this discharge, or to accommodate for pollutant trading provisions in approved TMDL watersheds as necessary to achieve compliance with water quality standards. Therefore, prior to upgrading or expanding this facility, the permittee should contact the Department to determine the status of the work being done to establish future effluent limitations and additional permit conditions.

K. PROHIBITION OF PCB DISCHARGES

There shall be no discharge of polychlorinated biphenyls (PCBs). The minimum quantification level for PCBs is 0.2 μg/l. If any individual analytical test result for PCBs is less than the minimum quantification level, then a value of zero (0) shall be used for the Discharge Monitoring Report (DMR) calculations and reporting requirements.

L. PROHIBITION OF 126 PRIORITY POLLUTANTS

There shall be no discharge of any 126 priority pollutants (40 CFR 423 Appendix A) associated with the chemicals added for cooling tower maintenance, except for Total Chromium and Total Zinc. The minimum quantification levels for the 126 priority pollutants are found in Part II, Paragraph H.

M. FREE AVAILABLE CHLORINE

The term "free available chlorine" shall mean the value obtained using the amperometric titration method for free available chlorine described in the latest edition of Standard Methods for the Examination of Water and Wastewater.

Free available chlorine may not be discharged from any unit for more than two hours in any one day and not more than one unit in any plant may discharge free available chlorine at any one time.

N. TEMPERATURE

Daily temperature discharge is defined as the flow-weighted average temperature (FWAT) and, on a daily basis, shall be monitored and recorded in accordance with Part I of this permit. FWAT shall be calculated at equal time intervals not greater than two hours. The method of calculating FWAT is as follows:

$$\text{FWAT} = \frac{\text{SUMMATION (INSTANTANEOUS FLOW X INSTANTANEOUS TEMPERATURE)}}{\text{SUMMATION (INSTANTANEOUS FLOW)}}$$

OTHER REQUIREMENTS (continued)

"Daily Average Temperature" (also known as monthly average) shall be the arithmetic average of all FWATs calculated during the calendar month.

"Daily Maximum Temperature" (also known as daily maximum) shall be the highest FWAT calculated during the calendar month.

O. CHEMICAL METAL CLEANING WASTE

The term "chemical metal cleaning waste" means any wastewater resulting from the cleaning of any metal process equipment with chemical compounds, including but not limited to, boiler tube cleaning.

P. METAL CLEANING WASTE

The term "metal cleaning waste" means any wastewater resulting from cleaning (with or without chemical cleaning compounds) any metal process equipment including, but not limited to, boiler tube cleaning, boiler fireside cleaning, and air preheater cleaning.

Q. LOW VOLUME WASTE SOURCES

The term "low volume waste sources" mean, taken collectively as if from one source, wastewater from all sources except those for which specific limitations are otherwise established in this part. Low volume wastes sources include, but are not limited to: wastewaters from wet scrubber air pollution control systems, ion exchange water treatment system, water treatment evaporator blowdown, laboratory and sampling streams, boiler blowdown, floor drains, cooling tower basin cleaning wastes, and recirculating house service water systems. Sanitary and air conditioning wastes are not included.

R. ZEBRA MUSSEL TREATMENT

The terms and conditions of the most recently approved zebra mussel treatment program submitted by Entergy Operations, Inc., River Bend Station shall be enforceable as if part of this permit.

According to Paragraph U. 3.d., "Samples and Composites", of the biomonitoring requirements paragraph of this permit, the permittee must collect composite samples that are "representative of any periodic episodes of chlorination, biocide usage, or other potentially toxic substances discharged on an intermittent basis." Any time the treatment method involves an increase in the concentration of a treatment chemical, a change in the type of treatment chemical used, or if any event occurs that creates the potential for an effluent with a higher toxic nature, additional biomonitoring according to the terms and conditions of the biomonitoring section of Part II of this permit shall be required.

The permittee must notifiy this Office if changes occur in the zebra mussel control plan and obtain approval prior to initiating the new treatment. If chlorine is applied to control zebra mussels, the discharge shall not exceed a daily maximum Total Residual Chlorine (TRC) concentration of 0.2 mg/L. Monitoring shall be performed at a frequency of 1/day by grab sample, during periods of chlorine application.

OTHER REQUIREMENTS (continued)

S. STORMWATER DISCHARGES

1. This section applies to all stormwater discharges from the facility, either through permitted outfalls or through outfalls which are not listed in the permit or as sheet flow. The purpose of the pollution prevention plan is to identify 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.

2. Any runoff leaving the developed areas of the facility, other than the permitted outfall(s), exceeding 50 mg/L TOC, 15 mg/L Oil and Grease, or having a pH less than 6.0 or greater than 9.0 standard units shall be a violation of this permit. Any discharge in excess of these limitations, which is attributable to offsite contamination shall not be considered a violation of this permit. A visual inspection of the facility shall be conducted and a report made annually as described in Paragraph 4 below.

3. **For first time permit issuance,** the permittee shall prepare, implement, and maintain a Storm Water Pollution Prevention Plan (SWP3) within six (6) months of the effective date of the final permit. **For renewal permit issuance,** the permittee shall review and update, if necessary, a Storm Water Pollution Prevention Plan (SWP3) within six (6) months of the effective date of the final permit. The terms and conditions of the SWP3 shall be an enforceable Part of the permit. If the permittee maintains other plans that contain duplicative information, those plans could be incorporated by reference into the SWP3. Examples of these type plans include, but are not limited to: Spill Prevention Control and Countermeasure Plan (SPCC), Best Management Plan (BMP), Response Plans, etc. EPA document 832-R-92-006 (Storm Water Management for Industrial Activities) may be used as a guidance and may be obtained by writing to the Water Resource Center (RC-4100T), U.S. Environmental Protection Agency, 1200 Pennsylvania Avenue NW, Washington D.C. 20460 or by calling (202) 566-1729 or via the Wetlands Helpline (800) 832-7828.

4. The following conditions are applicable to all facilities and shall be included in the SWP3 for the facility.

   a. The permittee shall conduct an annual inspection of the facility site to identify areas contributing to the storm water discharge from developed areas of the facility and evaluate whether measures to reduce pollutant loadings identified in the SWP3 are adequate and have been properly implemented in accordance with the terms of the permit or whether additional control measures are needed.

   b. The permittee shall develop a site map which includes all areas where stormwater may contact potential pollutants or substances which can cause pollution. Any location where reportable quantities leaks or spills have previously occurred are to be documented in the SWP3. The SWP3 shall contain a description of the potential pollutant sources, including, the type and quantity of material present and what action has been taken to assure stormwater precipitation will not directly contact the substances and result in contaminated runoff.

   c. Where experience indicates a reasonable potential for equipment failure (e.g. a tank overflow or leakage), natural condition of (e.g. precipitation), or other

OTHER REQUIREMENTS (continued)

circumstances which result in significant amounts of pollutants reaching surface waters, the SWP3 should include a prediction of the direction, rate of flow and total quantity of pollutants which could be discharged from the facility as a result of each condition or circumstance.

d. The permittee shall maintain for a period of three years a record summarizing the results of the inspection and a certification that the facility is in compliance with the SWP3, and identifying any incidents of noncompliance. The summary report should contain, at a minimum, the date and time of inspection, name of inspector(s), conditions found, and changes to be made to the SWP3.

e. The summary report and the following certification shall be signed in accordance with LAC 33:IX.2503. The summary report is to be attached to the SWP3 and provided to the Department upon request.

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Signatory requirements for the certification may be found in Part III, Section D.10 of this permit.

f. The permittee shall make available to the Department, upon request, a copy of the SWP3 and any supporting documentation.

5. The following shall be included in the SWP3, if applicable.

a. The permittee shall utilize all reasonable methods to minimize any adverse impact on the drainage system including but not limited to:

i. maintaining adequate roads and driveway surfaces;
ii. removing debris and accumulated solids from the drainage system; and
iii. cleaning up immediately any spill by sweeping, absorbent pads, or other appropriate methods.

b. All spilled product and other spilled wastes shall be immediately cleaned up and disposed of according to all applicable regulations, Spill Prevention and Control (SPC) plans or Spill Prevention Control and Countermeasures (SPCC) plans. Use of detergents, emulsifiers, or dispersants to clean up spilled product is prohibited except where necessary to comply with State or Federal safety regulations (i.e., requirement for non-slippery work surface) except where the cleanup practice does not result in a discharge and does not leave residues exposed to future storm events. In all such cases, initial cleanup shall be done by physical removal and chemical usage shall be minimized.

OTHER REQUIREMENTS (continued)

c. All equipment, parts, dumpsters, trash bins, petroleum products, chemical solvents, detergents, or other materials exposed to stormwater shall be maintained in a manner which prevents contamination of stormwater by pollutants.

d. All waste fuel, lubricants, coolants, solvents, or other fluids used in the repair or maintenance of vehicles or equipment shall be recycled or contained for proper disposal. Spills of these materials are to be cleaned up by dry means whenever possible.

e. If applicable, all storage tank installations (with a capacity greater than 660 gallons for an individual container, or 1,320 gallons for two or more containers in aggregate within a common storage area) shall be constructed so that a secondary means of containment is provided for the entire contents of the largest tank plus sufficient freeboard to allow for precipitation. Diked areas should be sufficiently impervious to contain spills.

f. All diked areas surrounding storage tanks or stormwater collection basins shall be free of residual oil or other contaminants so as to prevent the accidental discharge of these materials in the event of flooding, dike failure, or improper draining of the diked area. All drains from diked areas shall be equipped with valves which shall be kept in the closed condition except during periods of supervised discharge.

g. All check valves, tanks, drains, or other potential sources of pollutant releases shall be inspected and maintained on a regular basis to assure their proper operation and to prevent the discharge of pollutants.

h. The permittee shall assure compliance with all applicable regulations promulgated under the Louisiana Solid Waste and Resource Recovery Law and the Hazardous Waste Management Law (L.R.S. 30:2151, etc.). Management practices required under above regulations shall be referenced in the SWP3.

i. The permittee shall amend the SWP3 whenever there is a change in the facility or change in the operation of the facility which materially increases the potential for the ancillary activities to result in a discharge of significant amounts of pollutants.

j. If the SWP3 proves to be ineffective in achieving the general objectives of preventing the release of significant amounts of pollutants to water of the state, then the specific objectives and requirements of the SWP3 shall be subject to modification to incorporate revised SWP3 requirements.

6. Facility Specific SWP3 Conditions:

None

T. DISCHARGE MONITORING REPORTS

Monitoring results must be reported on a Discharge Monitoring Report (DMR) form (EPA No. 3320-1 or an approved substitute). All monitoring reports must be retained for a period of at least three (3) years from the date of the sample measurement. The permittee shall

OTHER REQUIREMENTS (continued)

make available to this Department, upon request, copies of all monitoring data required by this permit.

If there is no discharge during the reporting period, place an "X" in the NO DISCHARGE box located in the upper right corner of the Discharge Monitoring Report for that outfall.

Monitoring results for each reporting period shall be summarized on a Discharge Monitoring Report (DMR) Form (one DMR form per monitoring period per outfall) and submitted to the Office of Environmental Compliance either hand delivered, postmarked, or electronically submitted in accordance with LAC 33:I.2101.A and B no later than the 15th day of the month following each reporting period.

1. For parameter(s) with monitoring frequencies of 1/month or more frequent (i.e. continuous, 1/batch, 1/discharge event, 1/day, 3/week, 2/week, 1/week, 2/month, etc.), DMRs shall be submitted in accordance with the following schedule:

   Submit DMR postmarked by the 15th day of the following month.

2. For parameter(s) that require a monitoring frequency of 1/ 2 months, DMRs shall be submitted in accordance with the following schedule:

| Monitoring Period | DMR Postmark Date |
|---|---|
| January - June | July 15th |
| July - December | January 15th |

3. For parameter(s) that require a monitoring frequency of quarterly, DMRs shall be submitted in accordance with the following schedule:

| Monitoring Period | DMR Postmark Date |
|---|---|
| January, February, March | April 15th |
| April, May, June | July 15th |
| July, August, September | October 15th |
| October, November, December | January 15th |

4. For parameter(s) that require a semiannual monitoring frequency, DMRs shall be submitted in accordance with the following schedule:

| Monitoring Period | DMR Postmark Date |
|---|---|
| January - June | July 15th |
| July - December | January 15th |

5. For parameter(s) that require an annual monitoring frequency, DMRs shall be submitted in accordance with the following schedule:

| Monitoring Period | DMR Postmark Date |
|---|---|
| January-December | January 15th |

OTHER REQUIREMENTS (continued)

For facilities with individually permitted hydrostatic test water discharges, the monitoring results for each hydrostatic test shall be summarized and reported on a Discharge Monitoring Report (DMR) form EPA 3320-1 or an approved substitute, and submitted to the Office of Environmental Compliance on a quarterly basis (in accordance with the quarterly submittal schedule above). If there is no discharge during an entire quarter, the DMR shall be submitted with "No Discharge" written in the upper right corner of the DMR.

If not submitting electronically, duplicate sets of DMR's (one set of originals and one set of copies) signed and certified as required by LAC 33:IX.2503, and all other reports (one set of originals) required by this permit shall be submitted to the Permit Compliance Unit at the following address:

Department of Environmental Quality
Office of Environmental Compliance
Permit Compliance Unit
Post Office Box 4312
Baton Rouge, Louisiana 70821-4312

U. 48 HR ACUTE BIOMONITORING REQUIREMENTS: FRESHWATER

It is unlawful and a violation of this permit for a permittee or the designated agent to manipulate test samples in any manner, to delay shipment, or to terminate a toxicity test. Once initiated, all toxicity tests must be completed unless specific authority has been granted by the Louisiana Department of Environmental Quality.

1. SCOPE AND METHODOLOGY

a. The permittee shall test the effluent for toxicity in accordance with the provisions in this section.

| | |
|---|---|
| APPLICABLE TO OUTFALL(S): | 001 |
| CRITICAL DILUTION: | 0.14% |
| EFFLUENT DILUTION SERIES: | 0.06%, 0.08%, 0.11%, 0.14%, and 0.19% |
| COMPOSITE SAMPLE TYPE: | Defined at PART I |
| TEST SPECIES/METHODS: | 40 CFR Part 136 (See LAC 33:IX.4901) |

Daphnia pulex acute static renewal 48-hour definitive toxicity test using EPA 821-R-02-012, or the latest update thereof. A minimum of five (5) replicates with ten (10) organisms per replicate must be used in the control and in each effluent dilution of this test.

Pimephales promelas (Fathead minnow) acute static renewal 48-hour definitive toxicity test using EPA 821-R-02-012, or the latest update

OTHER REQUIREMENTS (continued)

thereof. A minimum of five (5) replicates with ten (10) organisms per replicate must be used in the control and in each effluent dilution of this test.

b. The NOEC (No Observed Effect Concentration) is defined as the greatest effluent dilution at and below which lethality that is statistically different from the control (0% effluent) at the 95% confidence level does not occur.

c. This permit may be reopened to require whole effluent toxicity limits, chemical specific effluent limits, additional testing, and/or other appropriate actions to address toxicity.

d. Test failure is defined as a demonstration of statistically significant sub-lethal or lethal effects to a test species at or below the effluent critical dilution.

2. PERSISTENT LETHALITY

The requirements of this subsection apply only when a toxicity test demonstrates significant lethal effects at or below the critical dilution. Significant lethal effects are herein defined as a statistically significant difference at the 95% confidence level between the survival of the appropriate test organism in a specified effluent dilution and the control (0% effluent).

If any valid test demonstrates significant lethal effects to a test species at or below the critical dilution, the frequency of testing for that species is automatically increased to once per quarter for the term of the permit.

a. The permittee shall conduct a total of three (3) additional tests for any species that demonstrates statistically significant lethal toxic effects at the critical dilution or lower effluent dilutions. The additional tests shall be conducted monthly during the next three consecutive months in which a discharge occurs to determine if toxicity is persistent or occurs on a periodic basis. The purpose of this testing is to determine whether toxicity is present at a level and frequency that will provide toxic sample results to use in performing a Toxicity Reduction Evaluation (TRE). If no additional test failures occur during the retest monitoring period, the testing frequency will be once per quarter for the term of the permit or until another test failure occurs. The permittee may substitute one of the additional tests in lieu of one routine toxicity test. A full report shall be prepared for each test required by this section in accordance with procedures outlined in Item 4 of this section and submitted with the period discharge monitoring report (DMR) to the permitting authority for review.

b. If any of the valid additional tests demonstrates significant lethal effects at or below the critical dilution, the permittee shall initiate Toxicity Reduction Evaluation (TRE) requirements as specified in Item 6 of this section. The permittee shall notify the Department of Environmental Quality, Office of Environmental Compliance - Permit Compliance Unit in writing within 5 days of the failure in any retest, and the TRE initiation date will be the test

OTHER REQUIREMENTS (continued)

completion date of the first failed retest. A TRE may also be required due to a demonstration of intermittent lethal effects at or below the critical dilution, or for failure to perform the required retests.

c. The provisions of Item 2.a are suspended upon submittal of the TRE Action Plan.

3. REQUIRED TOXICITY TESTING CONDITIONS

a. Test Acceptance

The permittee shall repeat a test, including the control and all effluent dilutions, if the procedures and quality assurance requirements defined in the test methods or in this permit are not satisfied, including the following additional criteria:

i. Each toxicity test control (0% effluent) must have a survival equal to or greater than 90%.

ii. The percent coefficient of variation between replicates shall be 40% or less in the control (0% effluent) for: Daphnia pulex survival test; and Fathead minnow survival test.

iii. The percent coefficient of variation between replicates shall be 40% or less in the critical dilution, unless significant lethal effects are exhibited for: Daphnia pulex survival test; and Fathead minnow survival test.

Test failure may not be construed or reported as invalid due to a coefficient of variation value of greater than 40%. A repeat test shall be conducted within the required reporting period of any test determined to be invalid.

b. Statistical Interpretation

For the Daphnia pulex survival test and the Fathead minnow survival test, the statistical analyses used to determine if there is a statistically significant difference between the control and the critical dilution shall be in accordance with the methods for determining the No Observed Effect Concentration (NOEC) as described in EPA 821-R-02-012, or the most recent update thereof.

If the conditions of Test Acceptability are met in Item 3.a above and the percent survival of the test organism is equal to or greater than 90% in the critical dilution concentration and all lower dilution concentrations, the test shall be considered to be a passing test regardless of the NOEC, and the permittee shall report a NOEC of not less than the critical dilution for the DMR reporting requirements found in Item 4 below.

OTHER REQUIREMENTS (continued)

c. Dilution Water

i. Dilution water used in the toxicity tests will be receiving water collected as close to the point of discharge as possible but unaffected by the discharge. The permittee shall substitute synthetic dilution water of similar pH, hardness and alkalinity to the closest downstream perennial water for;

(A) toxicity tests conducted on effluent discharges to receiving water classified as intermittent streams; and

(B) toxicity tests conducted on effluent discharges where no receiving water is available due to zero flow conditions.

ii. If the receiving water is unsatisfactory as a result of instream toxicity (fails to fulfill the test acceptance criteria of Item 3.a), the permittee may substitute synthetic dilution water for the receiving water in all subsequent tests provided the unacceptable receiving water test met the following stipulations:

(A) a synthetic dilution water control which fulfills the test acceptance requirements of Item 3.a was run concurrently with the receiving water control;

(B) the test indicating receiving water toxicity has been carried out to completion (i.e., 48 hours);

(C) the permittee includes all test results indicating receiving water toxicity with the full report and information required by Item 4 below; and

(D) The synthetic dilution water shall have a pH, hardness and alkalinity similar to that of the receiving water or closest downstream perennial water not adversely affected by the discharge, provided the magnitude of these parameters will not cause toxicity in the synthetic dilution water.

d. Samples and Composites

i. The permittee shall collect two 24-hour flow-weighted composite samples from the outfall(s) listed at Item 1.a above. A 24-hour composite sample consists of a minimum of 4 effluent portions collected at equal time intervals representative of a 24-hour operating day and combined proportional to flow or a sample continuously collected proportional to flow over a 24-hour operating day.

ii. The permittee shall collect a second 24-hour composite sample for use during the 24-hour renewal of each dilution concentration for both tests. The permittee must collect the 24-hour composite samples so that the maximum holding time for any effluent sample shall not

OTHER REQUIREMENTS (continued)

exceed 36 hours. The permittee must have initiated the toxicity test within 36 hours after the collection of the last portion of the first 24-hour composite sample. Samples shall be chilled to 0-6 degrees Centigrade during collection, shipping and/or storage.

iii. The permittee must collect the 24-hour composite samples such that the effluent samples are representative of any periodic episode of chlorination, biocide usage or other potentially toxic substance discharged on an intermittent basis.

iv. If the flow from the outfall(s) being tested ceases during the collection of effluent samples, the requirements for the minimum number of effluent samples, the minimum number of effluent portions and the sample holding time are waived during that sampling period. However, the permittee must collect an effluent composite sample volume during the period of discharge that is sufficient to complete the required toxicity tests with daily renewal of effluent. When possible, the effluent samples used for the toxicity tests shall be collected on separate days. The effluent composite sample collection duration and the static renewal protocol associated with the abbreviated sample collection must be documented in the full report required in Item 4. of this section.

4. REPORTING

a. A valid test must be completed and test results must be submitted for each species during each Monitoring Period. The permittee shall prepare a full report of the results of all tests conducted pursuant to this Part in accordance with the Report Preparation Section of EPA 821-R-02-012, for every valid or invalid toxicity test initiated, whether carried to completion or not. The permittee shall retain each full report pursuant to the provisions of Part III.C.3 of this permit. For any test which fails, is considered invalid or which is terminated early for any reason, the full report must be submitted for agency review. The permittee shall submit the first full report to the following address:

Department of Environmental Quality
Office of Environmental Compliance
Enforcement Division
P.O. Box 4312
Baton Rouge, Louisiana 70821-4312
Attn: Permit Compliance Unit

In addition, if enforcement authority has been retained by EPA, a copy of the report must also be submitted to the following address:

U.S. Environmental Protection Agency, Region 6
Water Enforcement Branch, 6 EN-WC
1445 Ross Ave.
Dallas, Texas 75202

OTHER REQUIREMENTS (continued)

b. The permittee shall submit the results of each valid toxicity test on the DMR for that Monitoring Period in accordance with Part III.D.4 of this permit. Submit retest information clearly marked as such on the DMR for the Monitoring Period in which the retest occurred. Only results of valid tests are to be reported on the DMR. The permittee shall submit the Table 1 Summary Sheet with each valid test.

i. Pimephales promelas (Fathead minnow)

(A) If the No Observed Effect Concentration (NOEC) for survival is less than the critical dilution, enter a "1"; otherwise, enter a "0" for Parameter No. TEM6C.

(B) Report the NOEC value for survival, Parameter No. TOM6C.

(C) Report the highest (critical dilution or control) Coefficient of Variation, Parameter No. TQM6C.

ii. Daphnia pulex

(A) If the NOEC for survival is less than the critical dilution, enter a "1"; otherwise, enter a "0" for Parameter No. TEM3D.

(B) Report the NOEC value for survival, Parameter No. TOM3D.

(C) Report the highest (critical dilution or control) Coefficient of Variation, Parameter No. TQM3D.

iii. The permittee shall report the following results for all VALID toxicity retests on the DMR for that Monitoring Period.

(A) Retest #1 (STORET 22415): If the first monthly retest following failure of a routine test for either test species results in an NOEC for survival less than the critical dilution, report a "1"; otherwise, report a "0".

(B) Retest #2 (STORET 22416): If the second monthly retest following failure of a routine test for either test species results in an NOEC for survival less than the critical dilution, report a "1"; otherwise, report a "0".

(C) Retest #3 (STORET 51443): If the third monthly retest following failure of a routine test for either test species results in an NOEC for survival less than the critical dilution, report a "1"; otherwise, report a "0".

If, for any reason, a retest cannot be performed during the Monitoring Period in which the triggering routine test failure is experienced, the permittee shall report it on the following Monitoring Period's DMR, and the comments section of the DMRs shall be annotated to that effect. If

OTHER REQUIREMENTS (continued)

retesting is not required during a given Monitoring Period, the permittee shall leave these DMR fields blank.

The permittee shall submit the toxicity testing information contained in Table 1 of this permit with the DMR subsequent to each and every toxicity test Monitoring Period. The DMR and the summary tables should be sent to the address indicated in 4.a.

5. MONITORING FREQUENCY REDUCTION

a. Upon successfully passing the first four quarters of WET testing after permit issuance/reissuance and in the absence of subsequent lethal toxicity for one or both test species at or below the critical dilution, the permittee may apply for a testing frequency reduction. If granted, the monitoring frequency for that test species may be reduced to not less than once per year for the less sensitive species (usually the Fathead minnow) and not less than once per six months for the more sensitive test species (usually the Daphnia pulex). Monitoring frequency reduction shall not apply to monitoring frequencies of once per year.

b. CERTIFICATION - The permittee must certify in writing that no test failures have occurred and that all tests meet all test acceptability criteria in Item 3.a. above. In addition, the permittee must provide a list with each test performed including test initiation date, species, NOEC's for lethal and sub-lethal effects and the maximum coefficient of variation for the controls. Upon review and acceptance of this information the agency will issue a letter of confirmation of the monitoring frequency reduction. A copy of the letter will be forwarded to the agency's Permit Compliance Unit to update the permit reporting requirements.

c. This monitoring frequency reduction applies only until the expiration date of this permit, at which time the Monitoring Frequency/Monitoring Period for both test species reverts to once per quarter until the permit is re-issued.

d. SURVIVAL FAILURES - If any test fails the survival endpoint at any time during the term of this permit, three monthly retests are required and the monitoring frequency for the affected test species shall be increased to once per quarter until the permit is reissued. Monthly retesting is not required if the permittee is performing a TRE.

6. TOXICITY REDUCTION EVALUATION (TRE)

a. Within ninety (90) days of confirming lethality in the retests, the permittee shall submit a Toxicity Reduction Evaluation (TRE) Action Plan and Schedule for conducting a TRE. The TRE Action Plan shall specify the approach and methodology to be used in performing the TRE. A Toxicity Reduction Evaluation is an investigation intended to determine those actions necessary to achieve compliance with water quality-based effluent requirements/and or chemical-specific limits by reducing an effluent's toxicity to an acceptable level. A TRE is defined as a step-wise process which combines toxicity testing and analyses of the physical and chemical characteristics of a toxic effluent to identify the constituents causing effluent toxicity and/or treatment methods which will reduce

OTHER REQUIREMENTS (continued)

the effluent toxicity. The TRE Action Plan shall lead to the successful elimination of effluent toxicity at the critical dilution and include the following:

i. Specific Activities. The plan shall detail the specific approach the permittee intends to utilize in conducting the TRE. The approach may include toxicity characterizations, identifications and confirmation activities, source evaluation, treatability studies, or alternative approaches. When the permittee conducts Toxicity Characterization Procedures the permittee shall perform multiple characterizations and follow the procedures specified in the document "Methods for Aquatic Toxicity Identification Evaluations: Phase I Toxicity Characterization Procedures" (EPA-600/6-91/003) or alternate procedures. When the permittee conducts Toxicity Identification Evaluations and Confirmations, the permittee shall perform multiple identifications and follow the methods specified in the documents "Methods for Aquatic Toxicity Identification Evaluations, Phase II Toxicity Identification Procedures for Samples Exhibiting Acute and Chronic Toxicity" (EPA/600/R-92/080) and "Methods for Aquatic Toxicity Identification Evaluations, Phase III Toxicity Confirmation Procedures for Samples Exhibiting Acute and Chronic Toxicity" (EPA/600/R-92/081), as appropriate.

   The documents referenced above may be obtained through the National Technical Information Service (NTIS) by phone at (703) 487-4650, or by writing:

   U.S. Department of Commerce
   National Technical Information Service
   5285 Port Royal Road
   Springfield, Va. 22161

ii. Sampling Plan (e.g., locations, methods, holding times, chain of custody, preservation, etc.). The effluent sample volume collected for all tests shall be adequate to perform the toxicity test, toxicity characterization, identification and confirmation procedures, and conduct chemical specific analyses when a probable toxicant has been identified;

   Where the permittee has identified or suspects specific pollutant(s) and/or source(s) of effluent toxicity, the permittee shall conduct, concurrent with toxicity testing, chemical specific analyses for the identified and/or suspected pollutant(s) and/or source(s) of effluent toxicity. Where lethality was demonstrated within 24 hours of test initiation, each composite sample shall be analyzed independently. Otherwise the permittee may substitute a composite sample, comprised of equal portions of the individual composite samples, for the chemical specific analysis;

iii. Quality Assurance Plan (e.g., QA/QC implementation, corrective actions, etc.); and

iv. Project Organization (e.g., project staff, project manager, consulting services, etc.).

OTHER REQUIREMENTS (continued)

b. The permittee shall initiate the TRE Action Plan within thirty (30) days of plan and schedule submittal. The permittee shall assume all risks for failure to achieve the required toxicity reduction.

c. The permittee shall submit a quarterly TRE Activities Report, with the Discharge Monitoring Report in the months of January, April, July and October, containing information on toxicity reduction evaluation activities including:

   i. any data and/or substantiating documentation which identify the pollutant(s) and/or source(s) of effluent toxicity;

   ii. any studies/evaluations and results on the treatability of the facility's effluent toxicity; and

   iii. any data which identify effluent toxicity control mechanisms that will reduce effluent toxicity to the level necessary to achieve compliance with permit biomonitoring requirements and/or chemical-specific limits.

   The TRE Activities Report shall be submitted to the following addresses:

   Department of Environmental Quality
   Office of Environmental Compliance
   Enforcement Division
   P.O. Box 4312
   Baton Rouge, Louisiana 70821-4312
   Attn: Permit Compliance Unit

   U.S. Environmental Protection Agency, Region 6
   Water Enforcement Branch, 6 EN-WC
   1445 Ross Avenue
   Dallas, Texas 75202

d. The permittee shall submit a Final Report on Toxicity Reduction Evaluation Activities no later than twenty-eight (28) months from confirming lethality in the retests, which provides information pertaining to the specific control mechanism selected that will, when implemented, result in the permittee achieving compliance with permit biomonitoring requirements and/or chemical-specific limits. The report will also provide a specific corrective action schedule for implementing the selected control mechanism.

   A copy of the Final Report on Toxicity Reduction Evaluation Activities shall also be submitted to the above addresses.

e. Quarterly testing during the TRE is a minimum monitoring requirement. LDEQ recommends that permittees required to perform a TRE not rely on quarterly testing alone to ensure success in the TRE, and that additional screening tests be performed to capture toxic samples for identification of toxicants. At the end of the TRE, LDEQ will consider all information submitted and establish appropriate controls to prevent future toxic discharges, including WET and/or chemical-specific limits per state regulations at LAC 33:IX.2707.D.1.e.

TABLE 1

**SUMMARY SHEET**

**Daphnia pulex** ACUTE SURVIVAL TEST RESULTS

PERMITTEE: Entergy Operations, Inc.
FACILITY SITE: River Bend Station
LPDES PERMIT NUMBER: LA0042731/ AI 2889
OUTFALL IDENTIFICATION: 001
OUTFALL SAMPLE IS FROM _______ SINGLE _______ MULTIPLE DISCHARGES
BIOMONITORING LABORATORY: ____________
DILUTION WATER USED: _________ RECEIVING WATER ______LAB WATER
CRITICAL DILUTION 0.14% DATE TEST INITIATED____________

1. LOW-FLOW LETHALITY:
   Is the mean survival at 48 hours significantly less (p=0.05) than the control survival for the low flow or critical dilution?
   _______yes _______no

**DILUTION SERIES RESULTS-DAPHNIA**

| TIME OF READING | REP | 0% | 0.06% | 0.08% | 0.11% | 0.14% | 0.19% |
|---|---|---|---|---|---|---|---|
| 24-HOUR | A | | | | | | |
| | B | | | | | | |
| | C | | | | | | |
| | D | | | | | | |
| | E | | | | | | |
| 48-HOUR | A | | | | | | |
| | B | | | | | | |
| | C | | | | | | |
| | D | | | | | | |
| | E | | | | | | |
| MEAN | | | | | | | |

2. Are the test results to be considered valid? ____yes ____no
   If X no (test invalid), what are the reasons for invalidity?

3. Is this a retest of a previous invalid test? ____ yes____no
   Is this a retest of a previous test failure? ____ yes____no

4. Enter percent effluent corresponding to each NOEC (No Observed Effect Concentration) for Daphnia pulex:
   NOEC = ____% effluent
   $LC_{50}48$ = ____% effluent

TABLE 1

**SUMMARY SHEET**

**Pimephales promelas** ACUTE SURVIVAL TEST RESULTS

PERMITTEE: Entergy Operations, Inc.

FACILITY SITE: River Bend Station

LPDES PERMIT NUMBER: LA0042731/ AI 2889

OUTFALL IDENTIFICATION: 001

OUTFALL SAMPLE IS FROM _______ SINGLE _______ MULTIPLE DISCHARGES

BIOMONITORING LABORATORY: ___________

DILUTION WATER USED: _________ RECEIVING WATER _______ LAB WATER

CRITICAL DILUTION 0.14% DATE TEST INITIATED ___________

1. LOW-FLOW LETHALITY:
   Is the mean survival at 48 hours significantly less (p=0.05) than the control survival for the low flow or critical dilution?
   _______yes _______no

**DILUTION SERIES RESULTS-PIMEPHALES**

| TIME OF READING | REP | 0% | 0.06% | 0.08% | 0.11% | 0.14% | 0.19% |
|---|---|---|---|---|---|---|---|
| 24-HOUR | A | | | | | | |
| | B | | | | | | |
| | C | | | | | | |
| | D | | | | | | |
| | E | | | | | | |
| 48-HOUR | A | | | | | | |
| | B | | | | | | |
| | C | | | | | | |
| | D | | | | | | |
| | E | | | | | | |
| MEAN | | | | | | | |

2. Are the test results to be considered valid? ____yes ____no
   If X no (test invalid), what are the reasons for invalidity?

3. Is this a retest of a previous invalid test? ____ yes____no
   Is this a retest of a previous test failure? ____ yes____no

4. Enter percent effluent corresponding to each NOEC (No Observed Effect Concentration) for Pimephales:
   NOEC = ____% effluent
   $LC_{50}48$ = ____% effluent

# PART III
# STANDARD CONDITIONS FOR LPDES PERMITS

## SECTION A. GENERAL CONDITIONS

1. Introduction
In accordance with the provisions of LAC 33:IX.2701, et seq., this permit incorporates either expressly or by reference ALL conditions and requirements applicable to the Louisiana Pollutant Discharge Elimination System Permits (LPDES) set forth in the Louisiana Environmental Quality Act (LEQA), as amended, as well as ALL applicable regulations.

2. Duty to Comply
The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act (CWA) and the Louisiana Environmental Quality Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of a permit renewal application.

3. Penalties for Violation of Permit Conditions
   a. La. R. S. 30:2025 provides for civil penalties for violations of these regulations and the Louisiana Environmental Quality Act. La. R. S. 30:2076.2 provides for criminal penalties for violation of any provisions of the LPDES or any order or any permit condition or limitation issued under or implementing any provisions of the LPDES program. (See Section E. Penalties for Violation of Permit Conditions for additional details).

   b. Any person may be assessed an administrative penalty by the State Administrative Authority under La. R. S. 30:2025 for violating a permit condition or limitation implementing any of the requirements of the LPDES program in a permit issued under the regulations or the Louisiana Environmental Quality Act.

4. Toxic Pollutants
   a. Other effluent limitations and standards under Sections 301, 302, 303, 307, 318, and 405 of the Clean Water Act. If any applicable toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is promulgated under Section 307(a) of the Clean Water Act for a toxic pollutant and that standard or prohibition is more stringent than any limitation on the pollutant in this permit, the state administrative authority shall institute proceedings under these regulations to modify or revoke and reissue the permit to conform to the toxic effluent standard or prohibition.

   b. The permittee shall comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants and with standards for sewage sludge use or disposal established under Section 405(d) of the Clean Water Act within the time provided in the regulations that establish these standards or prohibitions, or standards for sewage sludge use or disposal, even if the permit has not yet been modified to incorporate the requirement.

5. Duty to Reapply
   a. Individual Permits. If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a new permit. The new application shall be submitted at least 180 days before the expiration date of the existing permit, unless permission for a later date has been granted by the state administrative authority. (The state administrative authority shall not grant permission for applications to be submitted later than the expiration date of the existing permit.) Continuation of expiring permits shall be governed by regulations promulgated at LAC 33:IX.2321 and any subsequent amendments.

b. General Permits. General permits expire five years after the effective date. The 180-day reapplication period as defined above is not applicable to general permit authorizations. Reissued general permits may provide automatic coverage for permittees authorized under the previous version of the permit, and no new application is required. Requirements for obtaining authorization under the reissued general permit will be outlined in Part I of the new permit. Permittees authorized to discharge under an expiring general permit should follow the requirements for obtaining coverage under the new general permit to maintain discharge authorization.

6. Permit Action
This permit may be modified, revoked and reissued, or terminated for cause in accordance with LAC 33:IX.2903, 2905, 2907, 3105 and 6509. The causes may include, but are not limited to, the following:

   a. Noncompliance by the permittee with any condition of the permit;

   b. The permittee's failure in the application or during the permit issuance process to disclose fully all relevant facts, or the permittee's misrepresentation of any relevant facts at any time; or

   c. A determination that the permitted activity endangers human health or the environment and can only be regulated to acceptable levels by permit modification or termination;

   d. A change in any condition that requires either a temporary or a permanent reduction or elimination of any discharge;

   e. Failure to pay applicable fees under the provisions of LAC 33: IX. Chapter 13;

   f. Change of ownership or operational control.

The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not stay any permit condition.

7. Property Rights and State and Local Laws
Issuance of this permit does not authorize any injury to persons or property or invasion of other private rights, or any infringement of state or local law or regulations.

8. Duty to Provide Information
The permittee shall furnish to the state administrative authority, within a reasonable time, any information which the state administrative authority may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. The permittee shall also furnish to the state administrative authority, upon request, copies of records required to be kept by this permit.

9. Criminal and Civil Liability
Except as provided in permit conditions on "Bypassing" and "Upsets", nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance. Any false or materially misleading representation or concealment of information required to be reported by the provisions of the permit, the Act, or applicable regulations, which avoids or effectively defeats the regulatory purpose of the Permit may subject the Permittee to criminal enforcement pursuant to La. R.S. 30:2025.

10. Oil and Hazardous Substance Liability
Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Clean Water Act.

11. State Laws
Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable State law or regulation under authority preserved by Section 510 of the Clean Water Act.

12. Severability
If any provision of these rules and regulations, or the application thereof, is held to be invalid, the remaining provisions of these rules and regulations shall not be affected, so long as they can be given effect without the invalid provision. To this end, the provisions of these rules and regulations are declared to be severable.

13. Dilution
A permittee shall not achieve any effluent concentration by dilution unless specifically authorized in the permit. A permittee shall not increase the use of process water or cooling water or otherwise attempt to dilute a discharge as a partial or complete substitute for adequate treatment to achieve permit limitations or water quality.

14. Facilities Requiring Approval from Other State Agencies
In accordance with La. R.S.40.4(A)(6) the plans and specifications of all sanitary sewerage treatment systems, both public and private, must be approved by the Department of Health and Hospitals state health officer or his designee. It is unlawful for any person, firm, or corporation, both municipal and private to operate a sanitary sewage treatment facility without proper authorization from the state health officer.

In accordance with La. R.S.40.1149, it is unlawful for any person, firm or corporation, both municipal and private, operating a sewerage system to operate that system unless the competency of the operator is duly certified by the Department of Health and Hospitals state health officer. Furthermore, it is unlawful for any person to perform the duties of an operator without being duly certified.

In accordance with La. R.S.48.385, it is unlawful for any industrial wastes, sewage, septic tanks effluent, or any noxious or harmful matter, solid, liquid or gaseous to be discharged into the side or cross ditches or placed upon the rights-of-ways of state highways without the prior written consent of the Department of Transportation and Development chief engineer or his duly authorized representative and of the secretary of the Department of Health and Hospitals.

15. The standards provided in Chapter 11 – Surface Water Quality Standards are official regulations of the state, and any person who discharges pollutants to the waters of the state in such quantities as to cause these standards to be violated shall be subject to the enforcement procedures of the state as specified in R.S. 30:2025.

SECTION B. PROPER OPERATION AND MAINTENANCE

1. Need to Halt or Reduce not a Defense
It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

2. Duty to Mitigate
The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment. The permittee shall also take all reasonable steps to minimize or correct any adverse impact on the environment resulting from noncompliance with the permit, including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge.

3. Proper Operation and Maintenance
   a. The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of back-up

or auxiliary facilities or similar systems which are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit.

b. The permittee shall provide an adequate operating staff which is duly qualified to carry out operation, maintenance and other functions necessary to ensure compliance with the conditions of this permit.

4. Bypass of Treatment Facilities

a. ***Bypass***. The intentional diversion of waste streams from any portion of a treatment facility.

b. Bypass not exceeding limitations. The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of Section B.4.c. and 4.d of these standard conditions.

c. Notice

(1) Anticipated bypass. If the permittee knows in advance of the need for a bypass, it shall submit prior notice to the Office of Environmental Services, Water Permits Division, if possible at least ten days before the date of the bypass.

(2) Unanticipated bypass. The permittee shall submit notice of an unanticipated bypass as required in LAC 33:IX.2701.L.6 (24-hour notice) and Section D.6.e. of these standard conditions.

d. Prohibition of bypass

(1) Bypass is prohibited, and the state administrative authority may take enforcement action against a permittee for bypass, unless:

(a) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

(b) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and,

(c) The permittee submitted notices as required by Section B.4.c of these standard conditions.

(2) The state administrative authority may approve an anticipated bypass after considering its adverse effects, if the state administrative authority determines that it will meet the three conditions listed in Section B.4.d(1) of these standard conditions.

5. Upset Conditions

a. Upset. An exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

b. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the requirements of Section B.5.c. are met. No determination made during administrative review of claims that noncompliance was caused by an upset, and before an action for noncompliance, is final administrative action subject to judicial review.

c. Conditions necessary for a demonstration of upset. A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

(1) An upset occurred and that the permittee can identify the cause(s) of the upset;

(2) The permitted facility was at the time being properly operated; and

(3) The permittee submitted notice of the upset as required by LAC 33:IX.2701.L.6.b.ii. and Section D.6.e.(2) of these standard conditions; and

(4) The permittee complied with any remedial measures required by Section B.2 of these standard conditions.

d. Burden of proof. In any enforcement proceeding, the permittee seeking to establish the occurrence of an upset has the burden of proof.

6. Removed Substances
Solids, sewage sludges, filter backwash, or other pollutants removed in the course of treatment or wastewater control shall be properly disposed of in a manner such as to prevent any pollutant from such materials from entering waters of the state and in accordance with environmental regulations.

7. Percent Removal
For publicly owned treatment works, the 30-day average percent removal for Biochemical Oxygen Demand and Total Suspended Solids shall not be less than 85 percent in accordance with LAC 33:IX.5905.A.3. and B.3. Publicly owned treatment works utilizing waste stabilization ponds/oxidation ponds are not subject to the 85 percent removal rate for Total Suspended Solids.

SECTION C. MONITORING AND RECORDS

1. Inspection and Entry
The permittee shall allow the state administrative authority or an authorized representative (including an authorized contractor acting as a representative of the Administrator), upon the presentation of credentials and other documents as may be required by the law to:

a. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit.

   Enter upon the permittee's premises where a discharge source is or might be located or in which monitoring equipment or records required by a permit are kept for inspection or sampling purposes. Most inspections will be unannounced and should be allowed to begin immediately, but in no case shall begin more than thirty (30) minutes after the time the inspector presents his/her credentials and announces the purpose(s) of the inspection. Delay in excess of thirty (30) minutes shall constitute a violation of this permit. However, additional time can be granted if the inspector or the Administrative Authority determines that the circumstances warrant such action; and

b. Have access to and copy, at reasonable times, any records that the department or its authorized representative determines are necessary for the enforcement of this permit. For records maintained in either a central or private office that is open only during normal office hours and is closed at the time of inspection, the records shall be made available as soon as the office is open, but in no case later than the close of business the next working day;

c. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and

d. Sample or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act or the Louisiana Environmental Quality Act, any substances or parameters at any location.

e. Sample Collection

   (1) When the inspector announces that samples will be collected, the permittee will be given an additional thirty (30) minutes to prepare containers in order to collect duplicates. If the permittee

cannot obtain and prepare sample containers within this time, he is considered to have waived his right to collect duplicate samples and the sampling will proceed immediately. Further delay on the part of the permittee in allowing initiation of the sampling will constitute a violation of this permit.

(2) At the discretion of the administrative authority, sample collection shall proceed immediately (without the additional 30 minutes described in Section C.1.a. above) and the inspector shall supply the permittee with a duplicate sample.

f. It shall be the responsibility of the permittee to ensure that a facility representative familiar with provisions of its wastewater discharge permit, including any other conditions or limitations, be available either by phone or in person at the facility during all hours of operation. The absence of such personnel on-site who are familiar with the permit shall not be grounds for delaying the initiation of an inspection except in situations as described in Section C.1.b. of these standard conditions. The permittee shall be responsible for providing witnesses/escorts during inspections. Inspectors shall abide by all company safety rules and shall be equipped with standard safety equipment (hard hat, safety shoes, safety glasses) normally required by industrial facilities.

g. Upon written request copies of field notes, drawings, etc., taken by department personnel during an inspection shall be provided to the permittee after the final inspection report has been completed.

2. Representative Sampling

Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity. All samples shall be taken at the outfall location(s) indicated in the permit. The state administrative authority shall be notified prior to any changes in the outfall location(s). Any changes in the outfall location(s) may be subject to modification, revocation and reissuance in accordance with LAC 33:IX.2903.

3. Retention of Records

Except for records of monitoring information required by this permit related to the permittee's sewage sludge use and disposal activities, which shall be retained for a period of at least five years (or longer as required by 40 CFR 503), the permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 3 years from the date of the sample, measurement, report, or application. This period may be extended by request of the state administrative authority at any time.

4. Record Contents

Records of monitoring information shall include:

a. The date, exact place, and time of sampling or measurements;
b. The individual(s) who performed the sampling or measurements;
c. The date(s) analyses were performed;
d. The time(s) analyses were begun;
e. The individual(s) who performed the analyses;
f. The analytical techniques or methods used;
g. The results of such analyses; and
h. The results of all quality control procedures.

5. Monitoring Procedures

a. Monitoring results must be conducted according to test procedures approved under 40 CFR Part 136 or, in the case of sludge use or disposal, approved under 40 CFR Part 136 unless otherwise specified in 40 CFR Part 503, unless other test procedures have been specified in this permit.

b. The permittee shall calibrate and perform maintenance procedures on all monitoring and analytical instruments at intervals frequent enough to insure accuracy of measurements and shall maintain appropriate records of such activities.

c. The permittee or designated laboratory shall have an adequate analytical quality assurance/quality control program to produce defensible data of known precision and accuracy. All quality control measures shall be assessed and evaluated on an on-going basis and quality control acceptance criteria shall be used to determine the validity of the data. All method specific quality control as prescribed in the method shall be followed. If quality control requirements are not included in the method, the permittee or designated laboratory shall follow the quality control requirements as prescribed in the Approved Edition (40 CFR Part 136) Standard Methods for the Examination of Water and Wastes, Sections 1020A and 1020B. General sampling protocol shall follow guidelines established in the "Handbook for Sampling and Sample Preservation of Water and Wastewater, 1982 "U.S. Environmental Protection Agency. This publication is available from the National Technical Information Service (NTIS), Springfield, VA 22161, Phone number (800) 553-6847. Order by NTIS publication number PB-83-124503.

6. Flow Measurements
Appropriate flow measurement devices and methods consistent with accepted scientific practices shall be selected and used to ensure the accuracy and reliability of measurements of the volume of monitored discharges. The devices shall be installed, calibrated, and maintained to insure that the accuracy of the measurements is consistent with the accepted capability of that type of device. Devices selected shall be capable of measuring flows with a maximum deviation of less than 10% from true discharge rates throughout the range of expected discharge volumes. Guidance in selection, installation, calibration and operation of acceptable flow measurement devices can be obtained from the following references:
   a. "A Guide to Methods and Standards for the Measurement of Water Flow, 1975," U.S. Department of Commerce, National Bureau of Standards. This publication is available from the National Technical Information Service (NTIS), Springfield, VA 22161, Phone number (800) 553-6847. Order by NTIS publication number COM-75-10683.

   b. "Flow Measurement in Open Channels and Closed Conduits, Volumes 1 and 2," U.S. Department of Commerce, National Bureau of Standards. This publication is available from the National Technical Service (NTIS), Springfield, VA, 22161, Phone number (800) 553-6847. Order by NTIS publication number PB-273 535.

   c. "NPDES Compliance Flow Measurement Manual," U.S. Environmental Protection Agency, Office of Water Enforcement. This publication is available from the National Technical Information Service (NTIS), Springfield, VA 22161, Phone number (800) 553-6847. Order by NTIS publication number PB-82-131178.

7. Prohibition for Tampering: Penalties
   a. La. R.S. 30:2025 provides for punishment of any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit.

   b. La. R.S. 30:2076.2 provides for penalties for any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or non-compliance.

8. Additional Monitoring by the Permittee
If the Permittee monitors any pollutant more frequently than required by the permit using test procedures approved under 40 CFR Part 136 (See LAC 33:IX.4901) or, in the case of sludge use and disposal, approved under 40 CFR Part 136 (See LAC 33:IX.4901) unless otherwise specified in 40 CFR Part 503, or as specified in the permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR or sludge reporting form specified by the state administrative authority.

9. Averaging of Measurements
Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified by the state administrative authority in the permit.

10. Laboratory Accreditation
   a. LAC 33:I.Subpart 3, Chapters 45-59 provide requirements for an accreditation program specifically applicable to commercial laboratories, wherever located, that provide chemical analyses, analytical results, or other test data to the department, by contract or by agreement, and the data is:
      (1) Submitted on behalf of any facility, as defined in La. R.S.30:2004;
      (2) Required as part of any permit application;
      (3) Required by order of the department;
      (4) Required to be included on any monitoring reports submitted to the department;
      (5) Required to be submitted by contractor
      (6) Otherwise required by department regulations.

   b. The department laboratory accreditation program, Louisiana Environmental Laboratory Accreditation Program (LELAP) is designed to ensure the accuracy, precision, and reliability of the data generated, as well as the use of department-approved methodologies in generation of that data. Laboratory data generated by commercial environmental laboratories that are not (LELAP) accredited will not be accepted by the department. Retesting of analysis will be required by an accredited commercial laboratory.

      Where retesting of effluent is not possible (i.e. data reported on DMRs for prior month's sampling), the data generated will be considered invalid and in violation of the LPDES permit.

   c. Regulations on the Louisiana Environmental Laboratory Accreditation Program and a list of labs that have applied for accreditation are available on the department website located under DIVISIONS → PERMIT SUPPORT SERVICES → LABORATORY ACCREDITATION at the following link:

      **http://www.deq.louisiana.gov**

      Questions concerning the program may be directed to (225) 219-9800.

SECTION D. REPORTING REQUIREMENTS

1. Facility Changes
   The permittee shall give notice to the state administrative authority as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required only when:
   a. The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source in 40 CFR 122.29(b); or

   b. The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are subject neither to effluent limitations in the permit, nor to notification requirements under LAC 33:IX.2703.A.1.

   c. For Municipal Permits. Any new introduction of pollutants into the POTW from an indirect discharger which would be subject to Section 301, or 306 of the CWA if it were directly discharging those pollutants; and any substantial change in the volume or character of pollutants being introduced into that POTW by a source introducing pollutants into the POTW at the time of issuance of the permit. In no case are any new connections, increased flows, or significant changes in influent quality permitted that will cause violation of the effluent limitations specified herein.

2. Anticipated Noncompliance
   The permittee shall give advance notice to the state administrative authority of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

3. Transfers
   This permit is not transferable to any person except after notice to the state administrative authority. The state administrative authority may require modification or revocation and reissuance of the permit to change

the name of the permittee and incorporate such other requirements as may be necessary under the Clean Water Act or the Louisiana Environmental Quality Act. (See LAC 33:IX.2901; in some cases, modification or revocation and reissuance is mandatory.)

A permit may be transferred by the permittee to a new owner or operator only if: (1)the permit has been modified or revoked and reissued (under LAC 33:IX.2903.A.2.b) by the permittee and new owner submitting a Name/Ownership/Operator Change Form (NOC-1 Form) and approved by LDEQ (LAC 33:I.Chapter 19); or (2) a minor modification made (under LAC 33:IX.2905) to identify the new permittee and incorporate such other requirements as may be necessary under the Clean Water Act and the Louisiana Environmental Quality Act.

The NOC-1 form can be found at the following link: http://www.deq.louisiana.gov/portal/Portals/0/assistance/NOC-1%20FORM%20Jan%2025,%202006.pdf

4. Monitoring Reports
Monitoring results shall be reported at the intervals and in the form specified in Part I or Part II of this permit.

The permittee shall submit properly completed Discharge Monitoring Reports (DMRs) on the form specified in the permit. Preprinted DMRs are provided to majors/92-500s and other designated facilities. Please contact the Permit Compliance Unit concerning preprints. Self-generated DMRs must be pre-approved by the Permit Compliance Unit prior to submittal. Self-generated DMRs are approved on an individual basis. Requests for approval of self-generated DMRs should be submitted to:

Supervisor, Permit Compliance Unit
Office of Environmental Compliance
Post Office Box 4312
Baton Rouge, LA 70821-4312

Copies of blank DMR templates, plus instructions for completing them, and EPA's LPDES Reporting Handbook are available at the department website located at:

**http://www.deq.louisiana.gov/portal/Default.aspx?tabid=2276**

5. Compliance Schedules
Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each schedule date.

6. Requirements for Notification

a. Emergency Notification
As required by LAC 33.I.3915, in the event of an unauthorized discharge that does cause an emergency condition, the discharger shall notify the hotline (DPS 24-hour Louisiana Emergency Hazardous Materials Hotline) by telephone at (225) 925-6595 (collect calls accepted 24 hours a day) immediately (a reasonable period of time after taking prompt measures to determine the nature, quantity, and potential off-site impact of a release, considering the exigency of the circumstances), but in no case later than one hour after learning of the discharge. (An emergency condition is any condition which could reasonably be expected to endanger the health and safety of the public, cause significant adverse impact to the land, water, or air environment, or cause severe damage to property.) Notification required by this section will be made regardless of the amount of discharge. Prompt Notification Procedures are listed in Section D.6.c. of these standard conditions.

A written report shall be provided within seven calendar days after the notification. The report shall contain the information listed in Section D.6.d. of these standard conditions and any additional information in LAC 33:I.3925.B.

b. Prompt Notification
As required by LAC 33:I.3917, in the event of an unauthorized discharge that exceeds a reportable quantity specified in LAC 33:I.Subchapter E, but does not cause an emergency condition, the discharger shall promptly notify the department within 24 hours after learning of the discharge. Notification should be made to the Office of Environmental Compliance, Surveillance Division Single Point of Contact (SPOC) in accordance with LAC 33:I.3923.

In accordance with LAC 33:I.3923, prompt notification shall be provided within a time frame not to exceed 24 hours and shall be given to the Office of Environmental Compliance, Surveillance Division (SPOC) as follows:

(1) by the Online Incident Reporting screens found at http://www.deq.louisiana.gov/portal/tabid/66/Default.aspx ;or
(2) by e-mail utilizing the Incident Report Form and instructions found at http://www.deq.louisiana.gov/portal/tabid/66/Default.aspx;or
(3) by telephone at (225) 219-3640 during office hours, or (225) 342-1234 after hours and on weekends and holidays.

c. Content of Prompt Notifications. The following guidelines will be utilized as appropriate, based on the conditions and circumstances surrounding any unauthorized discharge, to provide relevant information regarding the nature of the discharge:
(1) the name of the person making the notification and the telephone number where any return calls from response agencies can be placed;
(2) the name and location of the facility or site where the unauthorized discharge is imminent or has occurred, using common landmarks. In the event of an incident involving transport, include the name and address of the transporter and generator;
(3) the date and time the incident began and ended, or the estimated time of continuation if the discharge is continuing;
(4) the extent of any injuries and identification of any known personnel hazards that response agencies may face;
(5) the common or scientific chemical name, the U.S. Department of Transportation hazard classification, and the best estimate of amounts of any and all discharged pollutants;
(6) a brief description of the incident sufficient to allow response agencies to formulate their level and extent of response activity.

d. Written Notification Procedures. Written reports for any unauthorized discharge that requires notification under Section D.6.a. or 6.b., or shall be submitted by the discharger to the Office of Environmental Compliance, Surveillance Division SPOC in accordance with LAC 33:I.3925 within seven calendar days after the notification required by D.6.a. or 6.b., unless otherwise provided for in a valid permit or other department regulation. Written notification reports shall include, but not be limited to, the following information:
(1) the name, address, telephone number, Agency Interest (AI) number (number assigned by the department) if applicable, and any other applicable identification numbers of the person, company, or other party who is filing the written report, and specific identification that the report is the written follow-up report required by this section;
(2) the time and date of prompt notification, the state official contacted when reporting, the name of person making that notification, and identification of the site or facility, vessel, transport vehicle, or storage area from which the unauthorized discharge occurred;
(3) date(s), time(s), and duration of the unauthorized discharge and, if not corrected, the anticipated time it is expected to continue;
(4) details of the circumstances (unauthorized discharge description and root cause) and events leading to any unauthorized discharge, including incidents of loss of sources of radiation, and if the release point is subject to a permit:
 (a) the current permitted limit for the pollutant(s) released;and
 (b) the permitted release point/outfall ID.

(5) the common or scientific chemical name of each specific pollutant that was released as the result of an unauthorized discharge, including the CAS number and U.S. Department of Transportation hazard classification, and the best estimate of amounts of any and all released pollutants (total amount of each compound expressed in pounds, including calculations);
(6) a statement of the actual or probable fate or disposition of the pollutant or source of radiation and what off-site impact resulted;
(7) remedial actions taken, or to be taken, to stop unauthorized discharges or to recover pollutants or sources of radiation.
(8) Written notification reports shall be submitted to the Office of Environmental Compliance, Surveillance Division SPOC by mail or fax. The transmittal envelope and report or fax cover page and report should be clearly marked "**UNAUTHORIZED DISCHARGE NOTIFICATION REPORT**."

Written reports (LAC 33:I.3925) should be mailed to:

Louisiana Department of Environmental Quality
Post Office Box 4312
Baton Rouge, LA 70821-4312
ATTENTION: EMERGENCY AND RADIOLOGICAL SERVICES DIVISION – SPOC
"UNAUTHORIZED DISCHARGE NOTIFICATION REPORT"

The Written Notification Report may also be faxed to the Louisiana Department of Environmental Quality, Office of Environmental Compliance, Emergency and Radiological Services Division at: (225)-219-4044.

Please see LAC 33:I.3925.B for additional written notification procedures.

e. Twenty-four Hour Reporting. The permittee shall report any noncompliance which may endanger human health or the environment. Any information shall be provided orally within 24 hours from the time the permittee becomes aware of the circumstances. A written submission shall also be provided within five days of the time the permittee becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance. The following shall be included as information which must be reported within 24hours:
(1) Any unanticipated bypass which exceeds any effluent limitation in the permit (see LAC 33:IX.2701.M.3.b.);
(2) Any upset which exceeds any effluent limitation in the permit;
(3) Violation of a maximum daily discharge limitation for any of the pollutants listed by the state administrative authority in Part II of the permit to be reported within 24 hours (LAC 33:IX.2707.G.).

7. Other Noncompliance
The permittee shall report all instances of noncompliance not reported under Section D.4., 5., and 6., at the time monitoring reports are submitted. The reports shall contain the information listed in Section D.6.e.

8. Other Information
Where the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the state administrative authority, it shall promptly submit such facts or information.

9. Discharges of Toxic Substances
In addition to the reporting requirements under Section D.1-8, all existing manufacturing, commercial, mining, and silvicultural dischargers must notify the Office of Environmental Services, Water Permits Division as soon as they know or have reason to believe:
a. That any activity has occurred or will occur which would result in the discharge, on a routine or frequent basis, of any toxic pollutant:

i. listed at LAC 33:IX.7107, Tables II and III (excluding Total Phenols) which is not limited in the permit, if that discharge will exceed the highest of the following notification levels:
   (1) One hundred micrograms per liter (100 µg/L);
   (2) Two hundred micrograms per liter (200 µg/L) for acrolein and acrylonitrile; five hundred micrograms per liter (500 µg/L) for 2,4 -dinitro-phenol and for 2-methyl-4,6-dinitrophenol; and one milligram per liter (1 mg/L) for antimony;
   (3) Five (5) times the maximum concentration value reported for that pollutant in the permit application in accordance with LAC33:IX.2501.G.7; or
   (4) The level established by the state administrative authority in accordance with LAC 33:IX.2707.F; or

ii. which exceeds the reportable quantity levels for pollutants at LAC 33:I. Subchapter E.

b. That any activity has occurred or will occur which would result in any discharge, on a non-routine or infrequent basis, of a toxic pollutant:
   i. listed at LAC 33:IX.7107, Tables II and III (excluding Total Phenols) which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

   (1) Five hundred micrograms per liter (500 µg/L);
   (2) One milligram per liter (1 mg/L) for antimony;
   (3) Ten (10) times the maximum concentration value reported for that pollutant in the permit application in accordance with LAC 33:IX.2501.G.7; or
   (4) The level established by the state administrative authority in accordance with LAC 33:IX.2707.F; or

   ii. which exceeds the reportable quantity levels for pollutants at LAC 33:I. Subchapter E.

10. Signatory Requirements
All applications, reports, or information submitted to the state administrative authority shall be signed and certified.

a. All permit applications shall be signed as follows:
   (1) For a corporation - by a responsible corporate officer. For the purpose of this section, a responsible corporate officer means:
      (a) A president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision making functions for the corporation; or,
      (b) The manager of one or more manufacturing, production, or operating facilities, provided: the manager is authorized to make management decisions that govern the operation of the regulated facility, including having the explicit or implicit duty of making major capital investment recommendations and initiating and directing other comprehensive measures to ensure long term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and the authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

**NOTE**: DEQ does not require specific assignments or delegations of authority to responsible corporate officers identified in Section D.10.a(1)(a). The agency will presume that these responsible corporate officers have the requisite authority to sign permit applications unless the corporation has notified the state administrative authority to the contrary. Corporate procedures governing authority to sign permit applications may provide for assignment or delegation to applicable corporate positions under Section D.10.a(1)(b) rather than to specific individuals.

   (2) For a partnership or sole proprietorship - by a general partner or the proprietor, respectively; or
   (3) For a municipality, state, federal, or other public agency - by either a principal executive officer or ranking elected official. For purposes of this section, a principal executive officer of a federal agency includes:

(a) The chief executive officer of the agency, or
(b) A senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrators of EPA).

b. All reports required by permits and other information requested by the state administrative authority shall be signed by a person described in Section D.10.a., or by a duly authorized representative of that person. A person is a duly authorized representative only if:
   (1) The authorization is made in writing by a person described in Section D.10.a. of these standard conditions;
   (2) The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company, (a duly authorized representative may thus be either a named individual or an individual occupying a named position, and,
   (3) The written authorization is submitted to the state administrative authority.

c. Changes to authorization. If an authorization under Section D.10.b. is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of Section D.10.b. must be submitted to the state administrative authority prior to or together with any reports, information, or applications to be signed by an authorized representative.

d. Certification. Any person signing a document under Section D.10. a. or b. above, shall make the following certification:

   "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

11. Availability of Reports

All recorded information (completed permit application forms, fact sheets, draft permits, or any public document) not classified as confidential information under La. R.S. 30:2030(A) and 30:2074(D) and designated as such in accordance with these regulations (LAC 33:IX.2323 and LAC 33:IX.6503) shall be made available to the public for inspection and copying during normal working hours in accordance with the Public Records Act, La. R.S. 44:1 et seq.

Claims of confidentiality for the following will be denied:
a. The name and address of any permit applicant or permittee;
b. Permit applications, permits, and effluent data.
c. Information required by LPDES application forms provided by the state administrative authority under LAC 33:IX.2501 may not be claimed confidential. This includes information submitted on the forms themselves and any attachments used to supply information required by the forms.

## SECTION E. PENALTIES FOR VIOLATIONS OF PERMIT CONDITION

1. Criminal
   a. Negligent Violations
   The Louisiana Revised Statutes La. R. S. 30:2076.2 provides that any person who negligently violates any provision of the LPDES, or any order issued by the secretary under the LPDES, or any permit condition or limitation implementing any such provision in a permit issued under the LPDES by the secretary, or any requirement imposed in a pretreatment program approved under the LPDES is subject

to a fine of not less than $2,500 nor more than $25,000 per day of violation, or by imprisonment for not more than 1 year, or both. If a conviction of a person is for a violation committed after a first conviction of such person, he shall be subject to a fine of not more than $50,000 per day of violation, or imprisonment of not more than two years, or both.

b. Knowing Violations
The Louisiana Revised Statutes La. R. S. 30:2076.2 provides that any person who knowingly violates any provision of the LPDES, or any permit condition or limitation implementing any such provisions in a permit issued under the LPDES, or any requirement imposed in a pretreatment program approved under the LPDES is subject to a fine of not less than $5,000 nor more than $50,000 per day of violation, or imprisonment for not more than 3 years, or both. If a conviction of a person is for a violation committed after a first conviction of such person, he shall be subject to a fine of not more than $100,000 per day of violation, or imprisonment of not more than six years, or both.

c. Knowing Endangerment
The Louisiana Revised Statutes La. R. S. 30:2076.2 provides that any person who knowingly violates any provision of the LPDES, or any order issued by the secretary under the LPDES, or any permit condition or limitation implementing any of such provisions in a permit issued under the LPDES by the secretary, and who knows at that time that he thereby places another person in imminent danger of death or serious bodily injury, shall, upon conviction, be subject to a fine of not more than $250,000, or by imprisonment for not more than 15 years, or both. A person which is an organization shall, upon conviction of violating this Paragraph, be subject to a fine of not more than one million dollars. If a conviction of a person is for a violation committed after a first conviction of such person under this Paragraph, the maximum punishment shall be doubled with respect to both fine and imprisonment.

d. False Statements
The Louisiana Revised Statutes La. R. S. 30:2076.2 provides that any person who knowingly makes any false material statement, representation, or certification in any application, record, report, plan, or other document filed or required to be maintained under the LPDES or who knowingly falsifies, tampers with, or renders inaccurate~~,~~ any monitoring device or method required to be maintained under the LPDES, shall, upon conviction, be subject to a fine of not more than $10,000, or imprisonment for not more than 2 years, or both. If a conviction of a person is for a violation committed after a first conviction of such person under this Subsection, he shall be subject to a fine of not more than $20,000 per day of violation, or imprisonment of not more than 4 years, or both.

2. Civil Penalties
The Louisiana Revised Statutes La. R. S. 30:2025 provides that any person found to be in violation of any requirement of this Subtitle may be liable for a civil penalty, to be assessed by the secretary, an assistant secretary, or the court, of not more than the cost to the state of any response action made necessary by such violation which is not voluntarily paid by the violator, and a penalty of not more than $32,500 for each day of violation. However, when any such violation is done intentionally, willfully, or knowingly, or results in a discharge or disposal which causes irreparable or severe damage to the environment or if the substance discharged is one which endangers human life or health, such person may be liable for an additional penalty of not more than one million dollars.

(**PLEASE NOTE**: These penalties are listed in their entirety in Subtitle II of Title 30 of the Louisiana Revised Statutes.)

SECTION F. DEFINITIONS

All definitions contained in Section 502 of the Clean Water Act shall apply to this permit and are incorporated herein by reference. Additional definitions of words or phrases used in this permit are as follows:

1. Clean Water Act (CWA) means the Clean Water Act (formerly referred to as the Federal Water Pollution Control Act or the Federal Water Pollution Control Act Amendments of 1972) Pub.L.92-500, as amended by Pub.L. 95-217, Pub.L. 95-576, Pub.L. 96-483 and Pub.L. 97-117, 33 U.S.C. 1251 et. seq.).

2. Accreditation means the formal recognition by the department of a laboratory's competence wherein specific tests or types of tests can be accurately and successfully performed in compliance with all minimum requirements set forth in the regulations regarding laboratory accreditation.

3. Administrator means the Administrator of the U.S. Environmental Protection Agency, or an authorized representative.

4. Applicable Standards and Limitations means all state, interstate and federal standards and limitations to which a discharge is subject under the Clean Water Act, including, effluent limitations, water quality standards of performance, toxic effluent standards or prohibitions, best management practices, and pretreatment standards under Sections 301, 302, 303, 304, 306, 307, 308 and 403.

5. Applicable water quality standards means all water quality standards to which a discharge is subject under the Clean Water Act.

6. Commercial Laboratory means any laboratory, wherever located, that performs analyses or tests for third parties for a fee or other compensation and provides chemical analyses, analytical results, or other test data to the department. The term commercial laboratory does not include laboratories accredited by the Louisiana Department of Health and Hospitals in accordance with La. R.S.49:1001 et seq.

7. Daily Discharge means the discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in terms of mass, the daily discharge is calculated as the total mass of the pollutant discharged over the sampling day. For pollutants with limitations expressed in other units of measurement, the daily discharge is calculated as the average measurement of the pollutant over the sampling day. Daily discharge determination of concentration made using a composite sample shall be the concentration of the composite sample.

8. Daily Maximum discharge limitation means the highest allowable "daily discharge".

9. Director means the U.S. Environmental Protection Agency Regional Administrator, or the state administrative authority, or an authorized representative.

10. Domestic septage means either liquid or solid material removed from a septic tank, cesspool, portable toilet, Type III marine sanitation device, or similar treatment works that receives only domestic sewage. Domestic septage does not include liquid or solid material removed from a septic tank, cesspool, or similar treatment works that receives either commercial wastewater or industrial wastewater and does not include grease removed from grease trap at a restaurant.

11. Domestic sewage means waste and wastewater from humans, or household operations that is discharged to or otherwise enters a treatment works.

12. Environmental Protection Agency or (EPA) means the U.S. Environmental Protection Agency.

13. Grab sample means an individual sample collected over a period of time not exceeding 15 minutes, unless more time is needed to collect an adequate sample, and is representative of the discharge.

14. Industrial user means a nondomestic discharger, as identified in 40 CFR 403, introducing pollutants to a publicly owned treatment works.

15. LEQA means the Louisiana Environmental Quality Act.

16. Louisiana Pollutant Discharge Elimination System (LPDES) means those portions of the Louisiana Environmental Quality Act and the Louisiana Water Control Law and all regulations promulgated under their authority which are deemed equivalent to the National Pollutant Discharge Elimination System (NPDES)

under the Clean Water Act in accordance with Section 402 of the Clean Water Act and all applicable federal regulations.

17. Monthly Average, other than for fecal coliform bacteria, discharge limitations are calculated as the sum of all "daily discharge(s)" measured during a calendar month divided by the number of "daily discharge(s)" measured during that month. When the permit establishes monthly average concentration effluent limitations or conditions, and flow is measured as continuous record or with a totalizer, the monthly average concentration means the arithmetic average (weighted by flow) of all "daily discharge(s)" of concentration determined during the calendar month where C = daily discharge concentration, F = daily flow and n = number of daily samples; monthly average discharge =

$$\frac{C_1F_1 + C_2F_2 + \ldots + C_nF_n}{F_1 + F_2 + \ldots + F_n}$$

When the permit establishes monthly average concentration effluent limitations or conditions, and the flow is not measured as a continuous record, then the monthly average concentration means the arithmetic average of all "daily discharge(s)" of concentration determined during the calendar month.

The monthly average for fecal coliform bacteria is the geometric mean of the values for all effluent samples collected during a calendar month.

18. National Pollutant Discharge Elimination System (NPDES) means the national program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits, and imposing and enforcing pretreatment requirements, under Sections 307, 318, 402, and 405 of the Clean Water Act.

19. Severe property damage means substantial physical damage to property, damage to the treatment facilities that causes them to become inoperable, or substantial and permanent loss of natural resources that can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

20. Sewage sludge means any solid, semi-solid, or liquid residue removed during the treatment of municipal wastewater or domestic sewage. *Sewage sludge* includes, but is not limited to, solids removed during primary, secondary, or advanced wastewater treatment, scum, domestic septage, portable toilet pumpings, Type III marine sanitation device pumpings (33 CFR Part 159), and sewage sludge products. *Sewage sludge* does not include grit or screenings, or ash generated during the incineration of sewage sludge.

21. Stormwater Runoff—aqueous surface runoff including any soluble or suspended material mobilized by naturally occurring precipitation events.

22. Surface Water: all lakes, bays, rivers, streams, springs, ponds, impounding reservoirs, wetlands, swamps, marshes, water sources, drainage systems and other surface water, natural or artificial, public or private within the state or under its jurisdiction that are not part of a treatment system allowed by state law, regulation, or permit.

23. Treatment works means any devices and systems used in the storage, treatment, recycling and reclamation of municipal sewage and industrial wastes of a liquid nature to implement Section 201 of the Clean Water Act, or necessary to recycle or reuse water at the most economical cost over the estimated life of the works, including intercepting sewers, sewage collection systems, pumping, power and other equipment, and their appurtenances, extension, improvement, remodeling, additions, and alterations thereof. (See Part 212 of the Clean Water Act)

24. For fecal coliform bacteria, a sample consists of one effluent grab portion collected during a 24-hour period at peak loads.

25. The term MGD shall mean million gallons per day.

26. The term GPD shall mean gallons per day.

27. The term mg/L shall mean milligrams per liter or parts per million (ppm).

28. The term SPC shall mean Spill Prevention and Control. Plan covering the release of pollutants as defined by the Louisiana Administrative Code (LAC 33:IX.Chapter 9).

29. The term SPCC shall mean Spill Prevention Control and Countermeasures Plan. Plan covering the release of pollutants as defined in 40 CFR Part 112.

30. The term µg/L shall mean micrograms per liter or parts per billion (ppb).

31. The term ng/L shall mean nanograms per liter or parts per trillion (ppt).

32. Visible Sheen: a silvery or metallic sheen, gloss, or increased reflectivity; visual color; or iridescence on the water surface.

33. Wastewater—liquid waste resulting from commercial, municipal, private, or industrial processes. Wastewater includes, but is not limited to, cooling and condensing waters, sanitary sewage, industrial waste, and contaminated rainwater runoff.

34. Waters of the State: for the purposes of the Louisiana Pollutant Discharge Elimination system, all surface waters within the state of Louisiana and, on the coastline of Louisiana and the Gulf of Mexico, all surface waters extending there from three miles into the Gulf of Mexico. For purposes of the Louisiana Pollutant Discharge Elimination System, this includes all surface waters which are subject to the ebb and flow of the tide, lakes, rivers, streams, (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, natural ponds, impoundments of waters within the state of Louisiana otherwise defined as "waters of the United States" in 40 CFR 122.2, and tributaries of all such waters. "Waters of the state" does not include waste treatment systems, including treatment ponds or lagoons designed to meet the requirements of the Clean Water Act, 33 U.S.C. 1251 et seq.

35. Weekly average, other than for fecal coliform bacteria, is the highest allowable arithmetic mean of the daily discharges over a calendar week, calculated as the sum of all "daily discharge(s)" measured during a calendar week divided by the number of "daily discharge(s)" measured during that week. When the permit establishes weekly average concentration effluent limitations or conditions, and flow is measured as continuous record or with a totalizer, the weekly average concentration means the arithmetic average (weighted by flow) of all "daily discharge(s)" of concentration determined during the calendar week where C = daily discharge concentration, F = daily flow and n = number of daily samples; weekly average discharge

$$= \frac{C_1F_1 + C_2F_2 + \ldots + C_nF_n}{F_1 + F_2 + \ldots + F_n}$$

When the permit establishes weekly average concentration effluent limitations or conditions, and the flow is not measured as a continuous record, then the weekly average concentration means the arithmetic average of all "daily discharge(s)" of concentration determined during the calendar week.

The weekly average for fecal coliform bacteria is the geometric mean of the values for all effluent samples collected during a calendar week.

36. Sanitary Wastewater Term(s):

a. 3-hour composite sample consists of three effluent portions collected no closer together than one hour (with the first portion collected no earlier than 10:00 a.m.) over the 3-hour period and composited according to flow, or a sample continuously collected in proportion to flow over the 3-hour period.

b. 6-hour composite sample consists of six effluent portions collected no closer together than one hour (with the first portion collected no earlier than 10:00 a.m.) over the 6-hour period and composited according to flow, or a sample continuously collected in proportion to flow over the 6-hour period.

c. 12-hour composite sample consists of 12 effluent portions collected no closer together than one hour over the 12-hour period and composited according to flow, or a sample continuously collected in proportion to flow over the 12-hour period. The daily sampling intervals shall include the highest flow periods.

d. 24-hour composite sample consists of a minimum of 12 effluent portions collected at equal time intervals over the 24-hour period and combined proportional to flow or a sample continuously collected in proportion to flow over the 24-hour period.

**LPDES PERMIT NO. LA0042731, AI No. 2889**

**LPDES FACT SHEET and RATIONALE**
FOR THE DRAFT LOUISIANA POLLUTANT DISCHARGE ELIMINATION SYSTEM (LPDES) PERMIT TO DISCHARGE TO WATERS OF LOUISIANA

| | | |
|---|---|---|
| **I.** | **Company/Facility Name:** | Entergy Operations, Inc.<br>River Bend Station<br>5485 U. S. Highway 61<br>St. Francisville, LA 70775 |
| **II.** | **Issuing Office:** | Louisiana Department of Environmental Quality (LDEQ)<br>Office of Environmental Services<br>Post Office Box 4313<br>Baton Rouge, Louisiana 70821-4313 |
| **III.** | **Prepared By:** | Lisa Kemp<br>Industrial Permits Section<br>Water Permits Division<br>Phone #: 225-219-3195<br>E-mail: lisa.kemp@la.gov |
| | **Date Prepared:** | March 18, 2011 |

**IV. Permit Action/Status:**

A. Reason For Permit Action:

Proposed reissuance of a Louisiana Pollutant Discharge Elimination System (LPDES) permit for a 5-year term following regulations promulgated at LAC 33:IX.2711/40 CFR 122.46.

<u>LAC 33:IX Citations:</u> Unless otherwise stated, citations to LAC 33:IX refer to promulgated regulations listed at Louisiana Administrative Code, Title 33, Part IX.

<u>40 CFR Citations:</u> Unless otherwise stated, citations to 40 CFR refer to promulgated regulations listed at Title 40, Code of Federal Regulations in accordance with the dates specified at LAC 33:IX.2301.F, 4901, and 4903.

B. LPDES permit – LPDES permit LA0042731 effective date: June 1, 2006
LPDES permit expiration date: May 31, 2011
EPA has not retained enforcement authority.

C. Application received on November 30, 2010; application addendum received March 11, 2011; Environmental Impact Questionnaire received May 4, 2011

**V. Facility Information:**

A. Location - 5485 U. S. Highway 61 in St. Francisville, West Feliciana Parish (Latitude 30°46' 01", Longitude 91°19' 51")

B. Applicant Activity - According to the application, Entergy Operations, Inc., River Bend Station, is an existing nuclear fueled steam electric generating facility with a net generating capacity of approximately 984 megawatts.

**The primary fuel source for the plant is enriched Uranium-235. This Office does not regulate radioactive materials in water discharge permits. Jurisdiction for regulation of these materials is held by the Nuclear Regulatory Commission (NRC) under the Atomic Energy Act, 42 U.S.C. 2021, et seq. Therefore, the permittee must comply with the radiation standards established and regulated by the NRC. This LPDES permit renewal does not address radiation standards.**

The primary discharge from the facility consists of cooling tower blowdown. The electric plant withdraws cooling water from a single intake structure on the Mississippi River. At the site, there are four eight-cell induced draft cooling towers that recirculate water that is pumped through the turbine condenser and service water heat exchangers, then the heated water is returned to the cooling towers. To control cooling water quality, some of the water is continually drained from the system (blowdown) and discharged at Outfall 001. Water loss in the cooling system due to evaporation and blowdown is replenished with clarified river water. The majority of process wastewater from the plant is cooling tower blowdown, although smaller wastewater flows are mixed with the blowdown prior to discharge.

C. Technology Basis - (40 CFR Chapter 1, Subchapter N/Parts 401 and 405-471 have been adopted by reference at LAC 33:IX.4903)

| <u>Guideline</u> | <u>Reference</u> |
|---|---|
| Steam Electric Power Generating | 40 CFR 423 |

<u>Other sources of technology based limits:</u>

- LDEQ Stormwater Guidance, letter dated 6/17/87, from J. Dale Givens (LDEQ) to Myron Knudson (EPA Region 6).
- LDEQ Sanitary General Permits
- Best Professional Judgement
- Previously effective LPDES permit
- Exterior Vehicle Wash Wastewater General Permit (LAG750000)
- Hydrostatic Test Wastewater General Permit (LAG670000)

D. Fee Rate -
1. Fee Rating Facility Type: Major
2. Complexity Type: V
3. Wastewater Type: III
4. SIC code: 4911

E. Continuous Facility Effluent Flow (Max 30-Day from Final Outfall 001) - 4.321 MGD.

**VI. Receiving Waters:** Mississippi River

**Basin and Subsegment:** River Bend Station is physically located in Subsegment 070501 of the Mississippi River Basin. However, the discharges from the facility are to Subsegment 070201 of the Mississippi River Basin. Final Outfall 001 discharges directly to the Mississippi River in Subsegment 070201. A review of the USGS Quad Maps shows that the discharges from Outfalls 002, 003, 004, and 005 of the River Bend Station flow to Grant's Bayou via the plant drainage ditch system, thence to Alligator Bayou, thence to Thompson Creek, thence to the Mississippi River in subsegment 070201. Therefore, Subsegment 070201 was used in the development of requirements for this permit.

1. TSS (15%), mg/L: 53 mg/L
2. Average Hardness, mg/L $CaCO_3$: 154 mg/L
3. Critical Flow, cfs: 141,955
4. Mixing Zone Fraction: 1/3
5. Harmonic Mean Flow, cfs: 366,748
6. River Basin: Mississippi River, Subsegment No. 070201
7. Designated Uses:
   The designated uses are primary contact recreation, secondary contact recreation, fish and wildlife propagation, and drinking water supply.

Information based on the following: LAC 33: IX Chapter 11/memo from Todd Franklin to Lisa Kemp dated February 24, 2011 (see Appendix B). Hardness and 15% TSS data come from monitoring station #3018 (Mississippi River at the Louisiana Ferry Landing near St. Francisville, midstream).

**I. Outfall Information:**

Outfall 001

A. Type of wastewater – The continuous discharge of cooling tower blowdown, previously monitored effluent from Internal Outfalls 101, 201, 301, 401, 501, and 601, and previously monitored hydrostatic test wastewater from Outfall 007

B. Location – at the exposed vacuum-break chamber of the buried 30-inch diameter discharge pipeline prior to discharge to Mississippi River at Latitude 30°43'43", Longitude 91°21'13". As an alternative, the permittee may report temperature measurements based on the balance of plant computer points, and flow may be measured from the auxiliary control room flow recorder.

C. Treatment – dechlorination, neutralization (when needed)

D. Flow - Continuous (Max 30-Day) 4.321 MGD

E. Receiving waters - Mississippi River

F. Basin and segment - Mississippi River Basin, Subsegment 070201

Internal Outfall 101

A Type of wastewater – The intermittent discharge of low level radioactive low volume wastewater from the liquid radwaste wastewater system (LWS) which includes equipment and building floor drain sumps, equipment washing, personnel decontamination, laboratory drains, filter press effluent, RO unit wastewater, other low volume wastewater sources as defined in 40 CFR 423 and maintenance wastewaters. During maintenance activities, Internal Outfall 101 may be discharged to Outfall 001 via the cooling tower flume rather than the common discharge header.

B. Location – at the point of discharge from the Radwaste building prior to combining with other waters at Latitude 30°45'21", Longitude 91°19'46".

C. Treatment – flocculation, mixing, multimedia filtration, screening, carbon adsorption, coagulation, ion exchange, reverse osmosis when required

D. Flow - Intermittent, average 0.02 MGD

E. Receiving waters – Final Outfall 001 to the Mississippi River

F. Basin and segment - Mississippi River Basin, Subsegment 070201

Internal Outfall 201

A. Type of wastewater – Treated sanitary wastewater; also, during maintenance activities, sanitary wastewater may be combined with previously monitored hydrostatic test wastewater, wastewater from floor drains of the control building and the diesel generator oil/water separator (and other low volume wastewaters as defined in 40 CFR 423), and maintenance wastewaters and may be routed to Outfall 002

B. Location - at the point of discharge from the sewage treatment facility prior to combining with other waters at Latitude 30°44'52", Longitude 91°19'38".

C. Treatment – mixing, screening, sedimentation (settling), slow sand filtration (if required), disinfection (UV light), activated sludge, and aerated lagoons

D. Flow - Intermittent, average flow is 0.02 MGD; Max. 30 Day Flow is 0.085 MGD (estimated sanitary flow: approximately 1000 total employees @ 20 gpd = 20,000 gpd)

E. Receiving waters – Final Outfall 001 to the Mississippi River or Final Outfall 002 to Grant's Bayou via the plant drainage system, thence to Alligator Bayou, thence to Thompson Creek, thence to the Mississippi River

F. Basin and segment - Mississippi River Basin, Subsegment 070201

Internal Outfall 301

A. Type of wastewater – Mobile metal (chemical and non-chemical) cleaning wastewater generated from cleaning processes of internal components of plant equipment

B. Location - at the point of discharge of metal cleaning wastewater prior to combining with other waters (from various locations on the property)

C. Treatment – flocculation, mixing, screening, sedimentation (settling), carbon adsorption, chemical precipitation, coagulation, ion exchange, neutralization, and vacuum filtration

D. Flow - Intermittent, (Max 30-Day Flow when discharging) 0.1 MGD.

E. Receiving waters – Final Outfall 001 to the Mississippi River

F. Basin and segment - Mississippi River Basin, Subsegment 070201

There have been no discharges from Outfall 301 since the permit was re-issued in 1999. The only discharge from this outfall since the facility became operational occurred during a 3-month period in 1992.

Internal Outfall 401

A. Type of wastewater – The intermittent discharge of previously monitored hydrostatic test wastewater and low volume wastewater treatment systems to Final Outfall 001 via the common header. The low volume waste management systems receive effluent from the following sources, including but not limited to: ion exchange resin backwash and regeneration, auxiliary boiler blowdown, floor washdown, equipment washing, personnel decontamination, laboratory drains, filter press, and maintenance wastewaters and other low volume wastewater sources as defined in 40 CFR 423. During maintenance activities, reverse osmosis reject from the makeup water polishing system may be discharged via Outfall 401 rather than Outfall 003. During maintenance activities, Internal Outfall 401 may be discharged via the cooling tower flume rather than the common discharge header.

B. Location - at the makeup water pump house off one of two discharge pumps, after filtration prior to combining with other waters at Latitude 30°45'20", Longitude 91°19'50".

C. Treatment – neutralization and filtration

D. Flow - Intermittent, (Max 30-Day Flow) 0.1 MGD.

E. Receiving waters – Final Outfall 001 to the Mississippi River

F. Basin and segment - Mississippi River Basin, Subsegment 070201

Internal Outfall 501

A. Type of wastewater – The intermittent discharge of low volume wastewaters including but not limited to wastewaters from the mobile standby service water reverse osmosis filtration unit and standby cooling tower reject

B. Location - at the northwest end of the flume at the point of discharge of low volume wastewater prior to combining with other waters at Latitude 30°45'20", Longitude 91°19'50".

C. Treatment – flocculation, mixing, screening, sedimentation (settling), carbon adsorption, chemical precipitation, coagulation, ion exchange, neutralization, reverse osmosis, and vacuum filtration

D. Flow - Intermittent, (Max 30-Day) 0.1 MGD.

E. Receiving waters – Final Outfall 001 to the Mississippi River

F. Basin and segment - Mississippi River Basin, Subsegment 070201

Flow at this outfall occurs only rarely (one or two times annually) and no flow was available for sampling during the preparation of this permit renewal application.

Internal Outfall 601

A. Type of wastewater – The intermittent discharge of low volume wastewater including but not limited to wastewaters from filter backwash from service water polishing and feed-and-bleed from the service water system. This system is not normally hooked up and would be for special projects.

B. Location - at the south end of the flume at the point of discharge of low volume wastewater prior to combining with other waters at Latitude 30°45'20", Longitude 91°19'50".

C. Treatment – flocculation, mixing, screening, sedimentation (settling), carbon adsorption, chemical precipitation, coagulation, ion exchange, neutralization, reverse osmosis, vacuum filtration

D. Flow - Intermittent, (Max 30-Day) 0.1 MGD.

E. Receiving waters – Final Outfall 001 to the Mississippi River

F. Basin and segment - Mississippi River Basin, Subsegment 070201

There have been no discharges from this outfall since it was initially established.

<u>Outfall 002</u>

A. Type of wastewater – Stormwater runoff from the industrial materials storage area, low-level storage building and sewage treatment plant area; air conditioning condensate; potable water, and previously monitored hydrostatic test wastewater. During periods of maintenance activities, previously monitored treated wastewater from Internal Outfall 201 may be discharged through Outfall 002.

B. Location - at the point of discharge from the plant drainage ditch system where the stormwater runoff from the sewage treatment plant area converges with that from the industrial materials storage area and the Low Level Waste Storage Building (Latitude 30°45'6", Longitude 91°19'38")

C. Treatment – none

D. Flow - Intermittent, average 0.264 MGD.

E. Receiving waters – Grant's Bayou via the plant drainage ditch system, thence to Alligator Bayou, thence to Thompson Creek, thence to the Mississippi River

F. Basin and segment - Mississippi River Basin, Subsegment 070201

<u>Outfall 003</u>

A. Type of wastewater – stormwater runoff from the reactor building, turbine building, services building, clarifiers, main transformer yard and auxiliary transformer yard; maintenance wastewaters including but not limited to flushing of piping systems and vessels (including Fire Protection Water Supply System and Automatic Sprinkler System); low volume wastewaters including but not limited to reverse osmosis reject water from the standby service water polishing system, effluent from floor drains within power plant buildings (domestic potable water, well water, reject mobile reverse osmosis and fire suppression water treated in the fire pump house oil/water separator), air compressor condensate, and reverse osmosis reject water from the makeup water polishing system; air conditioning condensate, previously monitored hydrostatic test wastewater, and de minimis quantities of cooling tower drift/mist

B. Location - at the point of discharge from the plant drainage ditch system along the East Creek prior to combining with other waters (Latitude 30°45'31", Longitude 91°20'5")

C. Treatment – Stormwater from main transformer yard and auxiliary transformer yard and fire suppression water treated by screening. Domestic potable water, well water, reject mobile reverse osmosis and fire suppression water treated in the fire pump house oil/water separator

D. Flow - Intermittent, average 1.53 MGD.

E. Receiving waters – Grant's Bayou via the plant drainage ditch system, thence to Alligator Bayou, thence to Thompson Creek, thence to the Mississippi River

F. Basin and segment - Mississippi River Basin, Subsegment 070201

Outfall 004

A. Type of wastewater – Stormwater runoff from the office areas, warehouse areas, materials storage areas, and equipment/vehicle maintenance areas; maintenance wastewaters including but not limited to flushing of piping systems and vessels (fire protection water supply system and automatic sprinkler system, etc.); air conditioning condensate, potable water, previously monitored hydrostatic test wastewater, and previously monitored effluent from Internal Outfall 104

B. Location - at the point of discharge from the plant drainage ditch system along the West Creek prior to combining with other waters (Latitude 30°45'2", Longitude 91°19'50")

C. Treatment – screening (Fire Protection Water Supply System)

D. Flow - Intermittent, average 1.49 MGD.

E. Receiving waters – Grant's Bayou via the plant drainage ditch system, thence to Alligator Bayou, thence to Thompson Creek, thence to the Mississippi River

F. Basin and segment - Mississippi River Basin, Subsegment 070201

Internal Outfall 104

A. Type of wastewater – Exterior vehicle washwater

B. Location - at the point of discharge from the vehicle washing area, prior to combining with other waters

C. Treatment – none

D. Flow - Intermittent, (Max. 30-Day Flow) 0.0004 MGD.

E. Receiving waters – Final Outfall 004 thence to Grant's Bayou via the plant drainage ditch system, thence to Alligator Bayou, thence to Thompson Creek, thence to the Mississippi River

F. Basin and segment - Mississippi River Basin, Subsegment 070201

There have been no discharges from this outfall since it was initially established in the permit in 1999.

Outfall 005

A. Type of wastewater – stormwater runoff from the cooling tower yard, air conditioning condensate, previously monitored hydrostatic test wastewater, and de minimis quantities of cooling tower drift/mist

B. Location - at the point of discharge from the stormwater drainage ditch east of the cooling towers and prior to combining with other waters (Latitude 30°45'32", Longitude 91°19'39")

C. Treatment – none

D. Flow - Intermittent, average 0.174 MGD.

E. Receiving waters – Grant's Bayou via the plant drainage ditch system, thence to Alligator Bayou, thence to Thompson Creek, thence to the Mississippi River

F. Basin and segment - Mississippi River Basin, Subsegment 070201

Outfall 006

A. Type of wastewater – clarifier underflow

B. Location - at the point of discharge of clarifier underflow prior to combining with other waters

C. Treatment – none

D. Flow - Intermittent, average 0.021 MGD

E. Receiving waters – Mississippi River

F. Basin and segment - Mississippi River Basin, Subsegment 070201

Outfall 007

A. Type of wastewater – hydrostatic test wastewater

B. Location - at the point of discharge from the hydrostatic testing activity, prior to combining with other wastewaters (may be discharged through Outfalls 001, 002, 003, 004, 005, 201, and 401))

C. Treatment – none

D. Flow - Intermittent

E. Receiving waters – Mississippi River or Grant's Bayou via the plant drainage ditch system, thence to Alligator Bayou, thence to Thompson Creek, thence to the Mississippi River

F. Basin and segment - Mississippi River Basin, Subsegment 070201

Other Discharges

River Bend Station currently utilizes MO-DAD sanitary treatment systems at the small structure located at the temporary checkpoint facility and the auxiliary control room located in the Unit-2 excavation. These leach-field systems generate no surface wastewater discharges and are regulated under Department of Health and Hospitals Permit Nos. 1030185 and 1089509.

**VIII. Previous Effluent Limitations** – see Appendix C

## IX. Proposed Permit Limits:

The specific effluent limitations and/or conditions will be found in the draft permit. Development and calculation of permit limits are detailed in the Permit Limit Rationale section below.

A. Summary of Proposed Changes From the Current LPDES Permit:

1. Internal Outfall 201: Monthly average effluent limitations were added for BOD, TSS, and Fecal Coliform and monthly average flow reporting has been added. Weekly average limitations are now daily maximum. The monitoring frequency has been changed from 1/6 months to 1/quarter because the sanitary flow is an estimated 20,000 gallons per day (gpd). These changes are based on current LDEQ guidance for similar discharges from other industrial facilities.

1. Minimum quantification levels (MQLs) for several pollutants have been revised in accordance with the <u>Permitting Guidance Document for Implementing Louisiana Surface Water Quality Standards</u>, LDEQ, October 26, 2010. See Part II of the permit.

2. Outfall 007 – This additional outfall for monitoring of hydrostatic test wastewater has been established in the permit.

3. Outfalls 201 and 003 – a footnote has been added to the effluent limitations pages for these outfalls stating that Discharge Monitoring Reports must be submitted for BOTH operational scenarios. If either scenario does not discharge within the monitoring period, mark "no discharge" on the top right hand corner of the DMR for that operational scenario.

## X. Permit Limit Rationale:

The following section sets forth the principal facts and the significant factual, legal, methodological, and policy questions considered in preparing the draft permit. Also set forth are any calculations or other explanations of the derivation of specific effluent limitations and conditions, including a citation to the applicable effluent limitation guideline or performance standard provisions as required under LAC 33:IX.2707/40 CFR Part 122.44 and reasons why they are applicable or an explanation of how the alternate effluent limitations were developed.

A. <u>TECHNOLOGY-BASED VERSUS WATER QUALITY STANDARDS-BASED EFFLUENT LIMITATIONS AND CONDITIONS</u>

Following regulations promulgated at LAC 33:IX.2707/40 CFR Part 122.44, the draft permit limits are based on either technology-based effluent limits pursuant to LAC 33:IX.2707.A/40 CFR Part 122.44(a) or on State water quality standards and requirements pursuant to LAC 33:IX.2707.D/40 CFR Part 122.44(d), whichever are more stringent.

B. TECHNOLOGY-BASED EFFLUENT LIMITATIONS AND CONDITIONS

Regulations promulgated at LAC 33:IX.2707.A/40 CFR Part 122.44(a) require technology-based effluent limitations to be placed in LPDES permits based on effluent limitations guidelines where applicable, on BPJ (best professional judgement) in the absence of guidelines, or on a combination of the two. The following is a rationale for types of wastewaters. See outfall information descriptions for associated outfall(s) in Section VII. Regulations also require permits to establish monitoring requirements to yield data representative of the monitored activity [LAC 33:IX.2715/40 CFR 122.48(b)] and to assure compliance with permit limitations [LAC 33:IX.2707.I./40 CFR 122.44(i)].

Entergy Operations, Inc., River Bend Station is subject to Best Practicable Control Technology Currently Available (BPT) and Best Available Technology Economically Achievable (BAT) effluent limitation guidelines listed below:

| Manufacturing Operation | Guideline |
|---|---|
| Steam Electric Power Generating | 40 CFR 423 |

C. WATER QUALITY-BASED EFFLUENT LIMITATIONS

Technology-based effluent limitations and/or specific analytical results from the permittee's application were screened against state water quality numerical standard based limits by following guidance procedures established in the Permitting Guidance Document for Implementing Louisiana Surface Water Quality Standards, LDEQ, October 26, 2010. Calculations, results, and documentation are given in Appendix B.

In accordance with 40 CFR § 122.44 (d)(1)/LAC 33:IX.2707.D.1, the existing (or potential) discharge (s) was evaluated in accordance with the Permitting Guidance Document for Implementing Louisiana Surface Water Quality Standards, LDEQ, October 26, 2010, to determine whether pollutants would be discharged "at a level which will cause, have the reasonable potential to cause, or contribute to an excursion above any state water quality standard." Calculations, results, and documentation are given in Appendix B.

The following pollutants received water quality based effluent limits:

| **POLLUTANT(S)** |
|---|
| None |

Minimum quantification levels (MQL's) for state water quality numerical standards-based effluent limitations are set at the values listed in the Permitting Guidance Document for Implementing Louisiana Surface Water Quality Standards, LDEQ, October 26, 2010. They are also listed in Part II of the permit.

D. MONITORING FREQUENCIES

Regulations also require permits to establish monitoring requirements to yield data representative of the monitored activity [LAC 33:IX.2715/40 CFR 122.48(b)] and to assure compliance with permit limitations [LAC 33:IX.2707.I/40 CFR 122.44(i)]. Specific monitoring frequencies per outfall are listed in Section E.

E. OUTFALL SPECIFIC RATIONALES

Internal Outfalls

In accordance with LAC 33:IX.3305, the following is an explanation for the establishment of Internal Outfalls 101, 201, 301, 401, 501, 601, 104, and 007. Certain permit effluent limitations at the point of discharge are impractical because at the final discharge points the wastewater is diluted as to make monitoring impracticable. Therefore, in accordance with LAC 33:IX.2709, the internal outfalls described below (Internal Outfalls 101, 201, 301, 401, 501, 601, 104, and 007) will be included in the permit.

**1. Outfall 001 – The continuous discharge of cooling tower blowdown, previously monitored Internal Outfalls 101, 201, 301, 401, 501, and 601, and previously monitored hydrostatic test wastewater from Outfall 007**

| PARAMETER(S) | MASS, LBS/DAY (unless otherwise stated) | | CONCENTRATION, MG/L (unless otherwise stated) | | MEASUREMENT FREQUENCY |
|---|---|---|---|---|---|
| | MONTHLY AVERAGE | DAILY MAXIMUM | MONTHLY AVERAGE | DAILY MAXIMUM | |
| Flow, MGD | Report | Report | --- | --- | Continuous |
| Temperature | 105°F | 110°F | --- | --- | Continuous |
| Free Available Chlorine | 0.63 | 1.64 | 0.2 | 0.5 | 1/week |
| Total Chromium | | | 0.2 | 0.2 | 1/year |
| Total Zinc | | | 1.0 | 1.0 | 1/week |
| pH (Standard Units) | --- | --- | 6.0 (Min) | 9.0 (Max) | 1/week |

| PARAMETER(S) | MASS, LBS/DAY (unless otherwise stated) | | CONCENTRATION, MG/L (unless otherwise stated) | | MEASUREMENT FREQUENCY |
|---|---|---|---|---|---|
| | MONTHLY AVERAGE | DAILY MAXIMUM | MONTHLY AVERAGE | DAILY MAXIMUM | |
| Biomonitoring | See Biomonitoring Requirements below | See Biomonitoring Requirements Below | --- | --- | See Biomonitoring Requirements Below |

Flow – The current permit established reporting requirements for monthly average and daily maximum flow. These requirements are retained with a monitoring frequency of continuous. Flow reporting requirements are consistent with LAC 33:IX.2707.I.1.b.

Temperature – The current permit established monthly average and daily maximum temperature limitations. These limits are retained with a monitoring frequency of continuous.

pH – The current permit established minimum and maximum pH limitations based on 40 CFR 423.12(b)(1). These limits are retained with a monitoring frequency of 1/week.

Free Available Chlorine – The current permit established monthly average and daily maximum limitations based on 40 CFR 423.13(d)(1). Mass loadings in the previous permits were not based on the conventional concentration to loading calculation (i.e. mg/l x MGD x 8.34). Therefore, the limitations in the draft renewal permit have not been recalculated using the above calculation because the results would produce limitations significantly higher than the limitations established in the previous permits. Since the permittee is consistently meeting the previous permit's more stringent mass limitations, in accordance with LAC 33:IX.2707.L, the basis for calculating the mass limitations for free available chlorine has not changed. Therefore, the limitations from the previous permit have been retained with a frequency of 1/week.

Total Chromium – The previous permit established limitations for Total Chromium based on 40 CFR 423.13(d)(1) and 40 CFR 423.13(g). These limitations are retained with a monitoring frequency of 1/year since compounds containing Chromium will not be used in the cooling towers.

Total Zinc – The previous permit established limitations for Total Zinc based on 40 CFR 423.13(d)(1) and 40 CFR 423.13(g). These limitations are retained with a monitoring frequency of 1/week.

Biomonitoring Requirements

It has been determined that there may be pollutants present in the effluent which may have the potential to cause toxic conditions in the receiving stream. The State of Louisiana has established a narrative criteria which states, "toxic substances shall not be present in quantities that alone or in combination will be toxic to plant or animal life." The Office of Environmental Services requires the use of the most recent EPA biomonitoring protocols.

Whole effluent biomonitoring is the most direct measure of potential toxicity which incorporates both the effects of synergism of effluent components and receiving stream water quality characteristics. Biomonitoring of the effluent is, therefore, required as a condition of this permit to assess potential toxicity. The biomonitoring procedures stipulated as a condition of this permit for Outfall 001 are as follows:

| TOXICITY TESTS | FREQUENCY (*1) |
|---|---|
| Acute static renewal 48-hour definitive toxicity test using Daphnia pulex | 1/year |
| Acute static renewal 48-hour definitive toxicity test using fathead minnow (Pimephales promelas) | 1/year |

(*1) Biomonitoring shall be conducted during periods of chlorination, biocide(s) usage or other potentially toxic substances being discharged. However, if no biofouling agent or chlorine is used during the monitoring period, the permittee must still conduct the required annual testing.

Toxicity tests shall be performed in accordance with protocols described in the latest revision of the "Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms." The stipulated test species are appropriate to measure the toxicity of the effluent consistent with the requirements of the State water quality standards. The biomonitoring frequency has been established to reflect the likelihood of ambient toxicity and to provide data representative of the toxic potential of the facility's discharge in accordance with regulations promulgated at LAC 33:IX.2715/40 CFR Part 122.48.

Results of all dilutions as well as the associated chemical monitoring of pH, temperature, hardness, dissolved oxygen, conductivity, and alkalinity shall be documented in a full report according to the test method publication mentioned in the previous paragraph. The permittee shall submit a copy of the first full report to the Office of Environmental Compliance. The full report and subsequent reports are to be retained for three (3) years following the provisions of Part III.C.3 of this permit. The permit requires the submission of certain toxicity testing information as an attachment to the Discharge Monitoring Report.

This permit may be reopened to require effluent limits, additional testing, and/or other appropriate actions to address toxicity if biomonitoring data show actual or potential ambient toxicity to be the result of the permittee's discharge to the receiving stream or water body. Modification or revocation of the permit is subject to the provisions of LAC 33:IX.3105/40 CFR 124.5. Accelerated or intensified toxicity testing may be required in accordance with Section 308 of the Clean Water Act.

Dilution Series

The permit requires five (5) dilutions in addition to the control (0% effluent) to be used in the toxicity tests. These additional effluent concentrations shall be 0.06%, 0.08%, 0.11%, 0.14%, and 0.19%. The low-flow effluent concentration (critical dilution) is defined as 0.14% effluent. See Biomonitoring Recommendation, Appendix A.

2.

**Internal Outfall 101 – The intermittent discharge of low level radioactive low volume wastewater from the liquid radwaste wastewater system (LWS) which includes equipment and building floor drain sumps, equipment washing, personnel decontamination, laboratory drains, filter press effluent, RO unit wastewater, other low volume wastewater sources as defined in 40 CFR 423 and maintenance wastewaters. During maintenance activities, Internal Outfall 101 may be discharged to Outfall 001 via the cooling tower flume rather than the common discharge header.**

**Internal Outfall 401 – The intermittent discharge of previously monitored hydrostatic test wastewater and low volume wastewater treatment systems to Final Outfall 001 via the common header. The low volume waste management systems receive effluent from the following sources, including but not limited to: ion exchange resin backwash and regeneration, auxiliary boiler blowdown, floor washdown, equipment washing, personnel decontamination, laboratory drains, filter press, and maintenance wastewaters and other low volume wastewater sources as defined in 40 CFR 423. During maintenance activities, Internal Outfall 401 may be discharged via the cooling tower flume rather than the common discharge header. During maintenance activities, reverse osmosis reject from the makeup water polishing system may be discharged via Outfall 401 rather than Outfall 003.**

**Internal Outfall 501 – The intermittent discharge of low volume wastewaters including but not limited to: wastewaters from the mobile standby service water reverse osmosis filtration unit and standby cooling tower reject.**

**Internal Outfall 601 – The intermittent discharge of low volume wastewater including but not limited to: wastewaters from filter backwash from service water polishing and feed-and-bleed from the service water system.**

| PARAMETER(S) | MASS, LBS/DAY (unless otherwise stated) | | CONCENTRATION, MG/L (unless otherwise stated) | | MEASUREMENT FREQUENCY |
|---|---|---|---|---|---|
| | MONTHLY AVERAGE | DAILY MAXIMUM | MONTHLY AVERAGE | DAILY MAXIMUM | |
| Flow, MGD | Report | Report | --- | --- | 1/month |
| Oil & Grease | --- | --- | 15 | 20 | 1/month |
| TSS | --- | --- | 30 | 100 | 1/month |

Flow – The current permit established reporting requirements for monthly average and daily maximum flow. These requirements are retained with a monitoring frequency of 1/month. Flow reporting requirements are consistent with LAC 33:IX.2707.I.1.b.

Oil & Grease – The previous permit established limitations for Oil & Grease based on 40 CFR 423.12 (b) (3) and 40 CFR 423.12 (b) (11). These limitations are retained with a monitoring frequency of 1/month.

TSS – The previous permit established limitations for TSS based on 40 CFR 423.12 (b) (3) and 40 CFR 423.12 (b) (11). These limitations are retained with a monitoring frequency of 1/month.

3. **Internal Outfall 201 – Treated sanitary wastewater; also, during maintenance activities, sanitary wastewater may be combined with previously monitored hydrostatic test wastewater, wastewater from floor drains of the control building and the diesel generator oil/water separator (and other low volume wastewaters as defined in 40 CFR 423), and maintenance wastewaters and may be routed to Outfall 002**

| PARAMETER(S) | MASS, LBS/DAY (unless otherwise stated) | | CONCENTRATION, MG/L (unless otherwise stated) | | MEASUREMENT FREQUENCY |
|---|---|---|---|---|---|
| | MONTHLY AVERAGE | DAILY MAXIMUM | MONTHLY AVERAGE | DAILY MAXIMUM | |
| Flow, MGD | Report | Report | --- | --- | 1/quarter |
| $BOD_5$ | --- | --- | 30 | 45 | 1/quarter |
| TSS | --- | --- | 30 | 45 | 1/quarter |
| Fecal Coliform colonies/100ml | --- | --- | 200 | 400 | 1/quarter |

The estimated flow for treated sanitary wastewater for Outfall 201 is 20,000 gpd. Therefore, effluent limitations and monitoring requirements are based on the LPDES Class II Sanitary Discharge General Permit, LAG540000 (Sanitary Class II, 0.005<= X <0.025 MGD).

**Internal Outfall 201 – In addition to the above requirements for Internal Outfall 201, the following monitoring and limitations shall be required during maintenance activities (when the discharge is routed to its alternate location (Final Outfall 002)**

| PARAMETER(S) | MASS, LBS/DAY (unless otherwise stated) | | CONCENTRATION, MG/L (unless otherwise stated) | | MEASUREMENT FREQUENCY |
|---|---|---|---|---|---|
| | MONTHLY AVERAGE | DAILY MAXIMUM | MONTHLY AVERAGE | DAILY MAXIMUM | |
| Flow, MGD | Report | Report | --- | --- | 1/week |
| Oil & Grease | --- | --- | 15 | 20 | 1/week |
| TSS | --- | --- | 30 | 45 | 1/week |

Flow – The current permit established reporting requirements for monthly average and daily maximum flow. These requirements are retained with a monitoring frequency of 1/week. Flow reporting requirements are consistent with LAC 33:IX.2707.I.1.b.

Oil & Grease – The previous permit established limitations for Oil & Grease based on 40 CFR 423.12 (b) (3) and 40 CFR 423.12 (b) (11). These limitations are retained with a monitoring frequency of 1/week.

TSS – Limitations for TSS are based on BPJ, the previous permit, and the Class II Sanitary Discharge General Permit, LAG540000. Monitoring frequency is 1/week.

4. **Internal Outfall 301 - Mobile metal cleaning wastewater (chemical and non-chemical) generated from cleaning processes of internal components of plant equipment**

| PARAMETER(S) | MASS, LBS/DAY (unless otherwise stated) | | CONCENTRATION, MG/L (unless otherwise stated) | | MEASUREMENT FREQUENCY |
|---|---|---|---|---|---|
| | MONTHLY AVERAGE | DAILY MAXIMUM | MONTHLY AVERAGE | DAILY MAXIMUM | |
| Flow, MGD | Report | Report | --- | --- | 1/week |
| TSS | --- | --- | 30 | 100 | 1/week |

| PARAMETER(S) | MASS, LBS/DAY (unless otherwise stated) | | CONCENTRATION, MG/L (unless otherwise stated) | | MEASUREMENT FREQUENCY |
|---|---|---|---|---|---|
| | MONTHLY AVERAGE | DAILY MAXIMUM | MONTHLY AVERAGE | DAILY MAXIMUM | |
| Oil & Grease | --- | --- | 15 | 20 | 1/week |
| Total Copper | --- | --- | 1.0 | 1.0 | 1/week |
| Total Iron | --- | --- | 1.0 | 1.0 | 1/week |

Flow – The current permit established reporting requirements for monthly average and daily maximum flow. These requirements are retained with a monitoring frequency of 1/week. Flow reporting requirements are consistent with LAC 33:IX.2707.I.1.b.

TSS and Oil & Grease – The current permit established limitations for TSS and Oil & Grease based on 40 CFR 423.12 (b) (5) and 40 CFR 423.12 (b) (11). These limitations are retained with a monitoring frequency of 1/week.

Total Copper and Total Iron – The current permit established limitations for Total Copper and Total Iron based on 40 CFR 423.12 (b) (5), 40 CFR 423.13 (e) and 40 CFR 423.12 (b) (11). These limitations are retained with a frequency of 1/week.

5. **Outfall 002 – Stormwater runoff from the industrial materials storage area, low-level storage building and sewage treatment plant area; air conditioning condensate, potable water, and previously monitored hydrostatic test wastewater. During periods of maintenance activities, previously monitored treated wastewater from Internal Outfall 201 may be discharged through Outfall 002.**

| PARAMETER(S) | MASS, LBS/DAY (unless otherwise stated) | | CONCENTRATION, MG/L (unless otherwise stated) | | MEASUREMENT FREQUENCY |
|---|---|---|---|---|---|
| | MONTHLY AVERAGE | DAILY MAXIMUM | MONTHLY AVERAGE | DAILY MAXIMUM | |
| Flow, MGD | --- | Report | --- | --- | 1/quarter |
| TOC | --- | --- | --- | 50 | 1/quarter |
| Oil & Grease | --- | --- | --- | 15 | 1/quarter |
| pH Standard Units | --- | --- | 6.0 (min) | 9.0 (max) | 1/quarter |

Flow – Flow reporting requirements are consistent with LAC 33:IX.2707.I.1.b.

TOC, Oil & Grease, and pH limitations are based on LDEQ Stormwater Guidance, letter dated 06/17/87 from J. Dale Givens (LDEQ) to Myron Knudson (EPA Region 6).

Monitoring frequency is 1/quarter based on the previous permit and similar discharges from other industrial facilities.

6. **Outfall 003 – Stormwater runoff from the reactor building, turbine building, services building, clarifiers, main transformer yard and auxiliary transformer yard; maintenance wastewaters including but not limited to flushing of piping systems and vessels (including fire protection water supply system and automatic sprinkler system) and low volume wastewaters including but not limited to reverse osmosis reject water from the standby service water polishing system, effluent from floor drains within power plant buildings (domestic potable water, well water, reject mobile reverse osmosis and fire suppression water treated in the fire pump house oil/water separator), air compressor condensate, and reverse osmosis reject water from the makeup water polishing system; air conditioning condensate, previously monitored hydrostatic test wastewater, and de minimis quantities of cooling tower drift/mist.**

| PARAMETER(S) | MASS, LBS/DAY (unless otherwise stated) | | CONCENTRATION, MG/L (unless otherwise stated) | | MEASUREMENT FREQUENCY |
|---|---|---|---|---|---|
| | MONTHLY AVERAGE | DAILY MAXIMUM | MONTHLY AVERAGE | DAILY MAXIMUM | |
| Flow, MGD | --- | Report | --- | --- | 1/quarter (*1) |
| TOC | --- | --- | --- | 50 | 1/quarter |
| Oil & Grease | --- | --- | --- | 15 | 1/quarter (*1) |
| TSS | --- | --- | --- | 100 | 1/month (*2) |
| pH Standard Units | --- | --- | 6.0 (min) | 9.0 (max) | 1/quarter (*1) |

(*1) Sampling shall be monthly when discharging low volume wastewater.

(*2) When discharging low volume wastewater, total suspended solids shall be monitored and reported as required above.

Flow – Flow reporting requirements are consistent with LAC 33:IX.2707.I.1.b. Monitoring frequency is 1/quarter based on the previous permit and similar discharges from other industrial facilities. Flow shall be monitored monthly when discharging low volume wastewater.

TOC and Oil & Grease limitations are based on LDEQ Stormwater Guidance, letter dated 06/17/87 from J. Dale Givens (LDEQ) to Myron Knudson (EPA Region 6). Monitoring frequency is 1/quarter based on the previous permit and similar discharges from other industrial facilities. Sampling for Oil & Grease shall be monthly when discharging low volume wastewater.

TSS – The current permit established a daily maximum limitation for TSS based on 40 CFR 423.12 (b) (3) and 40 CFR 423.12 (b) (11). This limitation is retained with a monitoring frequency of 1/month when discharging low volume wastewater.

pH limitations are based on LDEQ Stormwater Guidance, letter dated 06/17/87 from J. Dale Givens (LDEQ) to Myron Knudson (EPA Region 6) and 40 CFR 423.12(b)(1). Monitoring frequency is 1/quarter based on the previous permit and similar discharges from other industrial facilities. Sampling shall be monthly when discharging low volume wastewater.

7. **Outfall 004 – Stormwater runoff from the office areas, warehouse areas, materials storage areas and equipment/vehicle maintenance areas; maintenance wastewaters including but not limited to flushing of piping systems and vessels (fire protection water supply system and automatic sprinkler system, etc.); air conditioning condensate, potable water, previously monitored hydrostatic test wastewater, and previously monitored effluent from Internal Outfall 104.**

| PARAMETER(S) | MASS, LBS/DAY (unless otherwise stated) | | CONCENTRATION, MG/L (unless otherwise stated) | | MEASUREMENT FREQUENCY |
|---|---|---|---|---|---|
| | MONTHLY AVERAGE | DAILY MAXIMUM | MONTHLY AVERAGE | DAILY MAXIMUM | |
| Flow, MGD | --- | Report | --- | --- | 1/quarter |
| TOC | --- | --- | --- | 50 | 1/quarter |
| Oil & Grease | --- | --- | --- | 15 | 1/quarter |
| pH Standard Units | --- | --- | 6.0 (min) | 9.0 (max) | 1/quarter |

Flow – Flow reporting requirements are consistent with LAC 33:IX.2707.I.1.b.

TOC, Oil & Grease, and pH limitations are based on LDEQ Stormwater Guidance, letter dated 06/17/87 from J. Dale Givens (LDEQ) to Myron Knudson (EPA Region 6).

Monitoring frequency is 1/quarter based on the previous permit and similar discharges from other industrial facilities.

**8. Internal Outfall 104 – Exterior vehicle washwater**

| PARAMETER(S) | MASS, LBS/DAY (unless otherwise stated) | | CONCENTRATION, MG/L (unless otherwise stated) | | MEASUREMENT FREQUENCY |
|---|---|---|---|---|---|
| | MONTHLY AVERAGE | DAILY MAXIMUM | MONTHLY AVERAGE | DAILY MAXIMUM | |
| Flow, MGD | Report | Report | --- | --- | 1/quarter |
| COD | --- | --- | --- | 300 | 1/quarter |
| TSS | --- | --- | --- | 45 | 1/quarter |
| Oil & Grease | --- | --- | --- | 15 | 1/quarter |
| pH Standard Units | --- | --- | 6.0 (min) | 9.0 (max) | 1/quarter |
| Soaps and/or Detergents | --- | --- | Inventory/ Record | --- | 1/quarter |

Monitoring Frequency: Quarterly for flow, TSS, COD, oil and grease, and pH. Soaps and Detergents: document in a quarterly inventory record the quantity and type of any soap and/or detergent used during each calendar month.

Limits and monitoring frequencies are based on current guidance for similar discharges from other facilities and the Exterior Vehicle Wash Wastewater General Permit (LAG750000), effective March 15, 2009.

**9. Outfall 005 – Stormwater runoff from the cooling tower yard, air conditioning condensate, previously monitored hydrostatic test wastewater, and de minimis quantities of cooling tower drift/mist.**

| PARAMETER(S) | MASS, LBS/DAY (unless otherwise stated) | | CONCENTRATION, MG/L (unless otherwise stated) | | MEASUREMENT FREQUENCY |
|---|---|---|---|---|---|
| | MONTHLY AVERAGE | DAILY MAXIMUM | MONTHLY AVERAGE | DAILY MAXIMUM | |
| Flow, MGD | --- | Report | --- | --- | 1/quarter |
| TOC | --- | --- | --- | 50 | 1/quarter |
| Oil & Grease | --- | --- | --- | 15 | 1/quarter |
| pH Standard Units | --- | --- | 6.0 (min) | 9.0 (max) | 1/quarter |

Flow – Flow reporting requirements are consistent with LAC 33:IX.2707.I.1.b.

TOC, Oil & Grease, and pH limitations are based on LDEQ Stormwater Guidance, letter dated 06/17/87 from J. Dale Givens (LDEQ) to Myron Knudson (EPA Region 6).
Monitoring frequency is 1/quarter based on the previous permit and similar discharges from other industrial facilities.

**10. Outfall 006 – Clarifier underflow**

| PARAMETER(S) | MASS, LBS/DAY (unless otherwise stated) | | CONCENTRATION, MG/L (unless otherwise stated) | | MEASUREMENT FREQUENCY |
|---|---|---|---|---|---|
| | MONTHLY AVERAGE | DAILY MAXIMUM | MONTHLY AVERAGE | DAILY MAXIMUM | |
| Flow, MGD | --- | Report | --- | --- | 1/day |
| Coagulants | --- | Report | --- | --- | See below (*1) |

(*1) The quantity and types of all coagulants (clarifying agents) used in the intake raw river water treatment clarification system during the sampling month shall be recorded. Records of the quantity and type of coagulants used shall be retained for three (3) years following Part III.C.3. No DMR reporting shall be required.

Flow – Flow reporting requirements are consistent with LAC 33:IX.2707.I.1.b. Monitoring frequency is based on the previous permit.

Clarifying Agents - Reporting requirements for clarifying agents are based on the previous permit and similar discharges from other industrial facilities.

**11. Outfall 007 - Hydrostatic Test Waters**

| PARAMETER(S) | MASS, LBS/DAY (unless otherwise stated) | | CONCENTRATION, MG/L (unless otherwise stated) | | MEASUREMENT FREQUENCY |
|---|---|---|---|---|---|
| | MONTHLY AVERAGE | DAILY MAXIMUM | MONTHLY AVERAGE | DAILY MAXIMUM | |
| Flow, MGD | Report | Report | --- | --- | 1/discharge event |
| TSS | --- | --- | --- | 90 | 1/discharge event |
| Oil & Grease | --- | --- | --- | 15 | 1/discharge event |

| PARAMETER(S) | MASS, LBS/DAY (unless otherwise stated) | | CONCENTRATION, MG/L (unless otherwise stated) | | MEASUREMENT FREQUENCY |
|---|---|---|---|---|---|
| | MONTHLY AVERAGE | DAILY MAXIMUM | MONTHLY AVERAGE | DAILY MAXIMUM | |
| TOC | --- | --- | --- | 50 | 1/discharge event |
| Benzene | --- | --- | --- | 50 μg/L | 1/discharge event |
| Total BTEX | --- | --- | --- | 250 μg/L | 1/discharge event |
| Total Lead | --- | --- | --- | 50 μg/L | 1/discharge event |

Flow, TSS and Oil and Grease shall be measured on discharges from all new and existing pipelines, flowlines, vessels, or tanks. In addition, Total Organic Carbon (TOC) shall be measured on discharges from existing pipelines, flowlines, vessels, or tanks which have previously been in service; (i.e., those which are not new). Benzene, Total BTEX, and Total Lead shall be measured on discharges from existing pipelines, flowlines, vessels, or tanks which have been used for the storage or transportation of liquid or gaseous petroleum hydrocarbons.

Limits and monitoring frequencies are based on current guidance for similar discharges from other facilities and the LPDES Hydrostatic Test and Vessel Testing Wastewater General Permit (LAG670000).

STORM WATER POLLUTION PREVENTION PLAN (SWP3) REQUIREMENT

In accordance with LAC 33:IX.2707.I.3 and 4 [40 CFR 122.44(I)(3) and (4)], a Part II condition is proposed for applicability to all storm water discharges from the facility, either through permitted outfalls or through outfalls which are not listed in the permit or as sheet flow. **For first time permit issuance,** the Part II condition requires a Storm Water Pollution Prevention Plan (SWP3) within six (6) months of the effective date of the final permit. **For renewal permit issuance,** the Part II condition requires that the Storm Water Pollution Prevention Plan (SWP3) be reviewed and updated, if necessary, within six (6) months of the effective date of the final permit. If the permittee maintains other plans that contain duplicative information, those plans could be incorporated by reference to the SWP3. Examples of these type plans include, but are not limited to: Spill Prevention Control and Countermeasures Plan (SPCC), Best Management Plan (BMP), Response Plans, etc. The conditions will be found in the draft permit. Including Best Management Practice (BMP) controls in the form of a SWP3 is consistent with other LPDES and EPA permits regulating similar discharges of stormwater associated with industrial activity, as defined in LAC 33:IX.2511.B.14 [40 CFR 122.26(b)(14)].

## XI. Compliance History/DMR Review:

A. Inspections:

A compliance inspection was performed at this facility on September 9, 2009 (EDMS document # 6556054). A review of DMRs prior to the inspection and while on site noted several excursions during the period December, 2007 to July, 2009. There were no other areas of concern noted on the inspection report.

B. Enforcement Actions (COs, NOVs, Warning Letters, etc.):

A Notice of Deficiency (EDMS # 6565708) was issued on September 17, 2009 due to the excursions noted in the inspection report of September 9, 2009. A Response to the Notice of Deficiency (EDMS # 6070979) was received by this Office from Entergy on October 28, 2009. A Deficiency Clear Letter (EDMS #6095052) was issued to Entergy's River Bend Generating Station on November 16, 2009.

A review of the TEMPO and Discoverer databases on January 11, 20111, shows no open, appealed, or pending enforcement actions on file for this facility.

C. A DMR review covering the monitoring period of November 30, 2007 through December 31, 2010 revealed the following effluent excursions:

| DATE | PARAMETER | OUTFALL | REPORTED VALUE | | PERMIT LIMITS | |
|---|---|---|---|---|---|---|
| | | | MONTHLY AVERAGE | DAILY MAXIMUM | MONTHLY AVERAGE | DAILY MAXIMUM |
| 09/30/08 | TSS | 201 | --- | 55 mg/L | --- | 45 mg/L |
| 06/30/09 | Fecal Coliform | 201 | --- | 1000 col/100ml (weekly average) | --- | 400 col/100 ml (weekly average) |
| 09/30/09 | pH | 003 | -- | 9.5 (inst. max) | --- | 9.0 (inst. max) |
| 09/30/09 | TOC | 003 | --- | 54 mg/L | --- | 50 mg/L |
| 09/30/09 | Oil & Grease | 003 | --- | 20.4 mg/L | --- | 15 mg/L |

D. Company Compliance History – There are no recent company compliance actions.

E. Permit Actions Taken: List all permitting actions taken (e.g. refer to enforcement) in the fact sheet or statement of basis. If no actions are taken, N/A is appropriate

1. Referrals to Surveillance – N/A
2. Referrals to Enforcement – N/A
3. Referrals to Small Business/Small Community – N/A
4. Increased monitoring frequency – N/A
5. Additional permit conditions may be included in the permit to address compliance issues – N/A

Please be aware that the Department has the authority to reduce monitoring frequencies when a permittee demonstrates two or more consecutive years of permit compliance. Monitoring frequencies established in LPDES permits are based on a number of different factors, including but not limited to, the size of the discharge, the type of wastewater being discharged, the specific operations at the facility, past compliance history, similar facilities and best professional judgment of the reviewer. We encourage and invite each permittee to institute positive measures to ensure continued compliance with the LPDES permit, thereby qualifying for reduced monitoring frequencies upon permit reissuance. As a reminder, the Department will also consider an increase in monitoring frequency upon permit reissuance when the permittee demonstrates continued non-compliance.

## XII. TMDL Waterbodies

The discharges from this facility are to the Mississippi River, Subsegment No. 070201 of the Mississippi River Basin. Subsegment 070201 Mississippi River – from Old River Control Structure to Monte Sano Bayou, is not listed on LDEQ's Final 2006 303(d) List as impaired, and to date no TMDL's have been established. A reopener clause will be established in the permit to allow for the requirement of more stringent effluent limitations and requirements as imposed by any future TMDLs.

## XIII. Endangered Species:

The receiving waterbody, Subsegment 070201 of the Mississippi River Basin, has been identified by the U.S. Fish and Wildlife Service (FWS) as habitat for the Pallid Sturgeon, which is listed as a threatened and/or endangered species. Therefore, this draft permit was submitted to the FWS for review in accordance with a letter dated 04/01/11 from Rieck (FWS) to Nolan (LDEQ). The effluent limitations established in the permit ensure protection of aquatic life and maintenance of the receiving water as aquatic habitat. Therefore, the issuance of the LPDES permit is not likely to have an adverse effect on any endangered or candidate species or the critical habitat.

**XIV. Historic Sites:**

The discharge is from an existing facility location, which does not include an expansion on undisturbed soils. Therefore, there should be no potential effect to sites or properties on or eligible for listing on the National Register of Historic Places, and in accordance with the "Memorandum of Understanding for the Protection of Historic Properties in Louisiana Regarding LPDES Permits" no consultation with the Louisiana State Historic Preservation Officer is required.

**XV. Tentative Determination:**

On the basis of preliminary staff review, the Department of Environmental Quality has made a tentative determination to reissue a permit for the discharge described in the application.

**XVI. Variances:**

No requests for variances have been received by this Office.

**XVII. Public Notices:**

Upon publication of the public notice, a public comment period shall begin on the date of publication and last for at least 30 days thereafter. During this period, any interested persons may submit written comments on the draft permit and may request a public hearing to clarify issues involved in the permit decision at this Office's address on the first page of the fact sheet. A request for a public hearing shall be in writing and shall state the nature of the issues proposed to be raised in the hearing.

Public notice published in:

Local newspaper of general circulation

Office of Environmental Services Public Notice Mailing List

**XVIII. 316(b) Requirements:**

The River Bend Power Station is an existing electric generating facility that operates a cooling water intake structure on the Mississippi River. The intake structure has a design capacity of approximately 23 MGD. In preparing the renewal LPDES permit for the River Bend Station, this Office determined that this facility is not regulated by the 316(b) Phase I or Phase II rule for cooling water intake structures because it is an existing facility that has a design intake capacity of less than 50 MGD.

**IX.. "IT" Questions - Applicant's Responses**

This application does not include a substantial modification of the existing permit. Therefore, an Environmental Impact Questionnaire was not required to be submitted as part of the permit application. However, Entergy has submitted responses to Section VIII of the application – Environmental Impact Questionnaire. The "IT" Questions along with the applicant's responses can be found in the Permit Application addendum received May 4, 2011. See Appendix D.

# Appendix A

# Biomonitoring Recommendation

# BIOMONITORING FREQUENCY RECOMMENDATION AND RATIONALE FOR ADDITIONAL REQUIREMENTS

| | |
|---|---|
| Permit Number: | **LA0042731** |
| Facility Name: | **Entergy Operations, Inc./River Bend Station** |
| Previous Critical Biomonitoring Dilution: | **0.15% (10:1 ACR)** |
| Proposed Critical Biomonitoring Dilution: | **0.14% (10:1 ACR)** |
| Outfall discharge flow: | **4.321 mgd** |
| Receiving stream 7Q10: | **141,955 cfs** |
| Date of Review: | **01/11/11** |
| Name of Reviewer: | **Laura Thompson** |

Recommended Frequency by Species:

***Pimephales promelas* (Fathead minnow):** **Once/Year**[1]
***Daphnia pulex* (water flea):** **Once/Year**[1]

Recommended Dilution Series: **0.060%, 0.080%, 0.11%, 0.14%, and 0.19%**

Number of Tests Performed during previous 5 years by Species:

***Pimephales promelas* (Fathead minnow):** **4**
***Daphnia pulex* (water flea):** **4**

Number of Failed Tests during previous 5 years by Species:

***Pimephales promelas* (Fathead minnow):** **No failures on file during the past 5 years**
***Daphnia pulex* (water flea):** **No failures on file during the past 5 years**

Failed Test Dates during previous 5 years by Species:

***Pimephales promelas* (Fathead minnow):** **No failures on file during the past 5 years**
***Daphnia pulex* (water flea):** **No failures on file during the past 5 years**

Previous TRE Activities: **N/A – No previous TRE Activities**

[1] An acute biomonitoring critical dilution of less than 1% shall have an established biomonitoring frequency of once per year.

Additional Requirements (including WET Limits) Rationale / Comments Concerning Permitting:

**Entergy Operations, Inc./River Bend Station owns and operates a steam electric generating facility in St. Francisville, West Feliciana Parish, Louisiana. LPDES Permit LA0042731, effective June 1, 2006, contained freshwater acute biomonitoring as an effluent characteristic of Outfall 001 for *Daphnia pulex* and *Pimephales promelas*. The effluent series consisted of 0.06%, 0.09%, 0.11%, 0.15%, and 0.2% concentrations, with the critical biomonitoring dilution being defined as the 0.15% effluent concentration. The testing was to be performed once per year for the *Daphnia pulex* and the *Pimephales promelas*. Data on file indicate that the permittee has complied with the biomonitoring requirements contained in LA0042731 with no toxicity failures during the last five years.**

**It is recommended that freshwater acute biomonitoring continue to be an effluent characteristic of Outfall 001 (continuous discharge of 4.321 mgd of cooling tower blowdown and previously monitored effluent from Internal Outfalls 101, 201, 301, 401, 501, and 601) in LA0042731. The effluent dilution series shall be 0.060%, 0.080%, 0.11%, 0.14%, and 0.19% concentrations, with 0.14% being defined as the critical biomonitoring dilution (the 10:1 Acute-to-Chronic ratio has been implemented). Since the proposed critical biomonitoring dilution is less than 1% (10:1 ACR), the biomonitoring frequency shall be once per year for *Daphnia pulex* and *Pimephales promelas*.**

**This recommendation is in accordance with the LDEQ/OES Permitting Guidance Document for Implementing Louisiana Surface Water Quality Standards, Water Quality Management Plan Volume 3. Version 8 (October 26, 2010), and the Best Professional Judgment (BPJ) of the reviewer.**

MEMORANDUM

TO: Lisa Kemp

FROM: Todd Franklin

DATE: February 24, 2011

RE: Stream Flow Characteristics for the Mississippi River, receiving waters for Entergy Operations, Inc. / River Bend Station (LA0042731 / AI: 2889)

The discharge from Outfall 001 flows into the Mississippi River. Ambient data for hardness and TSS was taken from ambient monitoring station #0318 (Mississippi River at the Louisiana ferry landing near St. Francisville, midstream). The following results were obtained:

| | | |
|---|---|---|
| Average hardness | = | 154 mg/l |
| $15^{th}$ percentile TSS | = | 53 mg/l |

The following flow information was based on historical data obtain from the USGS regarding the Mississippi River:

| | | |
|---|---|---|
| 7Q10 | = | 141,955 cfs |
| Harmonic Mean Flow | = | 366,748 cfs |

If you have additional questions or comments, please contact me at 2-3209.

Developer: Bruce Fielding Time: 10:15 AM

Software: Lotus 4.0 LA0042731 AI 2889

Revision date: 11/03/10

Water Quality Screen for Entergy Operations, Inc./River Bend Station

Input variables:

| Receiving Water Characteristics: | |
|---|---|
| Receiving Water Name= | Mississippi River |
| Critical flow (Qr) cfs= | 141955 |
| Harm. mean/avg tidal cfs= | 366748 |
| Drinking Water=1 HHNPCR=2 | 1 |
| MW=1, BW=2, 0=n | |
| Rec. Water Hardness= | 154 |
| Rec. Water TSS= | 53 |
| Fisch/Specific=1,Stream=0 | |
| Diffuser Ratio= | |

| Effluent Characteristics: | |
|---|---|
| Permittee= | |
| Permit Number= | LA0042731, AI2889 |
| Facility flow (Qef),MGD= | 4.321 |
| Outfall Number = | 001 |
| Eff. data, 2=lbs/day | |
| MQL, 2=lbs/day | 1 |
| Effluent Hardness= | N/A |
| Effluent TSS= | N/A |
| WQBL ind. 0=y, 1=n | |
| Acute/Chr. ratio 0=n, 1=y | 1 |
| Aquatic,acute only1=y,0=n | |

| Page Numbering/Labeling | |
|---|---|
| Appendix | Appendix B-1 |
| Page Numbers 1=y, 0=n | 1 |
| Input Page # 1=y, 0=n | 1 |

| Fischer/Site Specific inputs: | |
|---|---|
| Pipe=1,Canal=2,Specific=3 | |
| Pipe width, feet | |
| ZID plume dist., feet | |
| MZ plume dist., feet | |
| HHnc plume dist., feet | |
| HHc plume dist., feet | |

| Fischer/site specific dilutions: | |
|---|---|
| Dilution = | --- |
| F/specific MZ Dilution = | --- |
| F/specific HHnc Dilution= | --- |
| F/specific HHc Dilution= | --- |

| Dilution: | |
|---|---|
| ZID Fs = | 0.0333333 |
| MZ Fs = | 0.3333333 |
| Critical Qr (MGD)= | 91745.517 |
| Harm. Mean (MGD)= | 237029.23 |
| ZID Dilution = | 0.0014109 |
| MZ Dilution = | 0.0001413 |
| HHnc Dilution= | 4.71E-05 |
| HHc Dilution= | 1.823E-05 |
| ZID Upstream = | 707.74911 |
| MZ Upstream = | 7077.4911 |
| MZhhnc Upstream= | 21232.473 |
| MZhhc Upstream= | 54855.18 |
| ZID Hardness= | --- |
| MZ Hardness= | --- |
| ZID TSS= | --- |
| MZ TSS= | --- |

| Multipliers: | |
|---|---|
| WLAa --> LTAa | 0.32 |
| WLAc --> LTAc | 0.53 |
| LTA a,c-->WQBL avg | 1.31 |
| LTA a,c-->WQBL max | 3.11 |
| LTA h --> WQBL max | 2.38 |
| WQBL-limit/report | 2.13 |
| WLA Fraction | 1 |
| WQBL Fraction | 1 |

| Conversions: | |
|---|---|
| ug/L-->lbs/day Qef | 0.0360371 |
| ug/L-->lbs/day Qeo | 0 |
| ug/L-->lbs/day Qr | 1183.9047 |
| lbs/day-->ug/L Qeo | 27.74915 |
| lbs/day-->ug/L Qef | 27.74915 |
| diss-->tot 1=y0=n | 1 |
| Cu diss->tot1=y0=n | 1 |
| cfs-->MGD | 0.6463 |

| Receiving Stream: | |
|---|---|
| Default Hardness= | 25 |
| Default TSS= | 10 |
| 99 Crit., 1=y, 0=n | 1 |
| Old MQL=1, New=0 | 0 |

| Toxicity Dilution Series: | |
|---|---|
| Biomonitoring dilution: | 0.0014127 |
| Dilution Series Factor: | 0.75 |
| | Percent Effluent |
| Dilution No. 1 | 0.188% |
| Dilution No. 2 | 0.1413% |
| Dilution No. 3 | 0.1060% |
| Dilution No. 4 | 0.0795% |
| Dilution No. 5 | 0.0596% |

Partition Coefficients; Dissolved-->Total

| METALS | FW |
|---|---|
| Total Arsenic | 2.402154 |
| Total Cadmium | 3.3872842 |
| Chromium III | 5.4364806 |
| Chromium VI | 1 |
| Total Copper | 3.919746 |
| Total Lead | 7.1945991 |
| Total Mercury | 2.6634103 |
| Total Nickel | 3.701685 |
| Total Zinc | 5.1133226 |

Aquatic Life, Dissolved

Metal Criteria, ug/L

| METALS | ACUTE | CHRONIC |
|---|---|---|
| Arsenic | 339.8 | 150 |
| Cadmium | 50.771357 | 1.4184043 |
| Chromium III | 781.52811 | 253.51964 |
| Chromium VI | 15.712 | 10.582 |
| Copper | 27.676806 | 17.765422 |
| Lead | 102.99742 | 4.0136617 |
| Mercury | 1.734 | 0.012 |
| Nickel | 2039.4999 | 226.50282 |
| Zinc | 165.00311 | 150.67286 |

| Site Specific Multiplier Values: | |
|---|---|
| CV = | --- |
| N = | --- |
| WLAa --> LTAa | --- |
| WLAc --> LTAc | --- |
| LTA a,c-->WQBL avg | --- |
| LTA a,c-->WQBL max | --- |
| LTA h --> WQBL max | --- |

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| (*1) Toxic Parameters | (*2) Cu Instream Conc. ug/L | (*3) Effluent /Tech (Avg) ug/L | (*4) Effluent /Tech (Max) ug/L | (*5) MQL ug/L | (*6) Effluent 1=No 95% 0=95 % | (*7) 95th % estimate Non-Tech ug/L | (*8) Numerical Criteria Acute FW ug/L | (*9) Chronic FW ug/L | (*10) HHDW ug/L | (*11) HH Carcinogen Indicator "C" |
|---|---|---|---|---|---|---|---|---|---|---|
| NONCONVENTIONAL | | | | | | | | | | |
| Total Phenols (4AAP) | | 5.6 | | 5 | 0 | 11.928 | 700 | 350 | 5 | |
| 3-Chlorophenol | | | | 10 | | | | | 0.1 | |
| 4-Chlorophenol | | | | 10 | | | 383 | 192 | 0.1 | |
| 2,3-Dichlorophenol | | | | 10 | | | | | 0.04 | |
| 2,5-Dichlorophenol | | | | 10 | | | | | 0.5 | |
| 2,6-Dichlorophenol | | | | 10 | | | | | 0.2 | |
| 3,4-Dichlorophenol | | | | 10 | | | | | 0.3 | |
| 2,4-Dichlorophenocy-acetic acid (2,4-D) | | | | --- | | | | | 100 | |
| 2-(2,4,5-Trichlorophen-oxy) propionic acid (2,4,5-TP, Silvex) | | | | --- | | | | | 10 | |
| METALS AND CYANIDE | | | | | | | | | | |
| Total Arsenic | | 14.5 | | 5 | 0 | 30.885 | 816.25194 | 360.3231 | 120.1077 | |
| Total Cadmium | | | | 1 | | | 171.97702 | 4.8045384 | 33.872842 | |
| Chromium III | | 200 | 200 | 10 | 1 | | 4248.7624 | 1378.2546 | 271.82403 | |
| Chromium VI | | 200 | 200 | 10 | 1 | | 15.712 | 10.582 | 50 | C |
| Total Copper | | 261 | | 3 | 0 | 555.93 | 108.48605 | 69.635942 | 3919.746 | |
| Total Lead | | | | 2 | | | 741.02516 | 28.876687 | 359.72996 | |
| Total Mercury | | 0.2 | | 0.005 | 0 | 0.426 | 4.6183534 | 0.0319609 | 5.3268205 | |
| Total Nickel | | | | 5 | | | 7549.586 | 838.44208 | | |
| Total Zinc | | 1000 | 1000 | 20 | 1 | | 843.71414 | 770.43896 | 25566.613 | |
| Total Cyanide | | | | 10 | | | 45.9 | 5.4 | 663.8 | |
| DIOXIN | | | | | | | | | | |
| 2,3,7,8 TCDD; dioxin | | | | 1.0E-05 | | | | | 7.1E-07 | C |
| VOLATILE COMPOUNDS | | | | | | | | | | |
| Benzene | | | | 10 | | | 2249 | 1125 | 1.1 | C |
| Bromoform | | | | 10 | | | 2930 | 1465 | 3.9 | C |
| Bromodichloromethane | | | | 10 | | | | | 0.2 | C |
| Carbon Tetrachloride | | | | 2 | | | 2730 | 1365 | 0.22 | C |
| Chloroform | | | | 10 | | | 2890 | 1445 | 5.3 | C |
| Dibromochloromethane | | | | 10 | | | | | 0.39 | C |
| 1,2-Dichloroethane | | | | 10 | | | 11800 | 5900 | 0.36 | C |
| 1,1-Dichloroethylene | | | | 10 | | | 1160 | 580 | 0.05 | C |
| 1,3-Dichloropropylene | | | | 10 | | | 606 | 303 | 9.86 | |
| Ethylbenzene | | | | 10 | | | 3200 | 1600 | 2390 | |
| Methyl Chloride | | | | 50 | | | 55000 | 27500 | | |
| Methylene Chloride | | | | 20 | | | 19300 | 9650 | 4.4 | C |
| 1,1,2,2-Tetrachloro-ethane | | | | 10 | | | 932 | 466 | 0.16 | C |

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| (*1) Toxic Parameters | (*12) WLAa Acute ug/L | (*13) WLAc Chronic ug/L | (*14) WLAh HHDW ug/L | (*15) LTAa Acute ug/L | (*16) LTAc Chronic ug/L | (*17) LTAh HHDW ug/L | (*18) Limiting A,C,HH ug/L | (*19) WQBL Avg 001 ug/L | (*20) WQBL Max 001 ug/L | (*21) WQBL Avg 001 lbs/day | (*22) WQBL Max 001 lbs/day | (*23) Need WQBL? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NONCONVENTIONAL | | | | | | | | | | | | |
| Total Phenols (4AAP) | 496124.37 | 2477471.9 | 106167.37 | 158759.8 | 1313060.1 | 106167.37 | 106167.37 | 106167.37 | 252678.33 | 3825.9682 | 9105.8044 | no |
| 3-Chlorophenol | --- | --- | 2123.3473 | --- | --- | 2123.3473 | 2123.3473 | 2123.3473 | 5053.5666 | 76.519364 | 182.11609 | no |
| 4-Chlorophenol | 271450.91 | 1359070.3 | 2123.3473 | 86864.29 | 720307.25 | 2123.3473 | 2123.3473 | 2123.3473 | 5053.5666 | 76.519364 | 182.11609 | no |
| 2,3-Dichlorophenol | --- | --- | 849.33893 | --- | --- | 849.33893 | 849.33893 | 849.33893 | 2021.4266 | 30.607746 | 72.846435 | no |
| 2,5-Dichlorophenol | --- | --- | 10616.737 | --- | --- | 10616.737 | 10616.737 | 10616.737 | 25267.833 | 382.59682 | 910.58046 | no |
| 2,6-Dichlorophenol | --- | --- | 4246.6946 | --- | --- | 4246.6946 | 4246.6946 | 4246.6946 | 10107.133 | 153.03873 | 364.23217 | no |
| 3,4-Dichlorophenol | --- | --- | 6370.0419 | --- | --- | 6370.0419 | 6370.0419 | 6370.0419 | 15160.7 | 229.55809 | 546.34826 | no |
| 2,4-Dichlorophenocy-acetic acid (2,4-D) | --- | --- | 2123347.3 | --- | --- | 2123347.3 | 2123347.3 | 2123347.3 | 5053566.6 | 76519.364 | 182116.09 | no |
| 2-(2,4,5-Trichlorophen-oxy) propionic acid (2,4,5-TP, Silvex) | --- | --- | 212334.73 | --- | --- | 212334.73 | 212334.73 | 212334.73 | 505356.66 | 7651.9364 | 18211.609 | no |
| METALS AND CYANIDE | | | | | | | | | | | | |
| Total Arsenic | 578517.83 | 2550543.9 | 2550303.6 | 185125.71 | 1351788.2 | 2550303.6 | 185125.71 | 242514.67 | 575740.94 | 8739.5353 | 20748.057 | no |
| Total Cadmium | 121888.56 | 34008.882 | 719238.09 | 39004.338 | 18024.707 | 719238.09 | 18024.707 | 23612.367 | 56056.84 | 850.92216 | 2020.1282 | no |
| Chromium III | 3011306.6 | 9755962.9 | 5771768.3 | 963618.1 | 5170660.3 | 5771768.3 | 963618.1 | 1262339.7 | 2996852.3 | 45491.113 | 107997.99 | no |
| Chromium VI | 11135.866 | 74904.592 | 2742809 | 3563.4771 | 39699.434 | 2742809 | 3563.4771 | 4668.155 | 11082.414 | 168.22696 | 399.3785 | no |
| Total Copper | 76889.391 | 492917.4 | 83229821 | 24604.605 | 261246.22 | 83229821 | 24604.605 | 32232.033 | 76520.322 | 1161.5503 | 2757.5735 | no |
| Total Lead | 525200.92 | 204403.37 | 7638316.3 | 168064.29 | 108333.78 | 7638316.3 | 108333.78 | 141917.26 | 336918.07 | 5114.2921 | 12141.564 | no |
| Total Mercury | 3273.2538 | 226.23511 | 113106.9 | 1047.4412 | 119.90461 | 113106.9 | 119.90461 | 157.07504 | 372.90333 | 5.6605351 | 13.438369 | no |
| Total Nickel | 5350762.3 | 5934904.7 | --- | 1712243.9 | 3145499.5 | --- | 1712243.9 | 2243039.6 | 5325078.7 | 80832.731 | 191900.61 | no |
| Total Zinc | 597981.64 | 5453545.3 | 542867993 | 191354.13 | 2890379 | 542867993 | 191354.13 | 250673.9 | 595111.33 | 9033.5706 | 21446.11 | no |
| Total Cyanide | 32531.584 | 38223.852 | 14094779 | 10410.107 | 20258.641 | 14094779 | 10410.107 | 13637.24 | 32375.432 | 491.44713 | 1166.718 | no |
| DIOXIN | | | | | | | | | | | | |
| 2,3,7,8 TCDD; dioxin | --- | --- | 0.0389479 | --- | --- | 0.0389479 | 0.0389479 | 0.0389479 | 0.092696 | 0.0014036 | 0.0033405 | no |
| VOLATILE COMPOUNDS | | | | | | | | | | | | |
| Benzene | 1593976.7 | 7963302.4 | 60341.798 | 510072.56 | 4220550.3 | 60341.798 | 60341.798 | 60341.798 | 143613.48 | 2174.5458 | 5175.419 | no |
| Bromoform | 2076634.9 | 10369989 | 213939.1 | 664523.16 | 5496094.4 | 213939.1 | 213939.1 | 213939.1 | 509175.06 | 7709.7534 | 18349.213 | no |
| Bromodichloromethane | --- | --- | 10971.236 | --- | --- | 10971.236 | 10971.236 | 10971.236 | 26111.542 | 395.37197 | 940.98528 | no |
| Carbon Tetrachloride | 1934885.1 | 9662140.3 | 12068.36 | 619163.22 | 5120934.4 | 12068.36 | 12068.36 | 12068.36 | 28722.696 | 434.90916 | 1035.0838 | no |
| Chloroform | 2048284.9 | 10228420 | 290737.75 | 655451.17 | 5421062.4 | 290737.75 | 290737.75 | 290737.75 | 691955.85 | 10477.357 | 24936.11 | no |
| Dibromochloromethane | --- | --- | 21393.91 | --- | --- | 21393.91 | 21393.91 | 21393.91 | 50917.506 | 770.97534 | 1834.9213 | no |
| 1,2-Dichloroethane | 8363239.4 | 41763097 | 19748.225 | 2676236.6 | 22134442 | 19748.225 | 19748.225 | 19748.225 | 47000.775 | 711.66954 | 1693.7735 | no |
| 1,1-Dichloroethylene | 822148.96 | 4105524.8 | 2742.809 | 263087.67 | 2175928.1 | 2742.809 | 2742.809 | 2742.809 | 6527.8854 | 98.842992 | 235.24632 | no |
| 1,3-Dichloropropylene | 429501.96 | 2144782.8 | 209362.05 | 137440.63 | 1136734.9 | 209362.05 | 137440.63 | 180047.22 | 427440.35 | 6488.3869 | 15403.728 | no |
| Ethylbenzene | 2267997.1 | 11325586 | 50748001 | 725759.08 | 6002560.4 | 50748001 | 725759.08 | 950744.4 | 2257110.8 | 34262.109 | 81339.816 | no |
| Methyl Chloride | 38981201 | 194658504 | --- | 12473984 | 103169007 | --- | 12473984 | 16340919 | 38794091 | 588880 | 1398028.1 | no |
| Methylene Chloride | 13678858 | 68307439 | 241367.19 | 4377234.5 | 36202942 | 241367.19 | 241367.19 | 241367.19 | 574453.92 | 8698.1833 | 20701.676 | no |
| 1,1,2,2-Tetrachloro-ethane | 660554.17 | 3298576.8 | 8776.9888 | 211377.33 | 1748245.7 | 8776.9888 | 8776.9888 | 8776.9888 | 20889.233 | 316.29757 | 752.78823 | no |

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| (*1) Toxic Parameters | (*2) Cu Instream Conc. ug/L | (*3) Effluent /Tech (Avg) ug/L | (*4) Effluent /Tech (Max) ug/L | (*5) MQL ug/L | (*6) Effluent 1=No 95% 0=95 % | (*7) 95th % estimate Non-Tech ug/L | (*8) Numerical Criteria Acute FW ug/L | (*9) Chronic FW ug/L | (*10) HHDW ug/L | (*11) HH Carcinogen Indicator "C" |
|---|---|---|---|---|---|---|---|---|---|---|
| VOLATILE COMPOUNDS (cont'd) | | | | | | | | | | |
| Tetrachloroethylene | | | | 10 | | | 1290 | 645 | 0.65 | C |
| Toluene | | | | 10 | | | 1270 | 635 | 6100 | |
| 1,1,1-Trichloroethane | | | | 10 | | | 5280 | 2640 | 200 | |
| 1,1,2-Trichloroethane | | | | 10 | | | 1800 | 900 | 0.56 | C |
| Trichloroethylene | | | | 10 | | | 3900 | 1950 | 2.8 | C |
| Vinyl Chloride | | | | 10 | | | | | 1.9 | C |
| ACID COMPOUNDS | | | | | | | | | | |
| 2-Chlorophenol | | | | 10 | | | 258 | 129 | 0.1 | |
| 2,4-Dichlorophenol | | | | 10 | | | 202 | 101 | 0.3 | |
| BASE NEUTRAL COMPOUNDS | | | | | | | | | | |
| Benzidine | | | | 50 | | | 250 | 125 | 0.00008 | C |
| Hexachlorobenzene | | | | 5 | | | | | 0.00025 | C |
| Hexachlorabutadiene | | | | 10 | | | 5.1 | 1.02 | 0.09 | C |
| PESTICIDES | | | | | | | | | | |
| Aldrin | | | | 0.01 | | | 3 | | 0.00004 | C |
| Hexachlorocyclohexane (gamma BHC, Lindane) | | | | 0.05 | | | 5.3 | 0.21 | 0.11 | C |
| Chlordane | | | | 0.2 | | | 2.4 | 0.0043 | 0.00019 | C |
| 4,4'-DDT | | | | 0.02 | | | 1.1 | 0.001 | 0.00019 | C |
| 4,4'-DDE | | | | 0.1 | | | 52.5 | 10.5 | 0.00019 | C |
| 4,4'-DDD | | | | 0.1 | | | 0.03 | 0.006 | 0.00027 | C |
| Dieldrin | | | | 0.02 | | | 0.2374 | 0.0557 | 0.00005 | C |
| Endosulfan | | | | 0.1 | | | 0.22 | 0.056 | 0.47 | |
| Endrin | | | | 0.02 | | | 0.0864 | 0.0375 | 0.26 | |
| Heptachlor | | | | 0.01 | | | 0.52 | 0.0038 | 0.00007 | C |
| | | | | | | | 2 | 0.014 | | |
| Toxaphene | | | | 0.3 | | | 0.73 | 0.0002 | 0.00024 | C |
| Other Parameters: | | | | | | | | | | |
| Fecal Col.(col/100ml) | | | | | | | | | | |
| Chlorine | | | | 33 | | | 19 | 11 | | |
| Ammonia | | | | | | | | | | |
| Chlorides | | | | | | | | | | |
| Sulfates | | | | | | | | | | |
| TDS | | | | | | | | | | |

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| (*1) Toxic Parameters | (*12) WLAa Acute ug/L | (*13) WLAc Chronic ug/L | (*14) WLAh HHDW ug/L | (*15) LTAa Acute ug/L | (*16) LTAc Chronic ug/L | (*17) LTAh HHDW ug/L | (*18) Limiting A,C,HH ug/L | (*19) WQBL Avg 001 ug/L | (*20) WQBL Max 001 ug/L | (*21) WQBL Avg 001 lbs/day | (*22) WQBL Max 001 lbs/day | (*23) Need WQBL? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tetrachloroethylene | 914286.35 | 4565626.7 | 35656.517 | 292571.63 | 2419782.2 | 35656.517 | 35656.517 | 35656.517 | 84862.51 | 1284.9589 | 3058.2022 | no |
| Toluene | 900111.36 | 4494841.8 | 129524186 | 288035.64 | 2382266.2 | 129524186 | 288035.64 | 377326.68 | 895790.83 | 13597.775 | 32281.74 | no |
| 1,1,1-Trichloroethane | 3742195.3 | 18687216 | 4246694.6 | 1197502.5 | 9904224.7 | 4246694.6 | 1197502.5 | 1568728.3 | 3724232.7 | 56532.48 | 134210.7 | no |
| 1,1,2-Trichloroethane | 1275748.4 | 6370641.9 | 30719.461 | 408239.48 | 3376440.2 | 30719.461 | 30719.461 | 30719.461 | 73112.317 | 1107.0415 | 2634.7588 | no |
| Trichloroethylene | 2764121.5 | 13803058 | 153597.3 | 884518.88 | 7315620.5 | 153597.3 | 153597.3 | 153597.3 | 365561.58 | 5535.2075 | 13173.794 | no |
| Vinyl Chloride | --- | --- | 104226.74 | --- | --- | 104226.74 | 104226.74 | 104226.74 | 248059.65 | 3756.0337 | 8939.3602 | no |
| ACID COMPOUNDS | | | | | | | | | | | | |
| 2-Chlorophenol | 182857.27 | 913125.35 | 2123.3473 | 58514.326 | 483956.43 | 2123.3473 | 2123.3473 | 2123.3473 | 5053.5666 | 76.519364 | 182.11609 | no |
| 2,4-Dichlorophenol | 143167.32 | 714927.6 | 6370.0419 | 45813.542 | 378911.63 | 6370.0419 | 6370.0419 | 6370.0419 | 15160.7 | 229.55809 | 546.34826 | no |
| BASE NEUTRAL COMPOUNDS | | | | | | | | | | | | |
| Benzidine | 177187.28 | 884811.38 | 4.3884944 | 56699.928 | 468950.03 | 4.3884944 | 4.3884944 | 4.3884944 | 10.444617 | 0.1581488 | 0.3763941 | no |
| Hexachlorobenzene | --- | --- | 13.714045 | --- | --- | 13.714045 | 13.714045 | 13.714045 | 32.639427 | 0.494215 | 1.1762316 | no |
| Hexachlorabutadiene | 3614.6204 | 7220.0609 | 4937.0562 | 1156.6785 | 3826.6323 | 4937.0562 | 1156.6785 | 1515.2489 | 3597.2703 | 54.605236 | 129.63533 | no |
| PESTICIDES | | | | | | | | | | | | |
| Aldrin | 2126.2473 | --- | 2.1942472 | 680.39914 | --- | 2.1942472 | 2.1942472 | 2.1942472 | 5.2223083 | 0.0790744 | 0.1881971 | no |
| Hexachlorocyclohexane (gamma BHC, Lindane) | 3756.3703 | 1486.4831 | 6034.1798 | 1202.0385 | 787.83605 | 6034.1798 | 787.83605 | 1032.0652 | 2450.1701 | 37.192679 | 88.297124 | no |
| Chlordane | 1700.9979 | 30.437512 | 10.422674 | 544.31931 | 16.131881 | 10.422674 | 10.422674 | 10.422674 | 24.805965 | 0.3756034 | 0.893936 | no |
| 4,4'-DDT | 779.62402 | 7.0784911 | 10.422674 | 249.47969 | 3.7516003 | 10.422674 | 3.7516003 | 4.9145963 | 11.667477 | 0.177108 | 0.4204625 | no |
| 4,4'-DDE | 37209.328 | 74324.156 | 10.422674 | 11906.985 | 39391.803 | 10.422674 | 10.422674 | 10.422674 | 24.805965 | 0.3756034 | 0.893936 | no |
| 4,4'-DDD | 21.262473 | 42.470946 | 14.811169 | 6.8039914 | 22.509602 | 14.811169 | 6.8039914 | 8.9132287 | 21.160413 | 0.3212073 | 0.7625608 | no |
| Dieldrin | 168.25704 | 394.27195 | 2.742809 | 53.842252 | 208.96413 | 2.742809 | 2.742809 | 2.742809 | 6.5278854 | 0.098843 | 0.2352463 | no |
| Endosulfan | 155.9248 | 396.3955 | 9979.7324 | 49.895937 | 210.08961 | 9979.7324 | 49.895937 | 65.363677 | 155.17636 | 2.35552 | 5.5921124 | no |
| Endrin | 61.235923 | 265.44341 | 5520.703 | 19.595495 | 140.68501 | 5520.703 | 19.595495 | 25.670099 | 60.94199 | 0.9250769 | 2.196175 | no |
| Heptachlor | 368.54953 | 26.898266 | 3.8399326 | 117.93585 | 14.256081 | 3.8399326 | 3.8399326 | 3.8399326 | 9.1390396 | 0.1383802 | 0.3293448 | no |
| Toxaphene | 517.38685 | 1.4156982 | 13.165483 | 165.56379 | 0.7503201 | 13.165483 | 0.7503201 | 0.9829193 | 2.3334954 | 0.0354216 | 0.0840925 | no |
| Other Parameters: | | | | | | | | | | | | |
| Fecal Col.(col/100ml) | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | no |
| Chlorine | 13466.233 | 77863.402 | --- | 4309.1946 | 41267.603 | --- | 4309.1946 | 5645.0449 | 13401.595 | 203.43127 | 482.95516 | no |
| Ammonia | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | no |
| Chlorides | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | no |
| Sulfates | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | no |
| TDS | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | no |
| | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | no |
| | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | no |

APPENDIX B-2 LA0042731, AI No. 2889

Documentation and Explanation of Water Quality Screen
and Associated Lotus Spreadsheet

Each reference column is marked by a set of parentheses enclosing a number and asterisk, for example (*1) or (*19). These columns represent inputs, existing data sets, calculation points, and results for determining Water Quality Based Limits for an effluent of concern. The following represents a summary of information used in calculating the water quality screen:

Receiving Water Characteristics:

Receiving Water: Mississippi River
Critical Flow, Qrc (cfs): 141,955
Harmonic Mean Flow, Qrh (cfs): 366,748
Segment No.: 070201
Receiving Stream Hardness (mg/L): 154 mg/L
Receiving Stream TSS (mg/L): 53 mg/L
MZ Stream Factor, Fs: 1/3
Plume distance, Pf: N/A

Effluent Characteristics:

Company: Entergy Operations, Inc./River Bend Station
Facility flow, Qe (MGD): 4.321 MGD
Effluent Hardness: N/A
Effluent TSS: N/A
Pipe/canal width, Pw: N/A
Permit Number: LA0042731

Variable Definition:
Qrc, critical flow of receiving stream, cfs
Qrh, harmonic mean flow of the receiving stream, cfs
Pf = Allowable plume distance in feet, specified in LAC 33.IX.1115.D
Pw = Pipe width or canal width in feet
Qe, total facility flow , MGD
Fs, stream factor from LAC.IX.33.11 (1 for harmonic mean flow)
Cu, ambient concentration, ug/L
Cr, numerical criteria from LAC.IX.1113, Table 1
WLA, wasteload allocation
LTA, long term average calculations
WQBL, effluent water quality based limit
ZID, Zone of Initial Dilution in % effluent
MZ, Mixing Zone in % effluent

Formulas used in aquatic life water quality screen (dilution type WLA):

Streams:

$$\text{Dilution Factor} = \frac{Qe}{(Qrc \times 0.6463 \times Fs + Qe)}$$

$$WLA\ a,c,h = \frac{Cr}{\text{Dilution Factor}} - \frac{(Fs \times Qrc \times 0.6463 \times Cu)}{Qe}$$

Static water bodies (in the absence of a site specific dilution):

Discharge from a pipe:

$$\text{Critical Dilution} = \frac{(2.8)\ Pw\ \pi^{1/2}}{Pf}$$

$$WLA = \frac{(Cr-Cu)\ Pf}{(2.8)\ Pw\ \pi^{1/2}}$$

Discharge from a canal:

$$\text{Critical Dilution} = \frac{(2.38)(Pw^{1/2})}{(Pf)^{1/2}}$$

$$WLA = \frac{(Cr-Cu)\ Pf^{1/2}}{2.38\ Pw^{1/2}}$$

Formulas used in human health water quality screen, human health non-carcinogens (dilution type WLA):

Streams:

$$\text{Dilution Factor} = \frac{Qe}{(Qrc \times 0.6463 + Qe)}$$

$$WLA\ a,c,h = \frac{Cr}{\text{Dilution Factor}} - \frac{(Qrc \times 0.6463 \times Cu)}{Qe}$$

Formulas used in human health water quality screen, human health carcinogens (dilution type WLA):

$$\text{Dilution Factor} = \frac{Qe}{(Qrh \times 0.6463 + Qe)}$$

$$WLA\ a,c,h = \frac{Cr}{\text{Dilution Factor}} - \frac{(Qrh \times 0.6463 \times Cu)}{Qe}$$

Static water bodies in the absence of a site specific dilution (human health carcinogens and human health non-carcinogens):

Discharge from a pipe:

$$\text{Critical Dilution} = \frac{(2.8)\ Pw\ \pi^{1/2}}{Pf}$$

$$WLA = \frac{(Cr-Cu)\ Pf^{*}}{(2.8)\ Pw\ \pi^{1/2}}$$

Discharge from a canal:

$$\text{Critical Dilution} = \frac{(2.38)(Pw^{1/2})}{(Pf)^{1/2}}$$

$$WLA = \frac{(Cr-Cu)\ Pf^{1/2*}}{2.38\ Pw^{1/2}}$$

* Pf is set equal to the mixing zone distance specified in LAC 33:IX.1115 for the static water body type, i.e., lake, estuary, Gulf of Mexico, etc.

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If a site specific dilution is used, WLA are calculated by subtracting Cu from Cr and dividing by the site specific dilution for human health and aquatic life criteria.

$$WLA = \frac{(Cr-Cu)}{\text{site specific dilution}}$$

Longterm Average Calculations:
LTAa = WLAa X 0.32
LTAc = WLAc X 0.53
LTAh = WLAh

WQBL Calculations:
Select most limiting LTA to calculate daily max and monthly avg WQBL

If aquatic life LTA is more limiting:
Daily Maximum = Min(LTAa, LTAc) X 3.11
Monthly Average = Min(LTAc, LTAc) X 1.31

If human health LTA is more limiting:
Daily Maximum = LTAh X 2.38
Monthly Average = LTAh

Mass Balance Formulas:

mass (lbs/day): (ug/L) X 1/1000 X (flow, MGD) X 8.34 = lbs/day

$$\text{concentration(ug/L)}: \frac{\text{lbs/day}}{\text{(flow, MGD) X 8.34 X 1/1000}} = \text{ug/L}$$

The following is an explanation of the references in the spreadsheet.

(*1) Parameter being screened.
(*2) Instream concentration for the parameter being screened in ug/L. In the absence of accurate supporting data, the instream concentration is assumed to be zero (0).
(*3) Monthly average effluent or technolgy value in concentration units of ug/L or mass units of lbs/day. Units determined on a case-by-case basis as appropriate to the particular situation.
(*4) Daily maximum technology value in concentration units of ug/L or mass units of lbs/day. Units determined on a case-by-case basis as appropriate to the particular situation.
(*5) Minimum analytical Quantification Levels (MQL's). Established in a letter dated January 27, 1994 from Wren Stenger of EPA Region 6 to Kilren Vidrine of LDEQ and from the "Permitting Guidance Document for Implementing Louisiana Surface Water Quality Standards". The applicant must test for the parameter at a level at least as sensitive as the specified MQL. If this is not done, the MQL becomes the application value for screening purposes if the pollutant is suspected to be present

on-site and/or in the waste stream. Units are in ug/l or lbs/day depending on the units of the effluent data.

(*6) States whether effluent data is based on 95th percentile estimation. A "1" indicates that a 95th percentile approximation is being used, a "0" indicates that no 95th percentile approximation is being used.

(*7) 95th percentile approximation multiplier (2.13). The constant, 2.13, was established in memorandum of understanding dated October 8, 1991 from Jack Ferguson of Region 6 to Jesse Chang of LDEQ and included in the "Permitting Guidance Document for Implementing Louisiana Surface Water Quality Standards". This value is screened against effluent Water Quality Based Limits established in columns (*18) - (*21). Units are in ug/l or lbs/day depending on the units of the measured effluent data.

(*8) LAC 33.IX.1113.C.6, Table 1, Numerical Criteria for Specific Toxic Substances, freshwater (FW) or marine water (MW) (whichever is applicable) aquatic life protection, acute criteria. Units are specified. Some metals are hardness dependent. The hardness of the receiving stream shall generally be used, however a flow weighted hardness may be determined in site-specific situations. Dissolved metals are converted to Total metals using partition coefficients in accordance with the "Permitting Guidance Document for Implementing Louisiana Surface Water Quality Standards". Similar to hardness, the TSS of the receiving stream shall generally be used, however, a flow weighted TSS may be determined in site-specific situations.

Hardness Dependent Criteria:

| Metal | Formula |
|---|---|
| Cadmium | $e^{(1.1280[\ln(\text{hardness})] - 1.6774)}$ |
| Chromium III | $e^{(0.8190[\ln(\text{hardness})] + 3.6880)}$ |
| Copper | $e^{(0.9422[\ln(\text{hardness})] - 1.3884)}$ |
| Lead | $e^{(1.2730[\ln(\text{hardness})] - 1.4600)}$ |
| Nickel | $e^{(0.8460[\ln(\text{hardness})] + 3.3612)}$ |
| Zinc | $e^{(0.8473[\ln(\text{hardness})] + 0.8604)}$ |

Dissolved to Total Metal Multipliers for Freshwater Streams (TSS dependent):

| Metal | Multiplier |
|---|---|
| Arsenic | $1 + 0.48 \times TSS^{-0.73} \times TSS$ |
| Cadmium | $1 + 4.00 \times TSS^{-1.13} \times TSS$ |
| Chromium III | $1 + 3.36 \times TSS^{-0.93} \times TSS$ |
| Copper | $1 + 1.04 \times TSS^{-0.74} \times TSS$ |
| Lead | $1 + 2.80 \times TSS^{-0.80} \times TSS$ |
| Mercury | $1 + 2.90 \times TSS^{-1.14} \times TSS$ |
| Nickel | $1 + 0.49 \times TSS^{-0.57} \times TSS$ |
| Zinc | $1 + 1.25 \times TSS^{-0.70} \times TSS$ |

Dissolved to Total Metal Multipliers for Marine Environments (TSS dependent):

| Metal | Multiplier |
|---|---|

| | |
|---|---|
| Copper | $1 + (10^{4.86} \times TSS^{-0.72} \times TSS) \times 10^{-6}$ |
| Lead | $1 + (10^{6.06} \times TSS^{-0.85} \times TSS) \times 10^{-6}$ |
| Zinc | $1 + (10^{5.36} \times TSS^{-0.52} \times TSS) \times 10^{-6}$ |

If a metal does not have multiplier listed above, then the dissolved to total metal multiplier shall be 1.

(*9) LAC 33.IX.1113.C.6, Table 1, Numerical Criteria for Specific Toxic Substances, freshwater (FW) or marine water (MW) (whichever is applicable) aquatic life protection, chronic criteria. Units are specified. Some metals are hardness dependent. The hardness of the receiving stream shall generally be used, however a flow weighted hardness may be determined in site-specific situations. Dissolved metals are converted to Total metals using partition coefficients in accordance with the "Permitting Guidance Document for Implementing Louisiana Surface Water Quality Standards". Similar to hardness, the TSS of the receiving stream shall generally be used, however, a flow weighted TSS may be determined in site-specific situations.
Hardness dependent criteria:

| Metal | Formula |
|---|---|
| Cadmium | $e^{(0.7852[\ln(hardness)] - 3.4900)}$ |
| Chromium III | $e^{(0.8473[\ln(hardness)] + 0.7614)}$ |
| Copper | $e^{(0.8545[\ln(hardness)] - 1.3860)}$ |
| Lead | $e^{(1.2730[\ln(hardness)] - 4.7050)}$ |
| Nickel | $e^{(0.8460[\ln(hardness)] + 1.1645)}$ |
| Zinc | $e^{(0.8473[\ln(hardness)] + 0.7614)}$ |

Dissolved to total metal multiplier formulas are the same as (*8), acute numerical criteria for aquatic life protection.

(*10) LAC 33.IX.1113.C.6, Table 1, Numerical Criteria for Specific Toxic Substances, human health protection, drinking water supply (HHDW), non-drinking water supply criteria (HHNDW), or human health non-primarry contact recreation (HHNPCR) (whichever is applicable). A DEQ and EPA approved Use Attainability Analysis is required before HHNPCR is used, e.g., Monte Sano Bayou. Units are specified.

(*11) C if screened and carcinogenic. If a parameter is being screened and is carcinogenic a "C" will appear in this column.

(*12) Wasteload Allocation for acute aquatic criteria (WLAa). Dilution type WLAa is calculated in accordance with the "Permitting Guidance Document for Implementing Louisiana Surface Water Quality Standards". Negative values indicate that the receiving water is not meeting the acute aquatic numerical criteria for that parameter. Units are in ug/L.
Dilution WLAa formulas for streams:

$$WLAa = (Cr/\text{Dilution Factor}) - \frac{(Fs \times Qrc \times 0.6463 \times Cu)}{Qe}$$

Dilution WLAa formulas for static water bodies:
WLAa = (Cr-Cu)/Dilution Factor)
Cr represents aquatic acute numerical criteria from column (*8).
If Cu data is unavailable or inadequate, assume Cu=0.

If water quality standards are being applied at end-of-pipe, such as in the case of certain TMDL's, then a blank shall appear in this column.

(*13) Wasteload Allocation for chronic aquatic criteria (WLAc). Dilution type WLAc is calculated in accordance with the "Permitting Guidance Document for Implementing Louisiana Surface Water Quality Standards". Negative values indicate that the receiving water is not meeting the chronic aquatic numerical criteria for that parameter. Units are in ug/L.

Dilution WLAc formula:

$$WLAc = (Cr/\text{Dilution Factor}) - \frac{(Fs \times Qrc \times 0.6463 \times Cu)}{Qe}$$

Dilution WLAc formulas for static water bodies:

WLAc = (Cr-Cu)/Dilution Factor)

Cr represents aquatic chronic numerical criteria from column (*9).

If Cu data is unavailable or inadequate, assume Cu=0.

If water quality standards are being applied at end-of-pipe, such as in the case of certain TMDL's, then a blank shall appear in this column.

(*14) Wasteload Allocation for human health criteria (WLAh). Dilution type WLAh is calculated in accordance with the "Permitting Guidance Document for Implementing Louisiana Surface Water Quality Standards". Negative values indicate that the receiving water is not meeting the human health numerical criteria for that parameter. Units are in ug/L. Dilution WLAh formula:

$$WLAh = (Cr/\text{Dilution Factor}) - \frac{(Fs \times Qrc,Qrh \times 0.6463 \times Cu)}{Qe}$$

Dilution WLAh formulas for static water bodies:

WLAh = (Cr-Cu)/Dilution Factor)

Cr represents human health numerical criteria from column (*10).

If Cu data is unavailable or inadequate, assume Cu=0.

If water quality standards are being applied at end-of-pipe, such as in the case of certain TMDL's, then a blank shall appear in this column.

(*15) Long Term Average for aquatic numerical criteria (LTAa). WLAa numbers are multiplied by a multiplier specified in the "Permitting Guidance Document for Implementing Louisiana Surface Water Quality Standards" which is 0.32. WLAa X 0.32 = LTAa.

If water quality standards are being applied at end-of-pipe, such as in the case of certain TMDL's, then a blank shall appear in this column.

(*16) Long Term Average for chronic numerical criteria (LTAc). WLAc numbers are multiplied by a multiplier specified in the "Permitting Guidance Document for Implementing Louisiana Surface Water Quality Standards" which is 0.53. WLAc X 0.53 = LTAc.

If water quality standards are being applied at end-of-pipe, such as in the case of certain TMDL's, then a blank shall appear in this column.

(*17) Long Term Average for human health numerical criteria (LTAh). WLAh numbers are multiplied by a multiplier specified in the "Permitting Guidance Document for Implementing Louisiana Surface Water Quality Standards" which is 1. WLAc X 1 = LTAh.

If water quality standards are being applied at end-of-pipe, such as in the case of certain TMDL's, then a blank shall appear in this column.

(*18) Limiting Acute, Chronic or Human Health LTA's. The most limiting LTA is placed in this column. Units are consistent with the WLA calculation. If standards are being applied at end-of-pipe, such as in the case of certain TMDL's, then the type of limit, Aquatic or Human Health (HH), is indicated.

(*19) End of pipe Water Quality Based Limit (WQBL) monthly average in terms of concentration, ug/L. If aquatic life criteria was the most limiting LTA then the limiting LTA is multiplied by 1.31 to determine the average WQBL ($LTA_{limiting\ aquatic}$ X 1.31 = $WQBL_{monthly\ average}$). If human health criteria was the most limiting criteria then LTAh = $WQBL_{monthly\ average}$. If water quality standards are being applied at end-of-pipe, such as in the case of certain TMDL's, then either the human health criteria or the chronic aquatic life criteria shall appear in this column depending on which is more limiting.

(*20) End of pipe Water Quality Based Limit (WQBL) daily maxium in terms of concentration, ug/L. If aquatic life criteria was the most limiting LTA then the limiting LTA is multiplied by 3.11 to determine the daily maximum WQBL ($LTA_{limiting\ aquatic}$ X 3.11 = $WQBL_{daily\ max}$). If human health criteria was the most limiting criteria then LTAh is multiplied by 2.38 to determine the daily maximum WQBL ($LTA_{limiting\ aquatic}$ X 2.38 = $WQBL_{daily\ max}$). If water quality standards are being applied at end-of-pipe, such as in the case of certain TMDL's, then either the human health criteria or the acute aquatic life criteria shall appear in this column depending on which is more limiting.

(*21) End of pipe Water Quality Based Limit (WQBL) monthly average in terms of mass, lbs/day. The mass limit is determined by using the mass balance equations above. Monthly average WQBL, ug/l/1000 X facility flow, MGD X 8.34 = monthly average WQBL, lbs/day.

(*22) End of pipe Water Quality Based Limit (WQBL) monthly average in terms of mass, lbs/day. Mass limit is determined by using the mass balance equations above. Daily maximum WQBL, ug/l/1000 X facility flow, MGD X 8.34 = daily maximum WQBL, lbs/day.

(*23) Indicates whether the screened effluent value(s) need water quality based limits for the parameter of concern: A "yes" indicates that a water quality based limit is needed in the permit; a "no" indicates the reverse.

Appendix C

Previous LPDES Permit

Effluent Limitations

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Outfall 001, the continuous discharge of cooling tower blowdown and previously monitored effluent from Internal Outfalls 101, 201, 301, 401, 501 and 601

Such discharges shall be limited and monitored by the permittee as specified below:

| Effluent Characteristic | | Discharge Limitations | | | | Monitoring Requirements | |
|---|---|---|---|---|---|---|---|
| | | (lbs/day, UNLESS STATED) | | Other Units (mg/L, UNLESS STATED) | | | |
| | STORET Code | Monthly Average | Daily Maximum | Monthly Average | Daily Maximum | Measurement Frequency | Sample Type |
| Flow-MGD | 50050 | Report | Report | --- | --- | Continuous | Recorder |
| Temperature (°F) (*1) | 00011 | 105 | 110 | --- | --- | Continuous | Recorder |
| Free Available Chlorine (*2) | 50064 | 0.63 | 1.64 | 0.2 | 0.5 | 1/week | Grab |
| Total Chromium | 01034 | --- | --- | 0.2 | 0.2 | 1/year | Grab |
| Total Zinc | 01092 | --- | --- | 1.0 | 1.0 | 1/week | Grab |
| pH Minimum/Maximum Values (Standard Units) | 00400 | --- | --- | 6.0 (*3) (Min) | 9.0 (*3) (Max) | 1/week | Grab |

| WHOLE EFFLUENT (ACUTE) TOXICITY TESTING | STORET CODE | | | (Percent %, UNLESS STATED) Monthly Avg Min | 48-Hour Min | Measurement Frequency(*4) | Sample Type |
|---|---|---|---|---|---|---|---|
| NOEC, Pass/Fail [0/1], Lethality, Static Renewal, 48-Hour Acute, Pimephales promelas | TEM6C | --- | --- | Report | Report | 1/year | 24-hour Composite |
| NOEC, Value [%], Lethality, Static Renewal, 48-Hour Acute, Pimephales promelas | TOM6C | --- | --- | Report | Report | 1/year | 24-hour Composite |
| NOEC, Value [%], Coefficient of Variation, Static Renewal, 48-Hour Acute, Pimephales promelas | TQM6C | --- | --- | Report | Report | 1/year | 24-hour Composite |
| NOEC, Pass/Fail [0/1], Lethality, Static Renewal, 48-Hour Acute, Daphnia pulex | TEM3D | --- | --- | Report | Report | 1/year | 24-hour Composite |

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| NOEC, Value [%], Lethality, Static Renewal, 48-Hour Acute, *Daphnia pulex* | TOM3D | --- | --- | Report | Report | 1/year | 24-hour Composite |
| NOEC, Value [%], Coefficient of Variation, Static Renewal, 48-Hour Acute, *Daphnia pulex* | TQM3D | --- | --- | Report | Report | 1/year | 24-hour Composite |

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

- Outfall 001, at the exposed vacuum-break chamber of the buried 30-inch diameter discharge pipeline prior to discharge to the Mississippi River. As an alternative, the permittee may report temperature measurements based on the balance of plant computer points, and flow may be measured from the auxiliary control room flow recorder.

FOOTNOTE(S):

(*1) See Part II.N.

(*2) Samples shall be representative of periods of chlorination.

(*3) The permittee shall report on the Discharge Monitoring Reports both the minimum and maximum instantaneous pH values measured.

(*4) The permittee must collect the 24-hour composite samples such that the effluent samples are representative of any periodic episode of chlorination, biocide usage or other potentially toxic substance discharged on an intermittent basis. However, if no biofouling agent or chlorine is used during the monitoring period, the permittee must still conduct the required annual testing.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Internal Outfall 101, The intermittent discharge of low level radioactive low volume wastewater from the liquid radwaste wastewater system (LWS) which includes equipment and building floor drain sumps, equipment washing, personnel decontamination, laboratory drains, filter press effluent, RO unit wastewater, other low volume wastewater sources as defined in 40 CFR 423 and maintenance wastewaters.

Such discharges shall be limited and monitored by the permittee as specified below:

| Effluent Characteristic | | Discharge Limitations | | | | Monitoring Requirements | |
|---|---|---|---|---|---|---|---|
| | | (lbs/day, UNLESS STATED) | | Other Units (mg/L, UNLESS STATED) | | | |
| | STORET Code | Monthly Average | Daily Maximum | Monthly Average | Daily Maximum | Measurement Frequency(*1) | Sample Type |
| Flow-MGD | 50050 | Report | Report | --- | --- | 1/month | Estimate |
| Oil & Grease | 03582 | --- | --- | 15 | 20 | 1/month | Grab |
| TSS | 00530 | --- | --- | 30 | 100 | 1/month | Grab |

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Internal Outfall 101, at the point of discharge from the Radwaste building prior to combining with other westestreams and the waters of Final Outfall 001

FOOTNOTE(S):

(*1) When discharging.

(*2) The permittee shall monitor all low volume wastewater sources that contribute to Outfall 001 from various locations on the property once per month when discharging.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Internal Outfall 201, the intermittent discharge of treated sanitary wastewater; also, during maintenance activities, sanitary wastewater may be combined with wastewater from floor drains of the control building and the diesel generator oil/water separator (and other low volume wastewaters as defined in 40 CFR 423), and maintenance wastewaters may be routed to Outfall 002.

Such discharges shall be limited and monitored by the permittee as specified below:

| Effluent Characteristic | | Discharge Limitations | | | | Monitoring Requirements | |
|---|---|---|---|---|---|---|---|
| | | (lbs/day, UNLESS STATED) | | Other Units (mg/L, UNLESS STATED) | | | |
| | STORET Code | Monthly Average | Weekly Average | Monthly Average | Weekly Average | Measurement Frequency(*1) | Sample Type |
| Flow-MGD | 50050 | --- | Report | --- | --- | 1/6 months | Estimate |
| $BOD_5$ | 00310 | --- | --- | --- | 45 | 1/6 months | Grab |
| TSS | 00530 | --- | --- | --- | 45 | 1/6 months | Grab |
| Fecal Coliform Colonies/100 ml | 74055 | --- | --- | --- | 400 | 1/6 months | Grab |

In addition to the above monitoring requirements, the following limitations and monitoring frequencies are applicable during maintenance activities:

| | STORET Code | Monthly Average | Daily Maximum | Monthly Average | Daily Maximum | Measurement Frequency(*2) | Sample Type |
|---|---|---|---|---|---|---|---|
| Flow-MGD | 50050 | Report | Report | --- | --- | 1/week | Estimate |
| TSS | 00530 | --- | --- | 30 | 45 | 1/week | Grab |
| Oil & Grease | 03582 | --- | --- | 15 | 20 | 1/week | Grab |

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Internal Outfall 201, at the point of discharge from the sewage treatment plant prior to combining with the waters of Final Outfall 001 or Final Outfall 002.

FOOTNOTE(S):

(*1) When discharging.

(*2) Samples shall be representative of discharges occurring during maintenance activities. During maintenance activities, flow, TSS, and oil and grease shall be monitored and reported as daily maximum rather than weekly average.

(*3) The permittee shall report on the Discharge Monitoring Reports both the minimum and maximum instantaneous pH values measured.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Internal Outfall 301, the intermittent discharge of mobile metal cleaning wastewater generated from cleaning processes of internal components of plant equipment.

Such discharges shall be limited and monitored by the permittee as specified below:

| Effluent Characteristic | | Discharge Limitations | | | | Monitoring Requirements | |
|---|---|---|---|---|---|---|---|
| | | (lbs/day, UNLESS STATED) | | Other Units (mg/L, UNLESS STATED) | | | |
| | STORET Code | Monthly Average | Daily Maximum | Monthly Average | Daily Maximum | Measurement Frequency(*1) | Sample Type |
| Flow-MGD | 50050 | Report | Report | --- | --- | 1/week | Estimate |
| TSS | 00530 | --- | --- | 30 | 100 | 1/week | Grab |
| Oil & Grease | 03582 | --- | --- | 15 | 20 | 1/week | Grab |
| Total Copper | 01042 | --- | --- | 1.0 | 1.0 | 1/week | Grab |
| Total Iron | 01045 | --- | --- | 1.0 | 1.0 | 1/week | Grab |

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Internal Outfall 301, at the point of discharge of metal cleaning wastewaters prior to combining with other waters and the waters of Final Outfall 001.

FOOTNOTE(S):

(*1) When discharging.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Internal Outfall 401. The intermittent internal discharge of low volume wastewater treatment systems to Final Outfall 001 via the common header. The low volume waste management systems receive effluent from the following sources, including but not limited to: ion exchange resin backwash and regeneration, auxiliary boiler blowdown, floor washdown, equipment washing, personnel decontamination, laboratory drains, filter press effluent, and maintenance wastewaters and other low volume wastewater sources as defined in 40 CFR 423. During maintenance activities, Internal Outfall 401 may be discharged via the cooling tower flume rather than the common discharge header. During maintenance activities, reverse osmosis reject water from the makeup water polishing system may be discharged via Outfall 401 rather than Outfall 003.

Such discharges shall be limited and monitored by the permittee as specified below:

| Effluent Characteristic | | Discharge Limitations | | | | Monitoring Requirements | |
|---|---|---|---|---|---|---|---|
| | | (lbs/day, UNLESS STATED) | | Other Units (mg/L, UNLESS STATED) | | | |
| | STORET Code | Monthly Average | Daily Maximum | Monthly Average | Daily Maximum | Measurement Frequency(*1) | Sample Type |
| Flow-MGD | 50050 | Report | Report | --- | --- | 1/month | Estimate |
| Oil & Grease | 03582 | --- | --- | 15 | 20 | 1/month | Grab |
| TSS | 00530 | --- | --- | 30 | 100 | 1/month | Grab |

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Internal Outfall 401, at the makeup water pump house off one of two discharge pumps, after filtration prior to combining with other wastestreams and the waters of Final Outfall 001

FOOTNOTE(S):

(*1) When discharging.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Internal Outfall 501, The intermittent discharge of low volume wastewater including but not limited to wastewaters from the mobile standby service water reverse osmosis filtration unit and standby cooling tower reject.

Such discharges shall be limited and monitored by the permittee as specified below:

| Effluent Characteristic | Discharge Limitations | | | | | Monitoring Requirements | |
|---|---|---|---|---|---|---|---|
| | | (lbs/day, UNLESS STATED) | | Other Units (mg/L, UNLESS STATED) | | | |
| | STORET Code | Monthly Average | Daily Maximum | Monthly Average | Daily Maximum | Measurement Frequency(*1) | Sample Type |
| Flow-MGD | 50050 | Report | Report | --- | --- | 1/month | Estimate |
| Oil & Grease | 03582 | --- | --- | 15 | 20 | 1/month | Grab |
| TSS | 00530 | --- | --- | 30 | 100 | 1/month | Grab |

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Internal Outfall 501, at the northwest end of the flume at the point of discharge of low volume wastewater prior to combining with other wastestreams and the waters of Final Outfall 001

FOOTNOTE(S):

(*1) When discharging.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Internal Outfall 601, The intermittent discharge of low volume wastewater including but not limited to wastewaters from filter backwash from service water polishing and feed-and-bleed from the service water system.

Such discharges shall be limited and monitored by the permittee as specified below:

| Effluent Characteristic | | Discharge Limitations | | | | Monitoring Requirements | |
|---|---|---|---|---|---|---|---|
| | | (lbs/day, UNLESS STATED) | | Other Units (mg/L, UNLESS STATED) | | | |
| | STORET Code | Monthly Average | Daily Maximum | Monthly Average | Daily Maximum | Measurement Frequency(*1) | Sample Type |
| Flow-MGD | 50050 | Report | Report | --- | --- | 1/month | Estimate |
| Oil & Grease | 03582 | --- | --- | 15 | 20 | 1/month | Grab |
| TSS | 00530 | --- | --- | 30 | 100 | 1/month | Grab |

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Internal Outfall 601, at the southeast end of the flume at the point of discharge of low volume wastewater prior to combining with other wastestreams and the waters of Final Outfall 001

FOOTNOTE(S):

(*1) When discharging.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Outfall 002, the intermittent discharge of stormwater runoff from the industrial materials storage area, low-level storage building and sewage treatment plant area; air conditioning condensate; potable water. During periods of maintenance activities, previously monitored treated wastewater (from Internal Outfall 201) may be discharged through Outfall 002.

Such discharges shall be limited and monitored by the permittee as specified below:

| Effluent Characteristic | | Discharge Limitations | | | | Monitoring Requirements | |
|---|---|---|---|---|---|---|---|
| | | | | Other Units | | | |
| | | (lbs/day, UNLESS STATED) | | (mg/L, UNLESS STATED) | | | |
| | STORET Code | Monthly Average | Daily Maximum | Monthly Average | Daily Maximum | Measurement Frequency(*1) | Sample Type |
| Flow-MGD | 50050 | --- | Report | --- | --- | 1/quarter | Estimate |
| TOC | 00680 | --- | --- | --- | 50 | 1/quarter | Grab |
| Oil and Grease | 03582 | --- | --- | --- | 15 | 1/quarter | Grab |
| pH Minimum/Maximum Values (Standard Units) | 00400 | --- | --- | 6.0 (*2) (Min) | 9.0 (*2) (Max) | 1/quarter | Grab |

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Outfall 002, at the point of discharge from the plant drainage ditch system where the stormwater runoff from the sewage treatment plant area converges with that from the industrial materials storage area and the Low Level Waste Storage Building prior to combining with the waters of Grant's Bayou.

FOOTNOTE(S):

(*1) When discharging.

(*2) The permittee shall report on the Discharge Monitoring Reports both the minimum and maximum instantaneous pH values measured.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Outfall 003, the intermittent discharge of stormwater runoff from the reactor building, turbine building, services building, clarifiers, main transformer yard and auxiliary transformer yard; maintenance wastewaters including but not limited to hydrostatic test water and flushing of piping systems and vessels (including fire protection water supply system and automatic sprinkler system) and reverse osmosis reject water from standby service water polishing system; low volume wastewaters including but not limited to effluent from floor drains within power plant buildings (domestic potable water, well water, reject mobile reverse osmosis and fire suppression water treated in the fire pump house oil/water separator), air compressor condensate; reverse osmosis reject water from makeup water polishing system; air conditioning condensate and de minimis quantities of cooling tower drift/mist.

Such discharges shall be limited and monitored by the permittee as specified below:

| Effluent Characteristic | | Discharge Limitations | | | | Monitoring Requirements | |
|---|---|---|---|---|---|---|---|
| | | (lbs/day, UNLESS STATED) | | Other Units (mg/L, UNLESS STATED) | | | |
| | STORET Code | Monthly Average | Daily Maximum | Monthly Average | Daily Maximum | Measurement Frequency(*1) | Sample Type |
| Flow-MGD | 50050 | --- | Report | --- | --- | 1/quarter (*2) | Estimate |
| TOC | 00680 | --- | --- | --- | 50 | 1/quarter | Grab |
| Oil and Grease | 03582 | --- | --- | --- | 15 | 1/quarter (*2) | Grab |
| TSS | 00530 | --- | --- | --- | 100 | 1/month (*3) | Grab |
| pH Minimum/Maximum Values (Standard Units) | 00400 | --- | --- | 6.0 (*4) (Min) | 9.0 (*4) (Max) | 1/quarter (*2) | Grab |

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Outfall 003, at the point of discharge from the plant drainage ditch system along the East Creek prior to combining with the waters of Grant's Bayou

FOOTNOTE(S):

(*1) When discharging.

(*2) Sampling shall be monthly when discharging low volume wastewaters.

(*3) When discharging low volume wastewater, total suspended solids shall be monitored and reported as required above.

(*4) The permittee shall report on the Discharge Monitoring Reports both the minimum and maximum instantaneous pH values measured.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Outfall 004, the intermittent discharge of stormwater runoff from the office areas, warehouse areas, materials storage areas and equipment/vehicle maintenance areas; maintenance wastewaters including but not limited to hydrostatic testing and flushing of piping systems and vessels (i.e. fire protection water supply system and automatic sprinkler system); air conditioning condensate; potable water; and previously monitored effluent from Internal Outfall 104.

Such discharges shall be limited and monitored by the permittee as specified below:

| Effluent Characteristic | | Discharge Limitations | | | | Monitoring Requirements | |
|---|---|---|---|---|---|---|---|
| | | (lbs/day, UNLESS STATED) | | Other Units (mg/L, UNLESS STATED) | | | |
| | STORET Code | Monthly Average | Daily Maximum | Monthly Average | Daily Maximum | Measurement Frequency(*1) | Sample Type |
| Flow-MGD | 50050 | --- | Report | --- | --- | 1/quarter | Estimate |
| TOC | 00680 | --- | --- | --- | 50 | 1/quarter | Grab |
| Oil and Grease | 03582 | --- | --- | --- | 15 | 1/quarter | Grab |
| pH Minimum/Maximum Values (Standard Units) | 00400 | --- | --- | 6.0 (*2) (Min) | 9.0 (*2) (Max) | 1/quarter | Grab |

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Outfall 004, at the point of discharge from the plant drainage ditch system along the West Creek prior to combining with the waters of Grant's Bayou.

FOOTNOTE(S):

(*1) When discharging.

(*2) The permittee shall report on the Discharge Monitoring Reports both the minimum and maximum instantaneous pH values measured.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Outfall 104, the intermittent discharge of vehicle washwater.

Such discharges shall be limited and monitored by the permittee as specified below:

| Effluent Characteristic | STORET Code | Discharge Limitations (lbs/day, UNLESS STATED) Monthly Average | Daily Maximum | Other Units (mg/L, UNLESS STATED) Monthly Average | Daily Maximum | Monitoring Requirements Measurement Frequency (*1) | Sample Type |
|---|---|---|---|---|---|---|---|
| Flow-MGD | 50050 | Report | Report | --- | --- | 1/quarter | Estimate |
| COD | 00340 | --- | --- | --- | 300 | 1/quarter | Grab |
| TSS | 00530 | --- | --- | --- | 45 | 1/quarter | Grab |
| Oil & Grease | 03582 | --- | --- | --- | 15 | 1/quarter | Grab |
| pH Minimum/Maximum Values (Standard Units) | 00400 | --- | --- | 6.0 (*2) (Min) | 9.0 (*2) (Max) | 1/quarter | Grab |
| Soaps and/or Detergents(*3) | ----- | --- | --- | Report | --- | 1/quarter | Inventory Calculation |

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Internal Outfall 104, at the point of discharge from the area where vehicles will be washed prior to combining with the waters of Final Outfall 004.

FOOTNOTE(S):

(*1) When discharging.

(*2) The permittee shall report on the Discharge Monitoring Reports both the minimum and maximum instantaneous pH values measured.

(*3) The quantity and type of all soaps and/or detergents used during the sampling month shall be recorded. Records of the quantity and types of soaps and/or detergents used shall be retained for three (3) years following Part III.C.3. Additionally, a Material Safety Data Sheet for each material used shall be retained. No DMR reporting shall be required.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Outfall 005, the intermittent discharge of stormwater runoff from the cooling tower yard, air conditioning condensate, and de minimis quantities of cooling tower drift/mist.

Such discharges shall be limited and monitored by the permittee as specified below:

| Effluent Characteristic | | Discharge Limitations | | | | Monitoring Requirements | |
|---|---|---|---|---|---|---|---|
| | | (lbs/day, UNLESS STATED) | | Other Units (mg/L, UNLESS STATED) | | | |
| | STORET Code | Monthly Average | Daily Maximum | Monthly Average | Daily Maximum | Measurement Frequency(*1) | Sample Type |
| Flow-MGD | 50050 | --- | Report | --- | --- | 1/quarter | Estimate |
| TOC | 00680 | --- | --- | --- | 50 | 1/quarter | Grab |
| Oil and Grease | 03582 | --- | --- | --- | 15 | 1/quarter | Grab |
| pH Minimum/Maximum Values (Standard Units) | 00400 | --- | --- | 6.0 (*2) (Min) | 9.0 (*2) (Max) | 1/quarter | Grab |

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Outfall 005, at the point of discharge from the stormwater drainage ditch east of the cooling towers and prior to combining with the waters of Grant's Bayou

FOOTNOTE(S):

(*1) When discharging.

(*2) The permittee shall report on the Discharge Monitoring Reports both the minimum and maximum instantaneous pH values measured.

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

During the period beginning the effective date and lasting through the expiration date the permittee is authorized to discharge from:

Outfall 006, the intermittent discharge of clarifier underflow.

Such discharges shall be limited and monitored by the permittee as specified below:

| Effluent Characteristic | | Discharge Limitations | | | | Monitoring Requirements | |
|---|---|---|---|---|---|---|---|
| | | | | Other Units | | | |
| | | (lbs/day, UNLESS STATED) | | (mg/L, UNLESS STATED) | | | |
| | STORET Code | Monthly Average | Daily Maximum | Monthly Average | Daily Maximum | Measurement Frequency(*1) | Sample Type |
| Flow-MGD | 50050 | Report | Report | --- | --- | 1/day | Estimate |

COAGULANTS:

The quantity and types of all coagulants (clarifying agents) used in the intake raw river water treatment clarification system during the sampling month shall be recorded. Records of the quantity and type of coagulants used shall be retained for three (3) years following Part III.C.3. No DMR reporting shall be required.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):

Outfall 006, at the point of discharge of the underflow from the raw river water intake clarifier.

FOOTNOTE(S):

(*1) When discharging.

# SECTION VIII – ENVIRONMENTAL IMPACT QUESTIONNAIRE

Those applicants that are **(1) major new facilities or (2) existing major facilities applying for a substantial modification** to their permit must complete this questionnaire.

There is no requirement that the information furnished in response to this questionnaire be certified by a professional engineer or other expert. However, simple **"yes"** or **"no"** answers **will not be acceptable**. A measured response should be given for each question posed, taking into consideration appropriate factors such as: the environmental sensitivity of the area, both for the proposed site and alternative sites; impacts on the economy of the area, both favorable and unfavorable; availability of raw materials, fuels and transportation and the impact of potential sites on their availability and economics; relationship of the facility to other facilities, either within or independent of the company, and the effects of location on these relationships; and other factors which may be appropriate on a case-by-case basis. **(Attach any additional pages if needed.)**

1. Have the potential and real adverse environmental effects of the proposed facility been avoided to the maximum extent possible?

   **Yes.** River Bend Station is an existing facility that has been in operation since 1986. During the licensing process of the facility, Entergy and the Nuclear Regulatory Commission assessed the environmental impacts from the operation of River Bend Station prior to start-up. These results are published in NUREG-1073, Final Environmental Statement Related to the Operation of River Bend Station (January 1985). Based on this assessment and the incorporation of safeguards, engineering controls, and operations and maintenance programs, potential and real adverse environmental effects of the facility have been avoided to the maximum extent possible.

2. Does a cost benefit analysis of the environmental-impact costs balanced against the social and economic benefits of the proposed facility demonstrate that the latter outweighs the former?

   **Yes.** River Bend Station is an existing facility and no measurable adverse environmental effects have been demonstrated as published in NUREG-1073 and are not anticipated from continued operation of the facility. Therefore, no cost-specific analysis is warranted. However, it is obvious that social and economic benefits outweigh the environmental impact costs since no adverse environmental impacts are demonstrated or anticipated.

3. Are there alternative projects which would offer more protection to the environment than the proposed facility without unduly curtailing nonenvironmental benefits?

   **No.** The present facility is designed and operated in accordance with a level of technology necessary to comply with and exceed the applicable effluent guidelines and other environmental standards that apply to the site. Because the effluent quality resulting from the present treatment levels at the plant is within the established criteria for discharge, no alternatives to the present system are necessary.

4. Are there alternative sites which would offer more protection to the environment than the proposed facility site without unduly curtailing nonenvironmental benefits?

   **No.** River Bend Station is an existing facility that discharges wastewater to the Mississippi River, Thompson Creek, Alligator Bayou, and Grant's Bayou. As no real environmental impacts have resulted or have been demonstrated or are anticipated to result, no alternative discharge locations are considered economically feasible or necessary.

5. Are there mitigating measures which would offer more protection to the environment than the facility as proposed without unduly curtailing nonenvironmental benefits?

   **No.** No measurable adverse environmental impacts have resulted from existing wastewater discharges and none are anticipated to result from the continuing operation of the facility; therefore, no additional mitigation measures are deemed necessary. Should discharge criteria be re-defined in the future, appropriate environmental controls and treatment measures would be implemented to meet the revised criteria as necessary.

## SIGNATORY AND AUTHORIZATION

Pursuant to the Water Quality Regulations (specifically LAC 33:IX.2333.A and B) which became effective October 20, 1995, the state permit application must be signed by a responsible individual as described in LAC 33:IX.2333.A and B and that person shall make the following certification:

> "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment for knowing violations."
>
> The applicant for this permit hereby authorizes the Department of Environmental Quality to publish the public notice for a draft permit once in the appropriate newspaper(s). In accordance with LAC 33:IX.2781.A, the applicant agrees to be responsible for the cost of publication. The newspaper(s) is authorized to invoice the applicant directly.

Signature: Eric W Olson

Printed Name: Eric Olson

Title: Vice President –Site

Date: April 28, 2011

Telephone: (225) 381-4374

# Attachment B

# Threatened and Endangered Species Consultation

## Attachment B

### Threatened and Endangered Species Consultation

- Rick Buckley, Entergy Services, Inc., to Brad Rieck, U.S. Fish and Wildlife Service—Louisiana Field Office. July 25, 2016.
- Rick Buckley, Entergy Services, Inc., to Carolyn Michon, Louisiana Natural Heritage Program—Department of Wildlife and Fisheries. August 10, 2016.
- Monica Sikes, U.S. Fish and Wildlife Service—Louisiana Field Office (stamp of receipt/review/finding), to Rick Buckley, Entergy Services, Inc. August 26, 2016.
- Nicole Lorenz (for Amity Bass), Louisiana Natural Heritage Program—Department of Wildlife and Fisheries, to Rick Buckley, Entergy Services, Inc. November 10, 2016.

Entergy

**Entergy Services, Inc**
1340 Echelon Parkway
Jackson, Mississippi 39213

July 25, 2016

Mr. Brad Rieck
Deputy Field Supervisor
U.S. Fish and Wildlife Service
Louisiana Field Office
646 Cajundome Blvd., Suite 400
Lafayette, LA 70506

SUBJECT: River Bend Station Unit 1
License Renewal Application

CEXO 2016-00100

Dear Mr. Rieck,

In 2017, Entergy Louisiana, LLC and Entergy Operations, Inc. (collectively referred to as "Entergy") plans to apply to the Nuclear Regulatory Commission (NRC) for renewal of the operating license for the River Bend Station Unit 1 (RBS), which is located on the east bank of the Mississippi River in the southern portion of West Feliciana Parish, Louisiana, approximately 24 miles north-northwest of Baton Rouge, Louisiana. The existing operating license for RBS was issued for a 40-year term that expires in 2025. If the NRC approves the application, Entergy will then have the option to continue operating RBS until 2045. In conjunction with this effort, Entergy is gathering information relative to this license renewal project to assist with the preparation of the application.

The NRC requires that the license renewal application for RBS include an environmental report that assesses potential environmental impacts from plant operations during the license renewal term. One of these potential environmental impacts would be the effect of license renewal on Federally-listed threatened, endangered or candidate species and designated critical habitat located on the RBS property and its immediate environs (Figure 1). Accordingly, the NRC requires that the environmental report for each license renewal application assess such a potential effect (10 CFR 51.53). Later, during its review of the license renewal environmental report pursuant to the National Environmental Policy Act, the NRC may request information from your office to ensure compliance with Section 7 of the Endangered Species Act.

Entergy is contacting you now in order to obtain input regarding issues that may need to be addressed in the RBS license renewal environmental report, and to assist in identifying any information your staff believes would be helpful to expedite NRC's review.

RBS is located on approximately 3,342 acres of Entergy owned land (Figure 1) that consists primarily of forest, woody wetlands and shrub. The RBS property is zoned as an industrial area by West Feliciana Parish. The land in the vicinity of the RBS site consists primarily of wetlands, forest, pasture, and shrub. Transmission lines that connect RBS to the regional electricity grid which the NRC considers to be within the scope of its environmental review for renewal of the RBS operating license are located entirely within the Entergy property. There is limited right-of-way (~8 acres) associated with the transmission lines since the lines span part of the RBS industrial area where vegetation is sparse.

Based on review of information available, Entergy has included in Table 1 threatened and endangered species identified as being Federally-listed in East Baton Rouge, East Feliciana, Pointe Coupee and West Feliciana parishes, which portions of are located within a 6-mile radius of RBS (Figure 1). No candidate species were identified. As shown in Table 1, there are four Federally-listed species which are either threatened or endangered within these four parishes. Three of these species (Alabama heelsplitter, Atlantic sturgeon, and West Indiana manatee) are not anticipated to be present in the "action area," defined as the RBS site and the portion of the Mississippi River that would be affected by water withdrawal and discharge effluent, because there are no documented known/possible occurrences in West Feliciana Parish, and the Mississippi River at RBS would not provide suitable habitat for these species. Although the remaining species (pallid sturgeon) could transit the "action area," the pallid sturgeon is a deepwater, channel-dwelling species and would be unaffected by water withdrawals and discharges. In addition during Entergy's review, no designated critical habitat was identified for the species listed in Table 1 within the immediate environs (6-mile radius) of RBS.

However, Entergy does not expect that RBS's operations during the license renewal term would result in adverse effects to threatened, endangered, or candidate species and designated critical habitats even if present since there are no plans to alter current operations during the 20-year license renewal period, and any maintenance activities necessary to support continued operation of RBS would be limited to currently developed areas of the site. Although administrative procedural controls are in place to comply with applicable state and federal laws to preserve biological resources when facility expansion or land disturbance activities do occur, no expansion is planned or needed in support of license renewal.

After your review of the information provided in this letter, I would appreciate you sending a letter detailing any concerns you may have about potential impacts to threatened, endangered or candidate species and designated critical habitat on the property where RBS is located, or the immediate environs, or alternatively, confirming our conclusion that these species and habitats will not be adversely affected as a result of renewing the RBS operating license for an additional 20 years. Entergy will include copies of this letter and your response in the environmental report submitted to the NRC as part of the RBS license renewal application.

If you have any questions, please contact me at (601) 368-5823 or through my email address, rbuckle@entergy.com.

Rick Buckley

Rick Buckley, CHMM, REM
Sr. Project Manager, Environmental

## Table 1

**Federal-Listed Species, East Baton Rouge, East Feliciana, Pointe Coupee and West Feliciana Parishes**

| Common Name | Applicable Parish | Federal Status | Occurrence in Parish | Species Observed on Entergy Property |
|---|---|---|---|---|
| ***Mammals*** | | | | |
| West Indian Manatee | EBR | E | Seasonal | No |
| ***Fish*** | | | | |
| Atlantic Sturgeon | EBR/EF | T | Known/Possible | No |
| Pallid Sturgeon | EBR/EF/PC/WF | E | Known | No |
| ***Mollusks*** | | | | |
| Alabama Heelsplitter Mussel | EBR/EF | T | Known | No |

EBR = East Baton Rouge

EF = East Feliciana

PC = Pointe Coupee

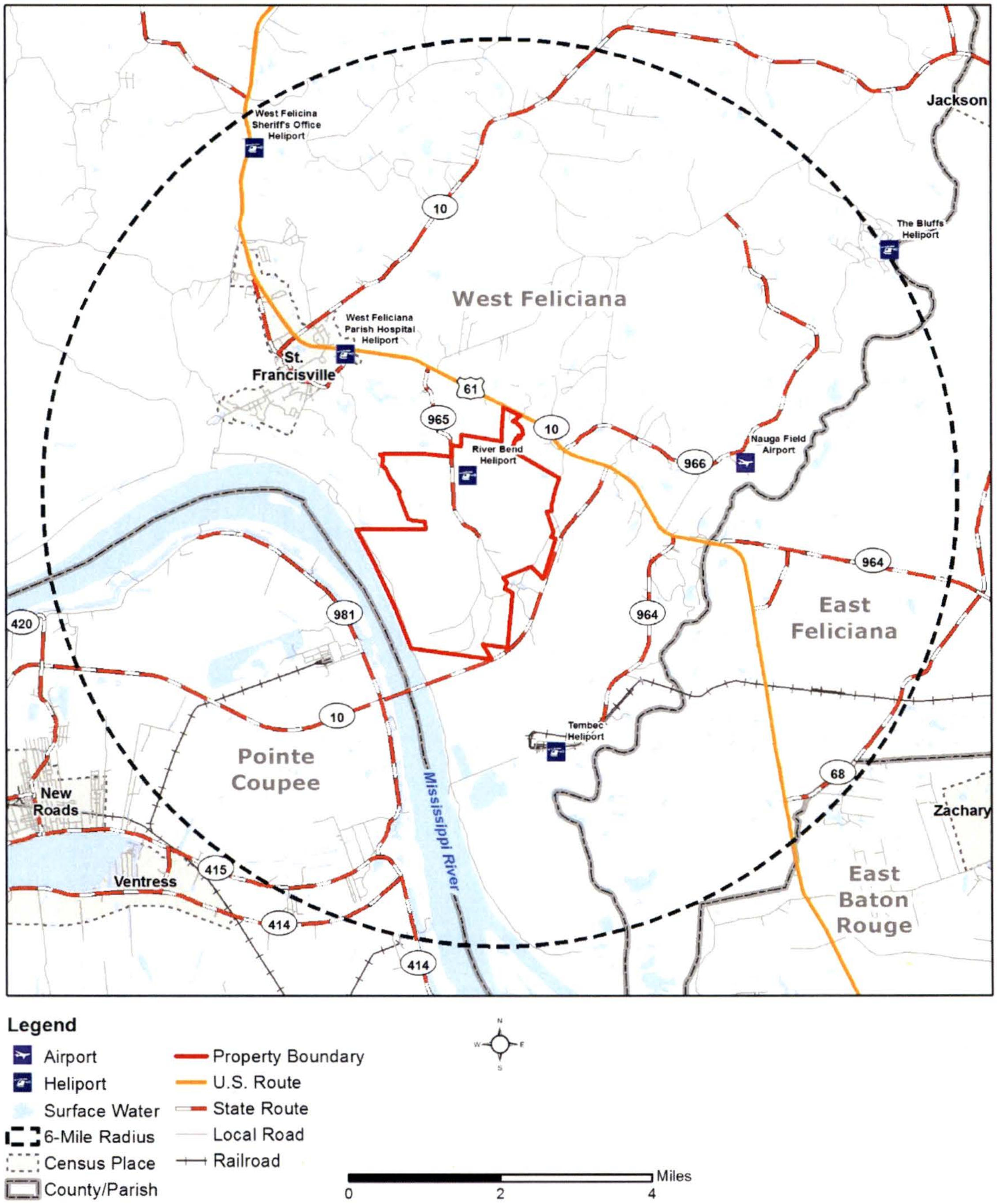
WF = West Feliciana

T = Threatened

E = Endangered

Figure 1

Location of Entergy Property, 6-Mile Radius Map



Entergy

**Entergy Services, Inc**
1340 Echelon Parkway
Jackson, Mississippi 39213

August 10, 2016

Ms. Carolyn Michon
Assistant Data Manager
Louisiana Natural Heritage Program
Department of Wildlife and Fisheries
Post Office Box 98000
Baton Rouge, LA 70898-9000

SUBJECT: River Bend Station Unit 1
License Renewal Application

CEXO 2016-00104

Dear Ms. Michon,

In 2017, Entergy Louisiana, LLC and Entergy Operations, Inc. (collectively referred to as "Entergy") plans to apply to the Nuclear Regulatory Commission (NRC) for renewal of the operating license for the River Bend Station Unit 1 (RBS), which is located on the east bank of the Mississippi River in the southern portion of West Feliciana Parish, Louisiana, approximately 24 miles north-northwest of Baton Rouge, Louisiana. The existing operating license for RBS was issued for a 40-year term that expires in 2025. If the NRC approves the application, Entergy will then have the option to continue operating RBS until 2045. In conjunction with this effort, Entergy is gathering information relative to this license renewal project to assist with the preparation of the application.

The NRC requires that the license renewal application for RBS include an environmental report that assesses potential environmental impacts from plant operations during the license renewal term. One of these potential environmental impacts would be the effect of license renewal on state-listed species located on the RBS property and its immediate environs (Figure 1). Accordingly, the NRC requires that the environmental report for each license renewal application assess such a potential effect (10 CFR 51.53).

Entergy is contacting you now in order to obtain input regarding issues that may need to be addressed in the RBS license renewal environmental report, and to assist in identifying any information your staff believes would be helpful to expedite NRC's review.

RBS is located on approximately 3,342 acres of Entergy owned land (Figure 1) that consists primarily of forest, woody wetlands and shrub. The RBS property is zoned as an industrial area by West Feliciana Parish. The land in the vicinity of the RBS site consists primarily of wetlands, forest, pasture, and shrub. Transmission lines that connect RBS to the regional electricity grid which the NRC considers to be within the scope of its environmental review for renewal of the RBS operating license are located entirely within the Entergy property. There is limited right-of-way (~8 acres) associated with the transmission lines since the lines span part of the RBS industrial area where vegetation is sparse.

Based on review of information available, Entergy has included in Table 1 state-listed species in East Baton Rouge, East Feliciana, Pointe Coupee and West Feliciana parishes, which portions of are located within a 6-mile radius of RBS (Figure 1). Although some of the listed species in West Feliciana Parish could possibly occur within the action area," defined as the RBS property and the portion of the Mississippi River that would be affected by water withdrawal and discharge effluent, none were recorded as being present on the RBS property during the development of the River Bend Station Unit 3 combined license application.

However, Entergy does not expect that RBS's operations during the license renewal term would result in adverse effects to state-listed species even if present since there are no plans to alter current operations during the 20-year license renewal period, and any maintenance activities necessary to support the continued operation of RBS would be limited to currently developed areas of the site. Although administrative procedural controls are in place to comply with applicable state and federal laws to preserve biological resources when facility expansion or land disturbance activities do occur, no expansion is planned or needed in support of license renewal.

After your review of the information provided in this letter, I would appreciate you sending a letter detailing any concerns you may have about potential impacts to state-listed species on the property where RBS is located, or the immediate environs, or alternatively, confirming our conclusion that these species will not be adversely affected as a result of renewing the RBS operating license for an additional 20 years. Entergy will include copies of this letter and your response in the environmental report submitted to the NRC as part of the RBS license renewal application.

If you have any questions, please contact me at (601) 368-5823 or through my email address, rbuckle@entergy.com.

Rick Buckley

Rick Buckley, CHMM, REM
Sr. Project Manager, Environmental

**Table 1**
**State-Listed Species: East Baton Rouge, East Feliciana, Pointe Coupee, & West Feliciana Parishes**

| Common Name | Scientific Name | Parish | Status |
|---|---|---|---|
| **Plants** | | | |
| Allegheny-spurge | *Pachysandra procumbens* | WF | S2 |
| American alumroot | *Heuchera americana* | WF | S2 |
| American ginseng | *Panax quinquefolius* | WF | S1 |
| Canada wild-ginger | *Asarum canadense* | WF | S1 |
| Carolina gentian | *Frasera caroliniensis* | WF | SH |
| Carpenter's ground-cherry | *Physalis carpenteri* | WF | S1 |
| Carpenter's square | *Silphium perfoliatum* | WF | S1? |
| Climbing bittersweet | *Celastrus scandens* | WF | S1 |
| Crested coral-root | *Hexalectris spicata* | WF | S2 |
| Dwarf filmy-fern | *Trichomanes petersii* | EBR/EF | S2 |
| Elliott sida | *Sida elliottii* | EBR/EF | SH |
| Enchanter's nightshade | *Circaea lutetiana* ssp. *canadensis* | EF/WF | S2 |
| Fairy wand | *Chamaelirium luteum* | WF | S2S3 |
| Glade fern | *Diplazium pycnocarpon* | WF | S2 |
| Low erythrodes | *Platythelys querceticola* | EBR/EF/WF | S1 |
| Nodding pogonia | *Triphora trianthophora* | WF | S2 |
| Powdery thalia | *Thalia dealbata* | EBR/EF | S2S3 |
| Pyramid magnolia | *Magnolia pyramidata* | WF | S2 |
| Riverweed | *Podostemum ceratophyllum* | EF | S1 |
| Rooted spike-rush | *Eleocharis radicans* | EF | S1? |
| Scarlet woodbine | *Schisandra glabra* | EF/WF | S3 |
| Shadow-witch orchid | *Ponthieva racemosa* | WF | S2 |
| Silky camellia | *Stewartia malacodendron* | EBR/EF | S2S3 |
| Silvery glade fern | *Deparia acrostichoides* | WF | S2 |
| Single-head pussytoes | *Antennaria solitaria* | EF | S2 |
| Southern shield wood-fern | *Dryopteris ludoviciana* | EBR/EF/WF | S2 |
| Southern shield wood-fern hybrid | *Dryopteris x australis* | EBR | SH |
| Square-stemmed monkey flower | *Mimulus ringens* | EBR/EF | S2 |
| Starry campion | *Silene stellata* | EF | S2 |
| Virginia saxifrage | *Saxifraga virginiensis* | WF | SH |
| Water-purslane | *Didiplis diandra* | EF | S2? |
| White baneberry | *Actaea pachypoda* | WF | S2 |

**Table 1**
**State-Listed Species: East Baton Rouge, East Feliciana, Pointe Coupee, & West Feliciana Parishes**

| Common Name | Scientific Name | Parish | Status |
|---|---|---|---|
| **Plants (cont'd)** | | | |
| Wolf spikerush | *Eleocharis wolfii* | EBR/EF | S3 |
| **Invertebrates** | | | |
| Six-banded longhorn beetle | *Dryobius sexnotatus* | PC | S1 |
| Yellow brachycercus mayfly | *Brachycercus flavus* | WF | S2 |
| **Mussels** | | | |
| Alabama hickorynut | *Obovaria unicolor* | EF | S1 |
| Elephant ear | *Elliptio crassidens* | EF | S3 |
| Inflated heelsplitter | *Potamilus inflatus* | EBR/EF | S1 |
| Mississippi pigtoe | *Pleurobema beadleianum* | EF | S2 |
| Rayed creekshell | *Anodontoides radiatus* | EBR/EF | S2 |
| Southern hickorynut | *Obovaria jacksoniana* | EBR/EF | S1S2 |
| Southern pocketbook | *Lampsilis ornata* | EBR/EF | S3 |
| Southern rainbow | *Villosa vibex* | EBR/EF | S2 |
| **Fish** | | | |
| Alabama shad | *Alosa alabamae* | EBR/EF | S1 |
| Bluntface shiner | *Cyprinella camura* | EF/WF | S2 |
| Broadstripe topminnow | *Fundulus euryzonus* | EF | S2 |
| Central stoneroller | *Campostoma anomalum* | WF | S2 |
| Pallid sturgeon | *Scaphirhynchus albus* | EBR/EF/PC/WF | S1 |
| Rainbow darter | *Etheostoma caeruleum* | WF | S2 |
| **Amphibians** | | | |
| Four-toed salamander | *Hemidactylium scutatum* | EBR/EF | S1 |
| Webster's salamander | *Plethodon websteri* | WF | S1 |
| **Reptiles** | | | |
| Eastern glass lizard | *Ophisaurus ventralis* | EBR/EF | S3 |
| Rainbow snake | *Farancia erytrogramma* | EBR/EF | S2 |
| **Birds** | | | |
| American redstart | *Setophaga ruticilla* | WF | S3B |
| American swallow-tail kite | *Elanoides forficatus* | EBR/PC | S1S2B |
| Bald eagle | *Haliaeetus leucocephalus* | EBR/EF/PC/WF | S3 |

**Table 1**
**State-Listed Species: East Baton Rouge, East Feliciana, Pointe Coupee, & West Feliciana Parishes**

| Common Name | Scientific Name | Parish | Status |
|---|---|---|---|
| **Birds (cont'd)** | | | |
| Interior least tern | *Sternula antillarum athalassos* | EBR/EF/PC/WF | S4BT1 |
| Louisiana waterthrush | *Seiurus motacilla* | EF/WF | S3S4B |
| Worm-eating warbler | *Helmitheros vermivorus* | EF/WF | S3B |
| **Mammals** | | | |
| Eastern harvest mouse | *Reithrodontomys humulis* | EBR/EF | S3 |
| Eastern spotted skunk | *Spilogale putorius* | WF | S1 |
| Long-tailed weasel | *Mustela frenata* | EBR/EF/WF | S3 |
| Louisiana black bear | *Ursus americanus luteolus* | PC/WF | S3 |
| Southeastern shrew | *Sorex longirostris* | EBR/EF/WF | S2 |
| West Indian manatee | *Trichechus manatus* | EBR/EF | S1N |

EBR = East Baton Rouge

EF = East Feliciana

PC = Pointe Coupee

WF = West Feliciana

**State Status Ranks**

S1 = critically imperiled in Louisiana because of extreme rarity (5 or fewer known extant populations) or because of some factor(s) making it especially vulnerable to extirpation.

S2 = imperiled in Louisiana because of rarity (6 to 20 known extant populations) or because of some factor(s) making it very vulnerable to extirpation.

S3 = rare and local throughout the state or found locally (even abundantly at some of its locations) in a restricted region of the state, or because of other factors making it vulnerable to extirpation (21 to 100 known extant populations).

S4 = apparently secure in Louisiana with many occurrences (100 to 1000 known extant populations).

S5 = demonstrably secure in Louisiana (1000+ known extant populations)

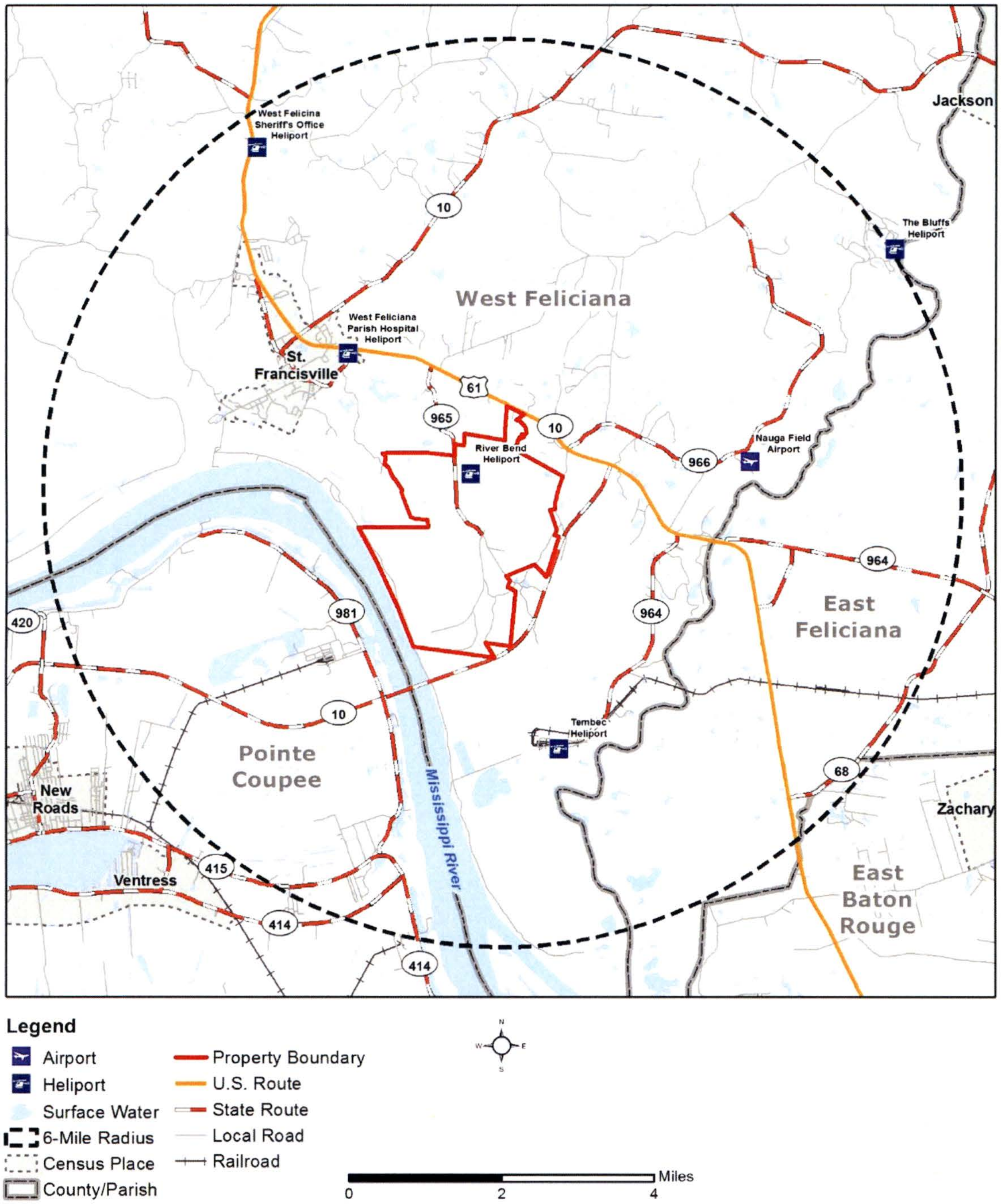
(B or N may be used as qualifier of numeric ranks and indicating whether the occurrence is breeding or nonbreeding).

SH = of historical occurrence in Louisiana, but no recent records verified within the last 20 years; formerly part of the established biota, possibly still persisting.

T = subspecies or variety rank (e.g., G5T4 applies to a subspecies with a global species rank of G5, but a subspecies rank of G4)

Figure 1

Location of Entergy Property, 6-Mile Radius Map



Entergy

**Entergy Services, Inc**
1340 Echelon Parkway
Jackson, Mississippi 39213

July 25, 2016

Mr. Brad Rieck
Deputy Field Supervisor
U.S. Fish and Wildlife Service
Louisiana Field Office
646 Cajundome Blvd., Suite 400
Lafayette, LA 70506

RECEIVED
JUL 28 2016
FISH & WLDL. S
LAFAYETTE

This project has been reviewed for effects to Federal trust resources under our jurisdiction and currently protected by the Endangered Species Act of 1973 (Act). The project, as proposed,
( ) Will have no effect on those resources
(✓) Is not likely to adversely affect those resources. PS
This finding fulfills the requirements under Section 7(a)(2) of the Act.

Monica Sikes 8-26-16
Acting Supervisor Date
Louisiana Field Office
U.S. Fish and Wildlife Service

SUBJECT: River Bend Station Unit 1
License Renewal Application

CEXO 2016-00100

Dear Mr. Rieck,

In 2017, Entergy Louisiana, LLC and Entergy Operations, Inc. (collectively referred to as "Entergy") plans to apply to the Nuclear Regulatory Commission (NRC) for renewal of the operating license for the River Bend Station Unit 1 (RBS), which is located on the east bank of the Mississippi River in the southern portion of West Feliciana Parish, Louisiana, approximately 24 miles north-northwest of Baton Rouge, Louisiana. The existing operating license for RBS was issued for a 40-year term that expires in 2025. If the NRC approves the application, Entergy will then have the option to continue operating RBS until 2045. In conjunction with this effort, Entergy is gathering information relative to this license renewal project to assist with the preparation of the application.

The NRC requires that the license renewal application for RBS include an environmental report that assesses potential environmental impacts from plant operations during the license renewal term. One of these potential environmental impacts would be the effect of license renewal on Federally-listed threatened, endangered or candidate species and designated critical habitat located on the RBS property and its immediate environs (Figure 1). Accordingly, the NRC requires that the environmental report for each license renewal application assess such a potential effect (10 CFR 51.53). Later, during its review of the license renewal environmental report pursuant to the National Environmental Policy Act, the NRC may request information from your office to ensure compliance with Section 7 of the Endangered Species Act.

Entergy is contacting you now in order to obtain input regarding issues that may need to be addressed in the RBS license renewal environmental report, and to assist in identifying any information your staff believes would be helpful to expedite NRC's review.

RBS is located on approximately 3,342 acres of Entergy owned land (Figure 1) that consists primarily of forest, woody wetlands and shrub. The RBS property is zoned as an industrial area by West Feliciana Parish. The land in the vicinity of the RBS site consists primarily of wetlands, forest, pasture, and shrub. Transmission lines that connect RBS to the regional electricity grid which the NRC considers to be within the scope of its environmental review for renewal of the RBS operating license are located entirely within the Entergy property. There is limited right-of-way (~8 acres) associated with the transmission lines since the lines span part of the RBS industrial area where vegetation is sparse.

Based on review of information available, Entergy has included in Table 1 threatened and endangered species identified as being Federally-listed in East Baton Rouge, East Feliciana, Pointe Coupee and West Feliciana parishes, which portions of are located within a 6-mile radius of RBS (Figure 1). No candidate species were identified. As shown in Table 1, there are four Federally-listed species which are either threatened or endangered within these four parishes. Three of these species (Alabama heelsplitter, Atlantic sturgeon, and West Indiana manatee) are not anticipated to be present in the "action area," defined as the RBS site and the portion of the Mississippi River that would be affected by water withdrawal and discharge effluent, because there are no documented known/possible occurrences in West Feliciana Parish, and the Mississippi River at RBS would not provide suitable habitat for these species. Although the remaining species (pallid sturgeon) could transit the "action area," the pallid sturgeon is a deepwater, channel-dwelling species and would be unaffected by water withdrawals and discharges. In addition during Entergy's review, no designated critical habitat was identified for the species listed in Table 1 within the immediate environs (6-mile radius) of RBS.

However, Entergy does not expect that RBS's operations during the license renewal term would result in adverse effects to threatened, endangered, or candidate species and designated critical habitats even if present since there are no plans to alter current operations during the 20-year license renewal period, and any maintenance activities necessary to support continued operation of RBS would be limited to currently developed areas of the site. Although administrative procedural controls are in place to comply with applicable state and federal laws to preserve biological resources when facility expansion or land disturbance activities do occur, no expansion is planned or needed in support of license renewal.

After your review of the information provided in this letter, I would appreciate you sending a letter detailing any concerns you may have about potential impacts to threatened, endangered or candidate species and designated critical habitat on the property where RBS is located, or the immediate environs, or alternatively, confirming our conclusion that these species and habitats will not be adversely affected as a result of renewing the RBS operating license for an additional 20 years. Entergy will include copies of this letter and your response in the environmental report submitted to the NRC as part of the RBS license renewal application.

If you have any questions, please contact me at (601) 368-5823 or through my email address, rbuckle@entergy.com.

Rick Buckley

Rick Buckley, CHMM, REM
Sr. Project Manager, Environmental

Table 1

Federal-Listed Species, East Baton Rouge, East Feliciana, Pointe Coupee and West Feliciana Parishes

| Common Name | Applicable Parish | Federal Status | Occurrence in Parish | Species Observed on Entergy Property |
|---|---|---|---|---|
| ***Mammals*** | | | | |
| West Indian Manatee | EBR | E | Seasonal | No |
| ***Fish*** | | | | |
| Atlantic Sturgeon | EBR/EF | T | Known/Possible | No |
| Pallid Sturgeon | EBR/EF/PC/WF | E | Known | No |
| ***Mollusks*** | | | | |
| Alabama Heelsplitter Mussel | EBR/EF | T | Known | No |

EBR = East Baton Rouge

EF = East Feliciana

PC = Pointe Coupee

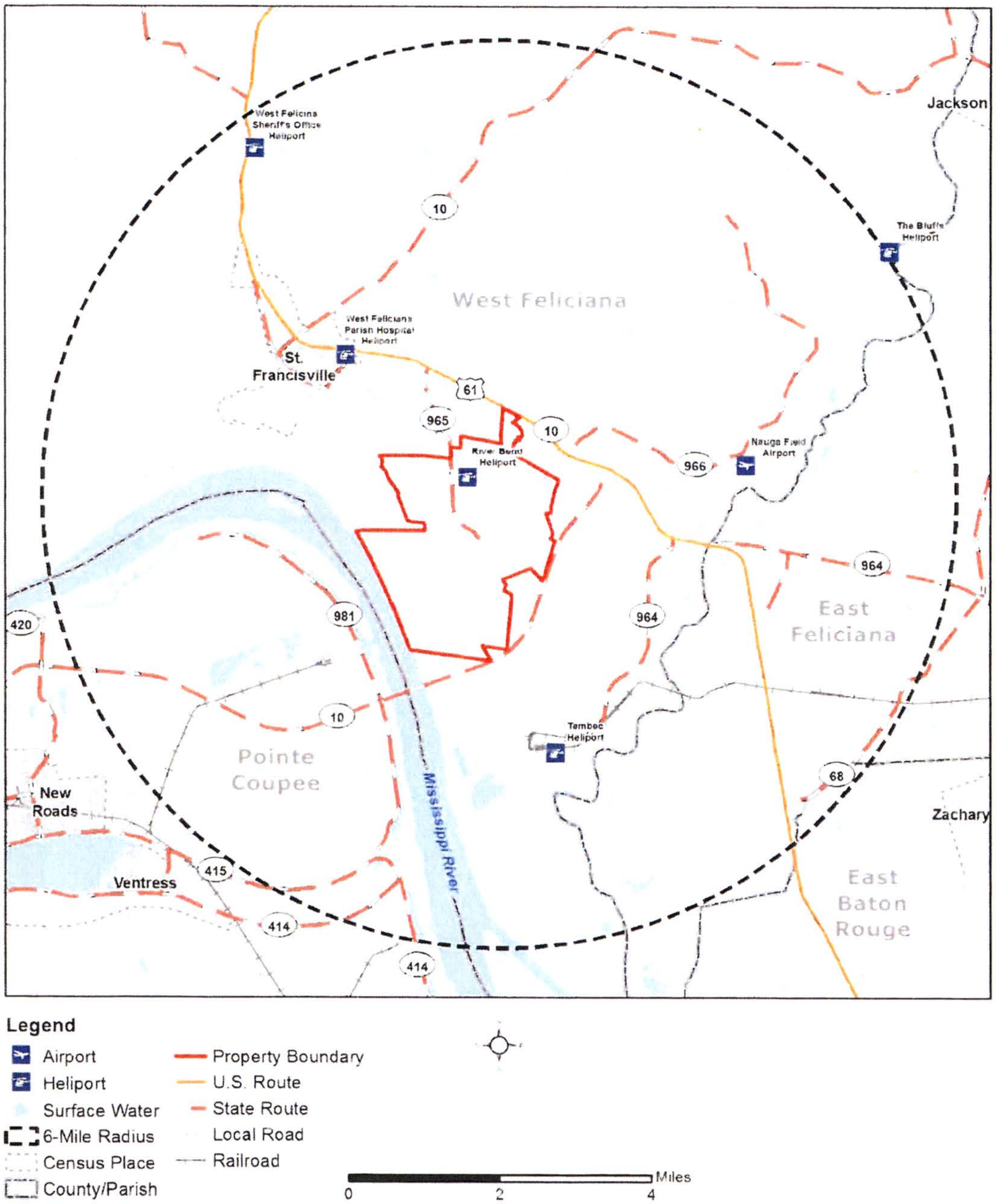
WF = West Feliciana

T = Threatened

E = Endangered

Figure 1

Location of Entergy Property, 6-Mile Radius Map



| | |
|---|---|
| ***Date*** | November 10, 2016 |
| ***Name*** | Rick Buckley |
| ***Company*** | Entergy Services, Inc. |
| ***Street Address*** | 1340 Echelon Parkway |
| ***City, State, Zip*** | Jackson, MS 39213 |
| ***Project*** | River Bend Sation Unit 1<br>License Renewal Application |
| ***Project ID*** | 2342016 |
| ***Invoice Number*** | 16111001 |

Personnel of the Coastal & Nongame Resources Division have reviewed the preliminary data for the captioned project.

The database indicates that the River Bend Natural Area is located within the project area that has been registered by the Louisiana Department of Wildlife and Fisheries through the Louisiana Natural Heritage Program. If you have any questions, please contact Chris Doffitt at 318-487-3412.

The rare plants Carpenter's Ground cherry (Physalis carpenteri) (S1), Deer-tongue Witchgrass (Dichanthelium clandestinum) (S4) & Silvery Glade Fern (Deporia acrostichoides) (S2) are located within the project area. Please contact LNHP botanist Chris Reid at (225) 765-2828 for more information on avoiding impacts to these rare plants.

The proposed project may impact the long-tailed weasel (Mustela frenata) which is considered rare in Louisiana with a S3 state rank. This species is found in a wide variety of habitats, usually near water and dens in abandoned burrows of other mammals, in rock crevices, brush piles, and spaces among tree roots. Threats to this species include wetland drainage and agriculturally induced habitat fragmentation. If you have any questions or need additional information, please contact Beau Gregory at 337-491-2576.

Our records also indicate the presence of a Hackberry-American Elm-Green Ash Bottomland Forest, Cypress Tupelo Swamp, Southern Mesophitic Forest & Batture within the proposed project. Contact LNHP botanist Chris Reid at (225) 765-2828 for more information on avoiding impacts to these rare natural communities.

After careful review of our database, no other impacts to rare, threatened, or endangered species or critical habitats are anticipated for the proposed project. No state or federal parks, wildlife refuges, scenic streams, or wildlife management areas are known at the specified site within Louisiana's boundaries.

The Louisiana Natural Heritage Program (LNHP) has compiled data on rare, endangered, or otherwise significant plant and animal species, plant communities, and other natural features throughout the state of Louisiana. Heritage reports summarize the existing information known at the time of the request regarding the location in question. The quantity and quality of data collected by the LNHP are dependent on the research and observations of many individuals. In most cases, this information is not the result of comprehensive or site-specific field surveys; many natural areas in Louisiana have not been surveyed. This report does not address the occurrence of wetlands at the site in question. Heritage reports should not be considered final statements on the biological elements or areas being considered, nor should they be substituted for on-site surveys required for environmental assessments. LNHP requires that this office be acknowledged in all reports as the source of all data provided here. If at any time Heritage tracked species are encountered within the project area, please contact the LNHP Data Manager at 225-765-2643. If you have any questions, or need additional information, please call 225-765-2357.

Sincerely,

Nicole Lorenz

for Amity Bass, Coordinator
Natural Heritage Program



P.O. BOX 98000 • BATON ROUGE, LOUISIANA 70898-9000 • PHONE (225) 765-2800
AN EQUAL OPPORTUNITY EMPLOYER

# Attachment C

# Cultural Resources Consultation

# Attachment C

## Cultural Resources Consultation

- Rick Buckley, Entergy Services, Inc. to Phil Boggan, Office of Historic Preservation—Division of Historic Preservation. June 15, 2016.
- Rick Buckley, Entergy Services, Inc. to Kimberly Walden, Tribal Historic Preservation Officer—Chitimacha Tribe of Louisiana. June 15, 2016.
- Rick Buckley, Entergy Services, Inc. to Ian Thompson, Tribal Historic Preservation Officer—Choctaw Nation of Oklahoma. June 15, 2016.
- Rick Buckley, Entergy Services, Inc. to Dr. Linda Langley, Tribal Historic Preservation Officer—Coushatta Tribe of Louisiana. June 15, 2016.
- Rick Buckley, Entergy Services, Inc. to Alina Shively, Deputy Tribal Historic Preservation Officer—Jena Band of Choctaw Indians. June 15, 2016.
- Rick Buckley, Entergy Services, Inc. to Phyliss J. Anderson, Chief—Mississippi Band of Choctaw Indians. June 15, 2016.
- Rick Buckley, Entergy Services, Inc. to Earl J. Barbry Jr, Tribal Historic Preservation Officer—Tunica-Biloxi Tribe of Louisiana. June 15, 2016.
- Jill Crawford, Section 106 Coordinator—Coushatta Tribe of Louisiana, to Rick Buckley, Entergy. July 7, 2016.
- Phil Boggan, State Historic Preservation Officer (stamp of receipt/review/acceptance), to Rick Buckley, Entergy Services, Inc. July 15, 2016.
- Lindsey Bilyeu and Ryan L. Spring, Choctaw Nation of Oklahoma, to Rick Buckley, Entergy Services, Inc. August 24, 2016.

Entergy

**Entergy Services, Inc**
1340 Echelon Parkway
Jackson, Mississippi 39213

June 15, 2016

Mr. Phil Boggan
Office of Historic Preservation
Division of Historic Preservation
Post Office Box 44247
Baton Rouge, LA 70804

SUBJECT: River Bend Station Unit 1
License Renewal Application

CEO 2016-00043

Dear Mr. Boggan,

In 2017, Entergy Louisiana, LLC and Entergy Operations, Inc. (collectively referred to as "Entergy") plans to apply to the Nuclear Regulatory Commission (NRC) for renewal of the operating license for the River Bend Station Unit 1 (RBS), which is located on the east bank of the Mississippi River in the southern portion of West Feliciana Parish, Louisiana, approximately 24 miles north-northwest of Baton Rouge, Louisiana. The existing operating license for RBS was issued for a 40-year term that expires in 2025. If the NRC approves the application, Entergy will then have the option to continue operating RBS until 2045. In conjunction with this effort, Entergy is gathering information relative to this license renewal project to assist with the preparation of the application.

The NRC requires that the license renewal application for RBS include an environmental report that assesses the potential environmental impacts from operation during the license renewal term. One of these potential environmental impacts would be the effect of license renewal on archaeological resources located on the RBS property, its immediate environs (6-mile radius) as shown in Figure 1, and transmission line corridors constructed for purposes of connecting the plant to the regional transmission grid. Accordingly, the NRC requires that the environmental report for each license renewal application assess such a potential effect (10 CFR 51.53). Later, during its review of the license renewal environmental report pursuant to the National Environmental Policy Act, the NRC may request information from your office to ensure compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (16 USC 470), and Federal Advisory Council on Historic Preservation regulations (36 CFR 800).

RBS is located on approximately 3,342 acres of Entergy owned land (Figure 1) that consists primarily of forest, woody wetlands and shrub. The RBS property is zoned as an industrial area by West Feliciana Parish. The land in the vicinity of the RBS site consists primarily of wetlands, forest, pasture, and shrub. Transmission lines that connect RBS to the regional electricity grid which the NRC considers to be within the scope of its environmental review for renewal of the RBS operating license are located entirely within the Entergy property.

Although not required, Entergy voluntarily contracted with Coastal Environments, Inc. to conduct a Phase 1A literature review and archaeological sensitivity assessment of the Entergy property in August 2015 to supplement RBS's existing administrative controls to ensure that potential resources are properly managed during the license renewal period. Table 1 lists archaeological resources within a 6-mile radius of RBS while Table 2 lists National Register of Historic Places (NRHP) properties within this same radius that were identified by Entergy during our view. This assessment, which is included in Attachment 1, determined that no cultural resources would be impacted as a result of renewal of the RBS operating license.

Entergy does not expect RBS operations during the license renewal term to adversely affect any historic or archaeological resources since there are no plans to alter current operations during the 20-year license renewal period, and any maintenance activities necessary to support continued operation of RBS would be limited to currently developed areas of the site. Although administrative procedural controls are in place to comply with applicable state and federal laws to preserve cultural resources when facility expansion or land disturbance activities do occur, no expansion is planned or needed in support of license renewal.

After your review of the information provided in this letter, I would appreciate you sending a letter detailing any concerns you may have about potential impacts to historic or archaeological resources on the property where RBS is located, or the immediate environs, or alternatively, confirming our conclusion that the operation of RBS during the license renewal term would have no effect on known historical or archaeological properties. Entergy will include copies of this letter and your response in the environmental report submitted to the NRC as part of the RBS license renewal application.

If you have any questions, please contact me at (601) 368-5823 or through my email address at rbuckle@entergy.com.

Rick Buckley

Rick Buckley, CHMM, REM
Sr. Project Manager, Environmental

**Table 1**
**Archaeological Sites, 6-Mile Radius of RBS**

| Site Number | Parish | Quadrangle | NRHP Status |
|---|---|---|---|
| *Listed/Eligible (11)* | | | |
| 16EBR42 | East Baton Rouge | Port Hudson | Eligible |
| 16EF7 | East Feliciana | Port Hudson | Listed |
| 16EF68 | East Feliciana | Port Hudson | Eligible |
| 16PC62 | Pointe Coupee | New Roads | Eligible/Partially Mitigated[b] |
| 16WF34 | West Feliciana | Elm Park | Listed |
| 16WF39 | West Feliciana | Elm Park | Eligible/Partially Mitigated[b] |
| 16WF89 | West Feliciana | Saint Francisville | Eligible/Partially Mitigated[b] |
| 16WF101 | West Feliciana | Elm Park | Eligible |
| 16WF156 | West Feliciana | Elm Park | Listed |
| 16WF175 | West Feliciana | Saint Francisville | Eligible |
| Bayou Sara-Baton Rouge Road | West Feliciana | Elm Park | Eligible |
| *Partially Ineligible/Unknown (9)* | | | |
| 16EF57 | East Feliciana | Port Hudson | Partially Ineligible/Unknown[a] |
| 16PC31 | Pointe Coupee | Port Hudson | Partially Ineligible/Unknown[a] |
| 16WF87 | West Feliciana | Saint Francisville | Partially Ineligible/Unknown[a] |
| 16WF90 | West Feliciana | Saint Francisville | Partially Ineligible/Unknown[a] |
| 16WF96 | West Feliciana | Port Hudson | Partially Ineligible/Unknown[a] |
| 16WF97 | West Feliciana | Port Hudson | Partially Ineligible/Unknown[a] |
| 16WF99 | West Feliciana | Elm Park | Partially Ineligible/Unknown[a] |
| 16WF102 | West Feliciana | Elm Park | Partially Ineligible/Unknown[a] |
| 16WF104 | West Feliciana | Elm Park | Partially Ineligible/Unknown[a] |
| *Ineligible (69)* | | | |
| 16EF56 | East Feliciana | Jackson | Ineligible |
| 16PC33 | Pointe Coupee | New Roads | Ineligible |
| 16EF137 | East Feliciana | Port Hudson | Ineligible |
| 16EF139 | East Feliciana | Port Hudson | Ineligible |
| 16EF140 | East Feliciana | Port Hudson | Ineligible |
| 16PC56 | Pointe Coupee | New Roads | Ineligible |
| 16PC58 | Pointe Coupee | New Roads | Ineligible |
| 16PC59 | Pointe Coupee | New Roads | Ineligible |
| 16PC60 | Pointe Coupee | New Roads | Ineligible |

**Table 1**
**Archaeological Sites, 6-Mile Radius of RBS**

| Site Number | Parish | Quadrangle | NRHP Status |
|---|---|---|---|
| *Ineligible (69) – cont'd* | | | |
| 16PC73 | Pointe Coupee | New Roads | Ineligible |
| 16PC75 | Pointe Coupee | New Roads | Ineligible |
| 16PC109 | Pointe Coupee | Port Hudson | Ineligible |
| 16PC111 | Pointe Coupee | New Roads | Ineligible |
| 16PC112 | Pointe Coupee | New Roads | Ineligible |
| 16PC113 | Pointe Coupee | New Roads | Ineligible |
| 16PC114 | Pointe Coupee | New Roads | Ineligible |
| 16PC115 | Pointe Coupee | New Roads | Ineligible |
| 16PC116 | Pointe Coupee | New Roads | Ineligible |
| 16PC123 | Pointe Coupee | New Roads | Ineligible |
| 16PC125 | Pointe Coupee | Port Hudson | Ineligible |
| 16PC126 | Pointe Coupee | New Roads | Ineligible |
| 16WF5 | West Feliciana | Port Hudson | Ineligible |
| 16WF41 | West Feliciana | Port Hudson | Ineligible |
| 16WF42 | West Feliciana | Port Hudson | Ineligible |
| 16WF43 | West Feliciana | Port Hudson | Ineligible |
| 16WF44 | West Feliciana | Port Hudson | Ineligible |
| 16WF45 | West Feliciana | Port Hudson | Ineligible |
| 16WF46 | West Feliciana | Port Hudson | Ineligible |
| 16WF47 | West Feliciana | Port Hudson | Ineligible |
| 16WF58 | West Feliciana | Saint Francisville | Ineligible |
| 16WF59 | West Feliciana | Saint Francisville | Ineligible |
| 16WF62 | West Feliciana | Elm Park | Ineligible |
| 16WF64 | West Feliciana | Port Hudson | Ineligible |
| 16WF65 | West Feliciana | Elm Park | Ineligible |
| 16WF67 | West Feliciana | Elm Park | Ineligible |
| 16WF68 | West Feliciana | Elm Park | Ineligible |
| 16WF69 | West Feliciana | Elm Park | Ineligible |
| 16WF72 | West Feliciana | Elm Park | Ineligible |
| 16WF73 | West Feliciana | Elm Park | Ineligible |
| 16WF74 | West Feliciana | Elm Park | Ineligible |
| 16WF75 | West Feliciana | Elm Park | Ineligible |

**Table 1**
**Archaeological Sites, 6-Mile Radius of RBS**

| Site Number | Parish | Quadrangle | NRHP Status |
|---|---|---|---|
| *Ineligible (69) – cont'd* | | | |
| 16WF76 | West Feliciana | Elm Park | Ineligible |
| 16WF78 | West Feliciana | Elm Park | Ineligible |
| 16WF79 | West Feliciana | Elm Park | Ineligible |
| 16WF85 | West Feliciana | Port Hudson | Ineligible |
| 16WF88 | West Feliciana | Saint Francisville | Ineligible |
| 16WF91 | West Feliciana | Elm Park | Ineligible |
| 16WF92 | West Feliciana | Elm Park | Ineligible |
| 16WF93 | West Feliciana | Elm Park | Ineligible |
| 16WF94 | West Feliciana | Elm Park | Ineligible |
| 16WF95 | West Feliciana | Elm Park | Ineligible |
| 16WF98 | West Feliciana | Port Hudson | Ineligible |
| 16WF100 | West Feliciana | Elm Park | Ineligible |
| 16WF103 | West Feliciana | Elm Park | Ineligible |
| 16WF105 | West Feliciana | Elm Park | Ineligible |
| 16WF113 | West Feliciana | Elm Park | Ineligible |
| 16WF114 | West Feliciana | Port Hudson | Ineligible |
| 16WF148 | West Feliciana | Saint Francisville | Ineligible |
| 16WF149 | West Feliciana | Port Hudson | Ineligible |
| 16WF150 | West Feliciana | Port Hudson | Ineligible |
| 16WF151 | West Feliciana | Port Hudson | Ineligible |
| 16WF152 | West Feliciana | Port Hudson | Ineligible |
| 16WF153 | West Feliciana | Port Hudson | Ineligible |
| 16WF154 | West Feliciana | Port Hudson | Ineligible |
| 16WF155 | West Feliciana | Port Hudson | Ineligible |
| 16WF180 | West Feliciana | Elm Park | Ineligible[(c)] |
| 16WF182 | West Feliciana | Port Hudson | Ineligible[(c)] |
| 16WF187 | West Feliciana | Elm Park | Ineligible |
| 16WF188 | West Feliciana | Elm Park | Ineligible |
| *Unknown (37)* | | | |
| 16EF16 | East Feliciana | Port Hudson | Unknown |
| 16EF17 | East Feliciana | Port Hudson | Unknown |
| 16EF18 | East Feliciana | Port Hudson | Unknown |

Table 1
Archaeological Sites, 6-Mile Radius of RBS

| Site Number | Parish | Quadrangle | NRHP Status |
|---|---|---|---|
| *Unknown (37) – cont'd* | | | |
| 16EF19 | East Feliciana | Port Hudson | Unknown |
| 16PC27 | Pointe Coupee | Port Hudson | Unknown |
| 16PC54 | Pointe Coupee | New Roads | Unknown |
| 16PC110 | Pointe Coupee | New Roads | Unknown |
| 16PC117 | Pointe Coupee | New Roads | Unknown |
| 16PC118 | Pointe Coupee | New Roads | Unknown |
| 16PC119 | Pointe Coupee | New Roads | Unknown |
| 16PC120 | Pointe Coupee | Port Hudson | Unknown |
| 16PC124 | Pointe Coupee | Port Hudson | Unknown |
| 16WF4 | West Feliciana | Port Hudson | Unknown |
| 16WF15 | West Feliciana | Saint Francisville | Unknown |
| 16WF19 | West Feliciana | Port Hudson | Unknown[c] |
| 16WF31 | West Feliciana | Port Hudson | Unknown |
| 16WF35 | West Feliciana | Elm Park | Unknown |
| 16WF36 | West Feliciana | Elm Park | Unknown[c] |
| 16WF37 | West Feliciana | Saint Francisville | Unknown |
| 16WF51 | West Feliciana | Port Hudson | Unknown |
| 16WF52 | West Feliciana | Port Hudson | Unknown |
| 16WF53 | West Feliciana | Port Hudson | Unknown |
| 16WF54 | West Feliciana | Port Hudson | Unknown[c] |
| 16WF55 | West Feliciana | Port Hudson | Unknown[c] |
| 16WF56 | West Feliciana | Port Hudson | Unknown[c] |
| 16WF57 | West Feliciana | Saint Francisville | Unknown |
| 16WF60 | West Feliciana | Elm Park | Unknown |
| 16WF61 | West Feliciana | Port Hudson | Unknown[c] |
| 16WF66 | West Feliciana | Elm Park | Unknown |
| 16WF70 | West Feliciana | Elm Park | Unknown |
| 16WF77 | West Feliciana | Elm Park | Unknown |
| 16WF84 | West Feliciana | Port Hudson | Unknown[c] |
| 16WF110 | West Feliciana | Elm Park | Unknown |
| 16WF111 | West Feliciana | Port Hudson | Unknown[c] |
| 16WF147 | West Feliciana | Elm Park | Unknown |

**Table 1**
**Archaeological Sites, 6-Mile Radius of RBS**

| Site Number | Parish | Quadrangle | NRHP Status |
|---|---|---|---|
| *Unknown (37) – cont'd* | | | |
| 16WF157 | West Feliciana | Saint Francisville | Unknown |
| 16WF181 | West Feliciana | Elm Park | Unknown[c] |
| *Destroyed (1)* | | | |
| 16WF112 | West Feliciana | Elm Park | Destroyed[c] |

a. Only a portion of site is determined not eligible for inclusion on the NRHP; the eligibility of the rest of the site is unknown.

b. The entire site is determined eligible for inclusion on the NRHP; portions of the site were excavated as part of a Phase III Data Recovery

c. Located on RBS property.

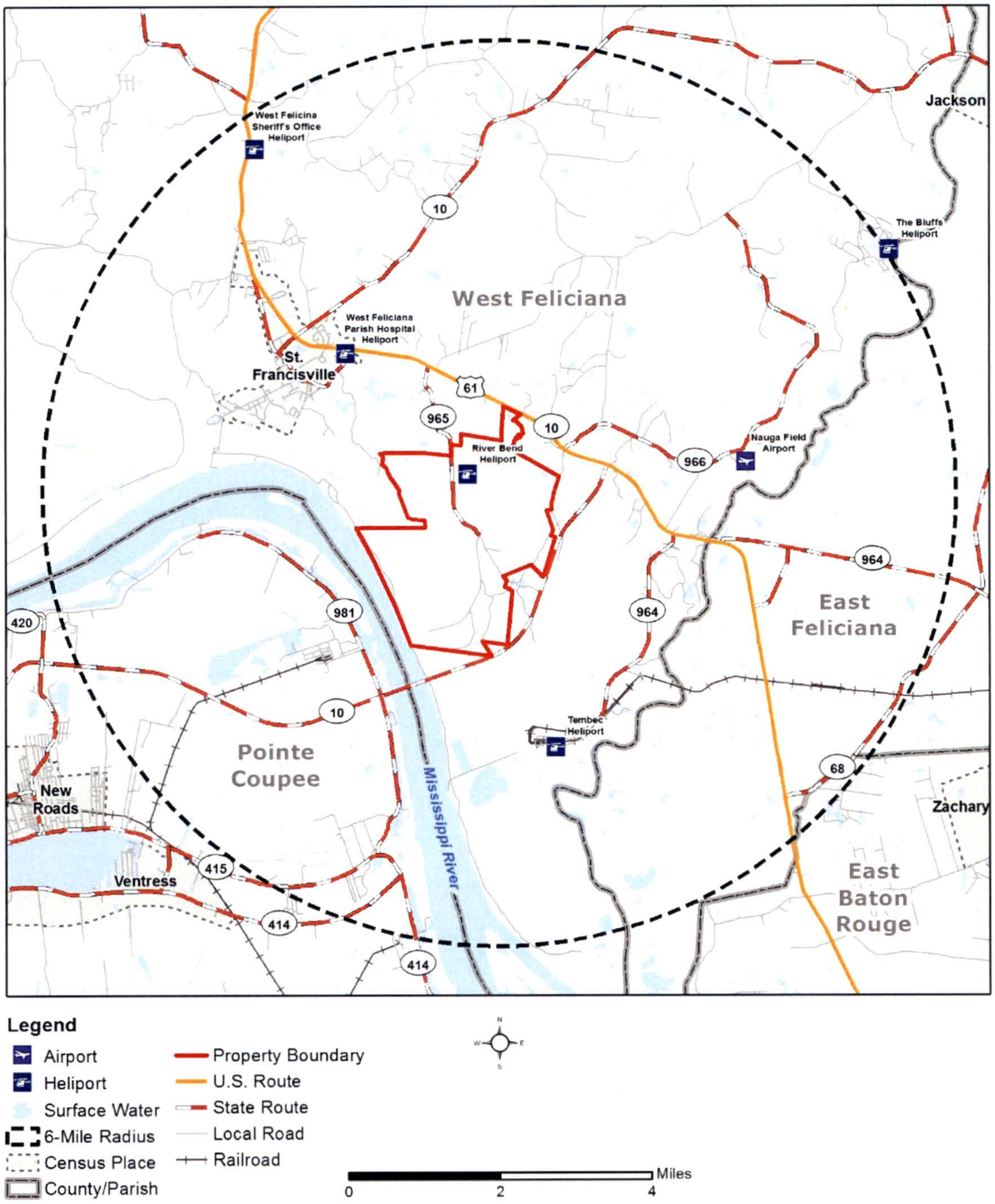
**Table 2**
**NRHP-Listed Properties, 6-Mile Radius of RBS**

| Resource Name | Parish | Quadrangle | NRHP Listed | Distance from RBS (mi) |
|---|---|---|---|---|
| Wildwood Plantation House | East Feliciana | Port Hudson | 1988 | 5.7 |
| Port Hudson Battlefield (16EF7/16EBR42) | East Feliciana | Port Hudson | 1974[a] | 5.8 |
| 3V Tourist Court | West Feliciana | St. Francisville | 1993 | 3 |
| Butler-Greenwood, Greenwood Plantation | West Feliciana | St. Francisville | 1979 | 5.5 |
| Grace Episcopal Church, Grace Church | West Feliciana | St. Francisville | 1979 | 3.5 |
| Myrtles Plantation | West Feliciana | St. Francisville | 1978 | 4.6 |
| Oakley Plantation House<br>Audubon Memorial State Park (16WF34) | West Feliciana | Elm Park | 1973 | 3.2 |
| Propinquity House | West Feliciana | St. Francisville | 1973 | 3.5 |
| Rosedown Plantation<br>Rosedown Plantation State Historic Site (16WF156) | West Feliciana | Elm Park | 2001[a] | 3.8 |
| St. Francisville Historic District | West Feliciana | St. Francisville | 1980 | 3.3 |
| Star Hill Post Office and Store | West Feliciana | Elm Park | 2000 | 1.5 |
| Star Hill Plantation Dependency, Star Hill Billiard Hall | West Feliciana | Elm Park | 2003 | 1 |
| The Oaks Plantation | West Feliciana | St. Francisville | 1979 | 4.9 |
| Wickliffe House | Pointe Coupee | New Roads | 1991 | 5.9 |

a. Also listed as a National Historic Landmark.

**Figure 1**

**Location of Entergy Property, 6-Mile Radius**



## Attachment 1

## Phase 1A Literature Review and Archaeological Sensitivity Assessment of the River Bend Station Unit 1

The attachment noted here that was sent to the Louisiana Historic Preservation Office is not enclosed because it contains sensitive information.

Entergy

**Entergy Services, Inc**
1340 Echelon Parkway
Jackson, Mississippi 39213

June 15, 2016

Ms. Kimberly Walden
Tribal Historic Preservation Officer
Chitimacha Tribe of Louisiana
Post Office Box 661
Charenton, LA 70523

SUBJECT: River Bend Station Unit 1
License Renewal Application

CEO 2016-00044

Dear Ms. Walden,

In 2017, Entergy Louisiana, LLC and Entergy Operations, Inc. (collectively referred to as "Entergy") plans to apply to the Nuclear Regulatory Commission (NRC) for renewal of the operating license for the River Bend Station Unit 1 (RBS), which is located on the east bank of the Mississippi River in the southern portion of West Feliciana Parish, Louisiana, approximately 24 miles north-northwest of Baton Rouge, Louisiana. The existing operating license for RBS was issued for a 40-year term that expires in 2025. If the NRC approves the application, Entergy will then have the option to continue operating RBS until 2045. In conjunction with this effort, Entergy is gathering information relative to this license renewal project to assist with the preparation of the application.

The NRC requires that the license renewal application for RBS include an environmental report that assesses the potential environmental impacts from operation during the license renewal term. One of these potential environmental impacts would be the effect of license renewal on archaeological resources located on the RBS site, its immediate environs (6-mile radius) as shown in Figure 1, and transmission line corridors constructed for purposes of connecting the plant to the regional transmission grid. Accordingly, the NRC requires that the environmental report for each license renewal

Accordingly, the NRC requires that the environmental report for each license renewal application assess such a potential effect (10 CFR 51 .53). Later, during its review of the license renewal environmental report pursuant to the National Environmental Policy Act, the NRC may request information from your office to ensure compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (16 USC 470), and Federal Advisory Council on Historic Preservation regulations (36 CFR 800).

RBS is located on approximately 3,342 acres of Entergy owned land (Figure 1) that consists primarily of forest, woody wetlands and shrub. The RBS property is zoned as an industrial area by West Feliciana Parish. The land in the vicinity of the RBS site consists primarily of wetlands, forest, pasture, and shrub. Transmission lines that connect RBS to the regional electricity grid which the NRC considers to be within the scope of its environmental review for renewal of the RBS operating license are located entirely within the Entergy property.

Entergy does not expect RBS operations during the license renewal term to adversely affect any historic or archaeological resources since there are no plans to alter current operations during the 20-year license renewal period, and any maintenance activities necessary to support continued operation of RBS would be limited to currently developed areas of the site. Although administrative procedural controls are in place to comply with applicable state and federal laws to preserve cultural resources when facility expansion or land disturbance activities do occur, no expansion is planned or needed in support of license renewal.

After your review of the information provided in this letter, I would appreciate you sending a letter detailing any concerns you may have about potential impacts to historic or archaeological resources on the property where RBS is located, or the immediate environs, or alternatively, confirming our conclusion that the operation of RBS during the license renewal term would have no effect on known historical or archaeological properties. Entergy will include copies of this letter and your response in the environmental report submitted to the NRC as part of the RBS license renewal application.

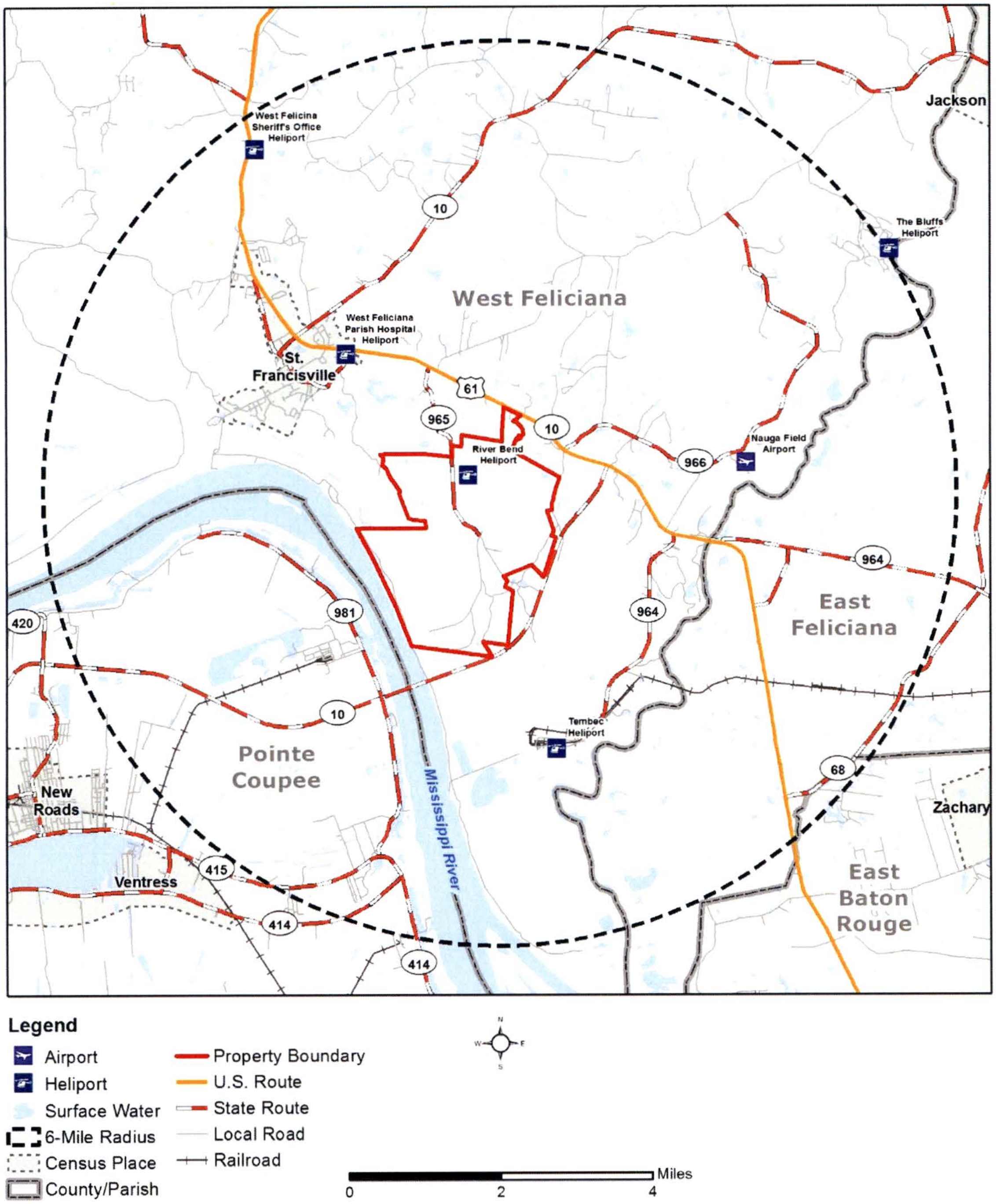
If you have any questions, please contact me at (601) 368-5823 or through my email address at rbuckle@entergy.com.

Rick Buckley

Rick Buckley, CHMM, REM
Sr. Project Manager, Environmental

**Figure 1**

**Location of Entergy Property, 6-Mile Radius Map**



Entergy

**Entergy Services, Inc**
1340 Echelon Parkway
Jackson, Mississippi 39213

June 15, 2016

Mr. Ian Thompson
Tribal Historic Preservation Officer
Choctaw Nation of Oklahoma
Post Office Box 1210
Durant, OK 74702-1210

SUBJECT: River Bend Station Unit 1
License Renewal Application

CEO 2016-00045

Dear Mr. Thompson,

In 2017, Entergy Louisiana, LLC and Entergy Operations, Inc. (collectively referred to as "Entergy") plans to apply to the Nuclear Regulatory Commission (NRC) for renewal of the operating license for the River Bend Station Unit 1 (RBS), which is located on the east bank of the Mississippi River in the southern portion of West Feliciana Parish, Louisiana, approximately 24 miles north-northwest of Baton Rouge, Louisiana. The existing operating license for RBS was issued for a 40-year term that expires in 2025. If the NRC approves the application, Entergy will then have the option to continue operating RBS until 2045. In conjunction with this effort, Entergy is gathering information relative to this license renewal project to assist with the preparation of the application.

The NRC requires that the license renewal application for RBS include an environmental report that assesses the potential environmental impacts from operation during the license renewal term. One of these potential environmental impacts would be the effect of license renewal on archaeological resources located on the RBS site, its immediate environs (6-mile radius) as shown in Figure 1, and transmission line corridors constructed for purposes of connecting the plant to the regional transmission grid. Accordingly, the NRC requires that the environmental report for each license renewal

application assess such a potential effect (10 CFR 51 .53). Later, during its review of the license renewal environmental report pursuant to the National Environmental Policy Act, the NRC may request information from your office to ensure compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (16 USC 470), and Federal Advisory Council on Historic Preservation regulations (36 CFR 800).

RBS is located on approximately 3,342 acres of Entergy owned land (Figure 1) that consists primarily of forest, woody wetlands and shrub. The RBS property is zoned as an industrial area by West Feliciana Parish. The land in the vicinity of the RBS site consists primarily of wetlands, forest, pasture, and shrub. Transmission lines that connect RBS to the regional electricity grid which the NRC considers to be within the scope of its environmental review for renewal of the RBS operating license are located entirely within the Entergy property.

Entergy does not expect RBS operations during the license renewal term to adversely affect any historic or archaeological resources since there are no plans to alter current operations during the 20-year license renewal period, and any maintenance activities necessary to support continued operation of RBS would be limited to currently developed areas of the site. Although administrative procedural controls are in place to comply with applicable state and federal laws to preserve cultural resources when facility expansion or land disturbance activities do occur, no expansion is planned or needed in support of license renewal.

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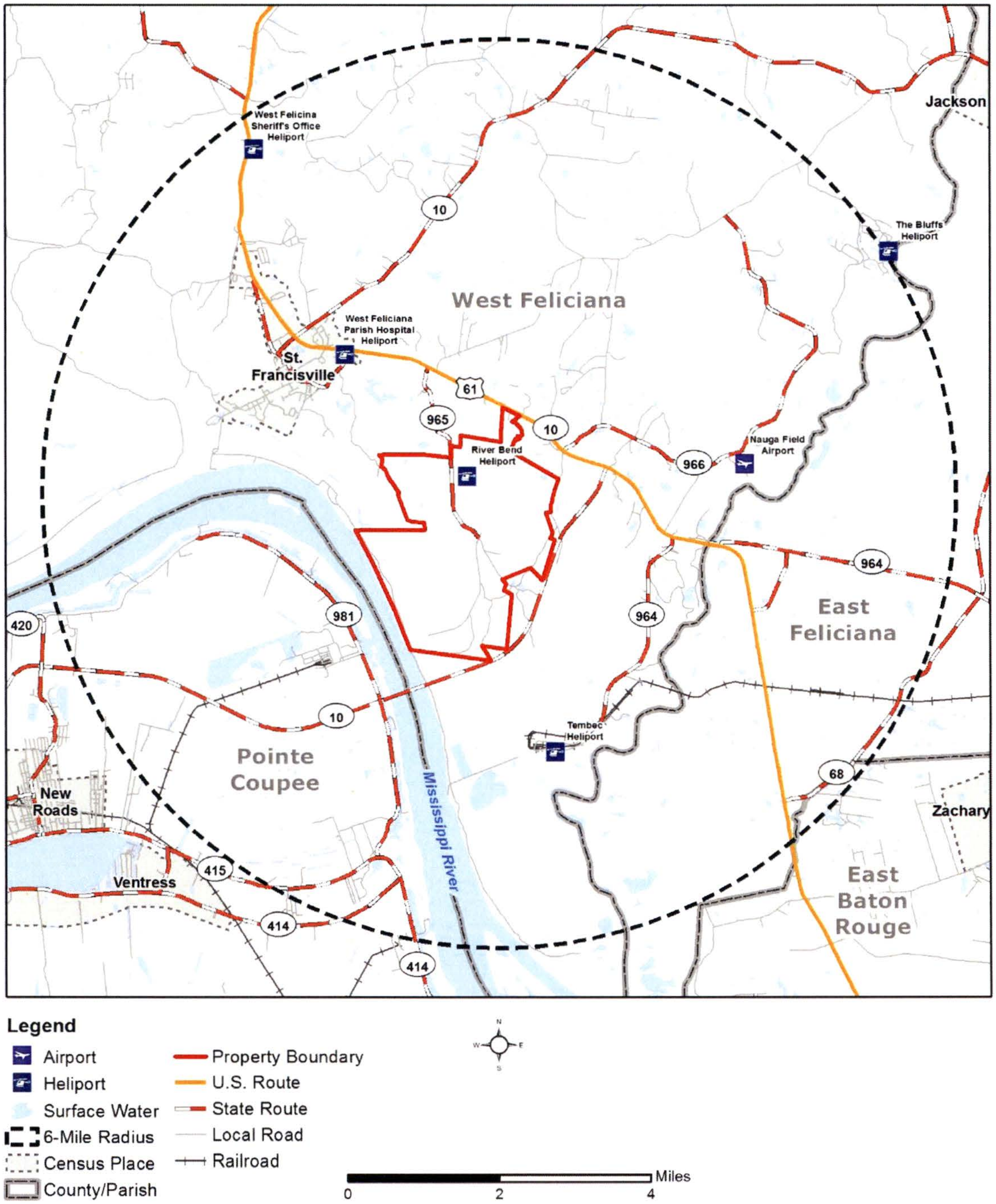
If you have any questions, please contact me at (601) 368-5823 or through my email address at rbuckle@entergy.com.

Rick Buckley

Rick Buckley, CHMM, REM
Sr. Project Manager, Environmental

Figure 1

Location of Entergy Property, 6-Mile Radius Map



Entergy

**Entergy Services, Inc**
1340 Echelon Parkway
Jackson, Mississippi 39213

June 15, 2016

Dr. Linda Langley
Tribal Historic Preservation Officer
Coushatta Tribe of Louisiana
Post Office Box 10
Elton, LA 70532

SUBJECT: River Bend Station Unit 1
License Renewal Application

CEO 2016-00046

Dear Dr. Langley,

In 2017, Entergy Louisiana, LLC and Entergy Operations, Inc. (collectively referred to as "Entergy") plans to apply to the Nuclear Regulatory Commission (NRC) for renewal of the operating license for the River Bend Station Unit 1 (RBS), which is located on the east bank of the Mississippi River in the southern portion of West Feliciana Parish, Louisiana, approximately 24 miles north-northwest of Baton Rouge, Louisiana. The existing operating license for RBS was issued for a 40-year term that expires in 2025. If the NRC approves the application, Entergy will then have the option to continue operating RBS until 2045. In conjunction with this effort, Entergy is gathering information relative to this license renewal project to assist with the preparation of the application.

The NRC requires that the license renewal application for RBS include an environmental report that assesses the potential environmental impacts from operation during the license renewal term. One of these potential environmental impacts would be the effect of license renewal on archaeological resources located on the RBS site, its immediate environs (6-mile radius) as shown in Figure 1, and transmission line corridors constructed for purposes of connecting the plant to the regional transmission grid. Accordingly, the NRC requires that the environmental report for each license renewal application assess such a potential effect (10 CFR 51 .53). Later, during its review of the license renewal environmental report pursuant to the National Environmental Policy the license renewal environmental report pursuant to the National Environmental Policy Act, the NRC may request information from your office to ensure compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (16 USC 470), and Federal Advisory Council on Historic Preservation regulations (36 CFR 800).

RBS is located on approximately 3,342 acres of Entergy owned land (Figure 1) that consists primarily of forest, woody wetlands and shrub. The RBS property is zoned as an industrial area by West Feliciana Parish. The land in the vicinity of the RBS site consists primarily of wetlands, forest, pasture, and shrub. Transmission lines that connect RBS to the regional electricity grid which the NRC considers to be within the scope of its environmental review for renewal of the RBS operating license are located entirely within the Entergy property.

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After your review of the information provided in this letter, I would appreciate you sending a letter detailing any concerns you may have about potential impacts to historic or archaeological resources on the property where RBS is located, or the immediate environs, or alternatively, confirming our conclusion that the operation of RBS during the license renewal term would have no effect on known historical or archaeological properties. Entergy will include copies of this letter and your response in the environmental report submitted to the NRC as part of the RBS license renewal application.

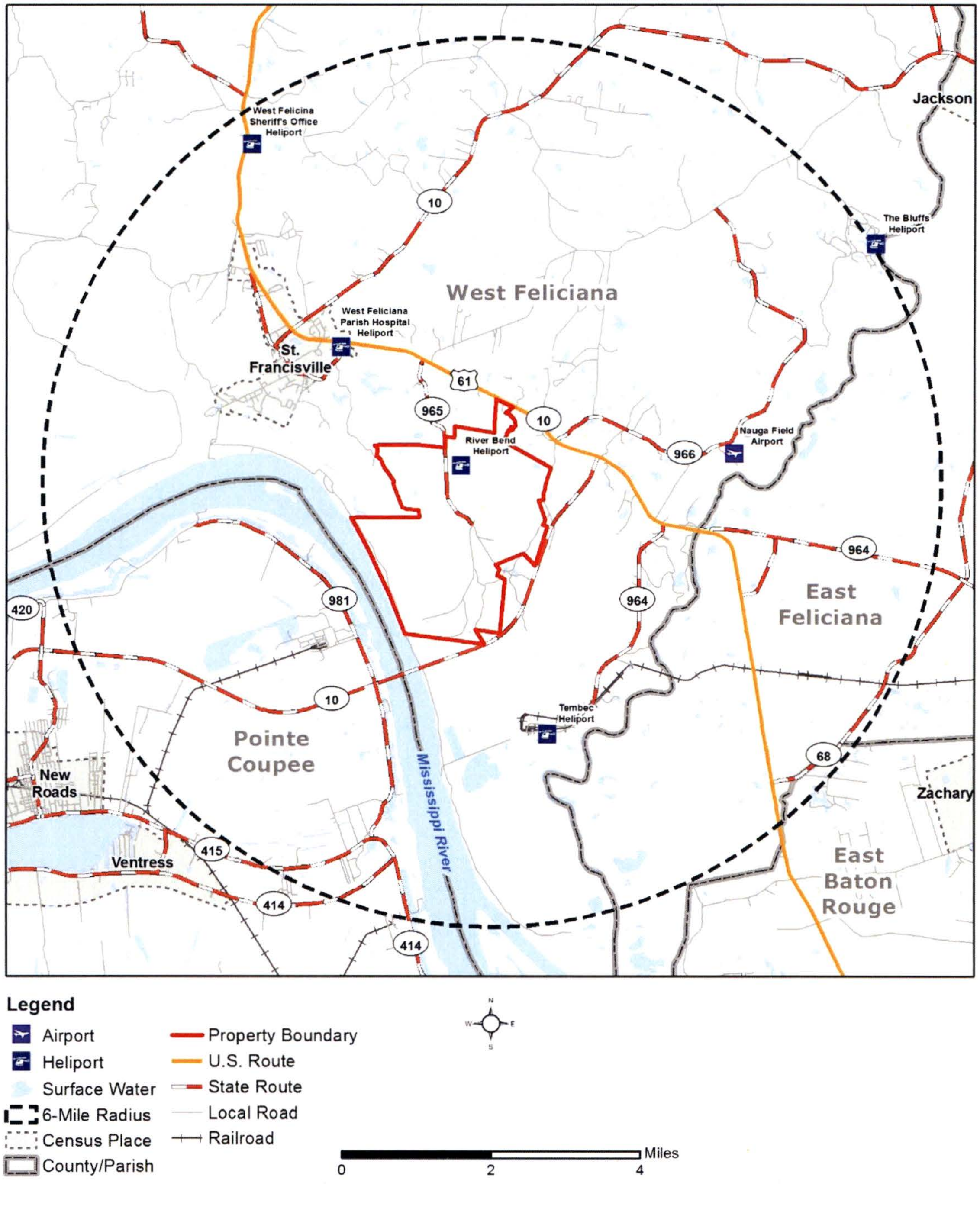
If you have any questions, please contact me at (601) 368-5823 or through my email address at rbuckle@entergy.com.

Rick Buckley

Rick Buckley, CHMM, REM
Sr. Project Manager, Environmental

## Figure 1

## Location of Entergy Property, 6-Mile Radius Map



**Entergy Services, Inc**
1340 Echelon Parkway
Jackson, Mississippi 39213

June 15, 2016

Ms. Alina Shively
Deputy Tribal Historic Preservation Officer
Jena Band of Choctaw Indians
Post Office Box 14
Jena, LA 71342

SUBJECT: River Bend Station Unit 1
License Renewal Application

CEO 2016-00047

Dear Ms. Shively,

In 2017, Entergy Louisiana, LLC and Entergy Operations, Inc. (collectively referred to as "Entergy") plans to apply to the Nuclear Regulatory Commission (NRC) for renewal of the operating license for the River Bend Station Unit 1 (RBS), which is located on the east bank of the Mississippi River in the southern portion of West Feliciana Parish, Louisiana, approximately 24 miles north-northwest of Baton Rouge, Louisiana. The existing operating license for RBS was issued for a 40-year term that expires in 2025. If the NRC approves the application, Entergy will then have the option to continue operating RBS until 2045. In conjunction with this effort, Entergy is gathering information relative to this license renewal project to assist with the preparation of the application.

The NRC requires that the license renewal application for RBS include an environmental report that assesses the potential environmental impacts from operation during the license renewal term. One of these potential environmental impacts would be the effect of license renewal on archaeological resources located on the RBS site, its immediate environs (6-mile radius) as shown in Figure 1, and transmission line corridors constructed for purposes of connecting the plant to the regional transmission grid. Accordingly, the NRC requires that the environmental report for each license renewal

application assess such a potential effect (10 CFR 51 .53). Later, during its review of the license renewal environmental report pursuant to the National Environmental Policy Act, the NRC may request information from your office to ensure compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (16 USC 470), and Federal Advisory Council on Historic Preservation regulations (36 CFR 800).

RBS is located on approximately 3,342 acres of Entergy owned land (Figure 1) that consists primarily of forest, woody wetlands and shrub. The RBS property is zoned as an industrial area by West Feliciana Parish. The land in the vicinity of the RBS site consists primarily of wetlands, forest, pasture, and shrub. Transmission lines that connect RBS to the regional electricity grid which the NRC considers to be within the scope of its environmental review for renewal of the RBS operating license are located entirely within the Entergy property.

Entergy does not expect RBS operations during the license renewal term to adversely affect any historic or archaeological resources since there are no plans to alter current operations during the 20-year license renewal period, and any maintenance activities necessary to support continued operation of RBS would be limited to currently developed areas of the site. Although administrative procedural controls are in place to comply with applicable state and federal laws to preserve cultural resources when facility expansion or land disturbance activities do occur, no expansion is planned or needed in support of license renewal.

After your review of the information provided in this letter, I would appreciate you sending a letter detailing any concerns you may have about potential impacts to historic or archaeological resources on the property where RBS is located, or the immediate environs, or alternatively, confirming our conclusion that the operation of RBS during the license renewal term would have no effect on known historical or archaeological properties. Entergy will include copies of this letter and your response in the environmental report submitted to the NRC as part of the RBS license renewal application.

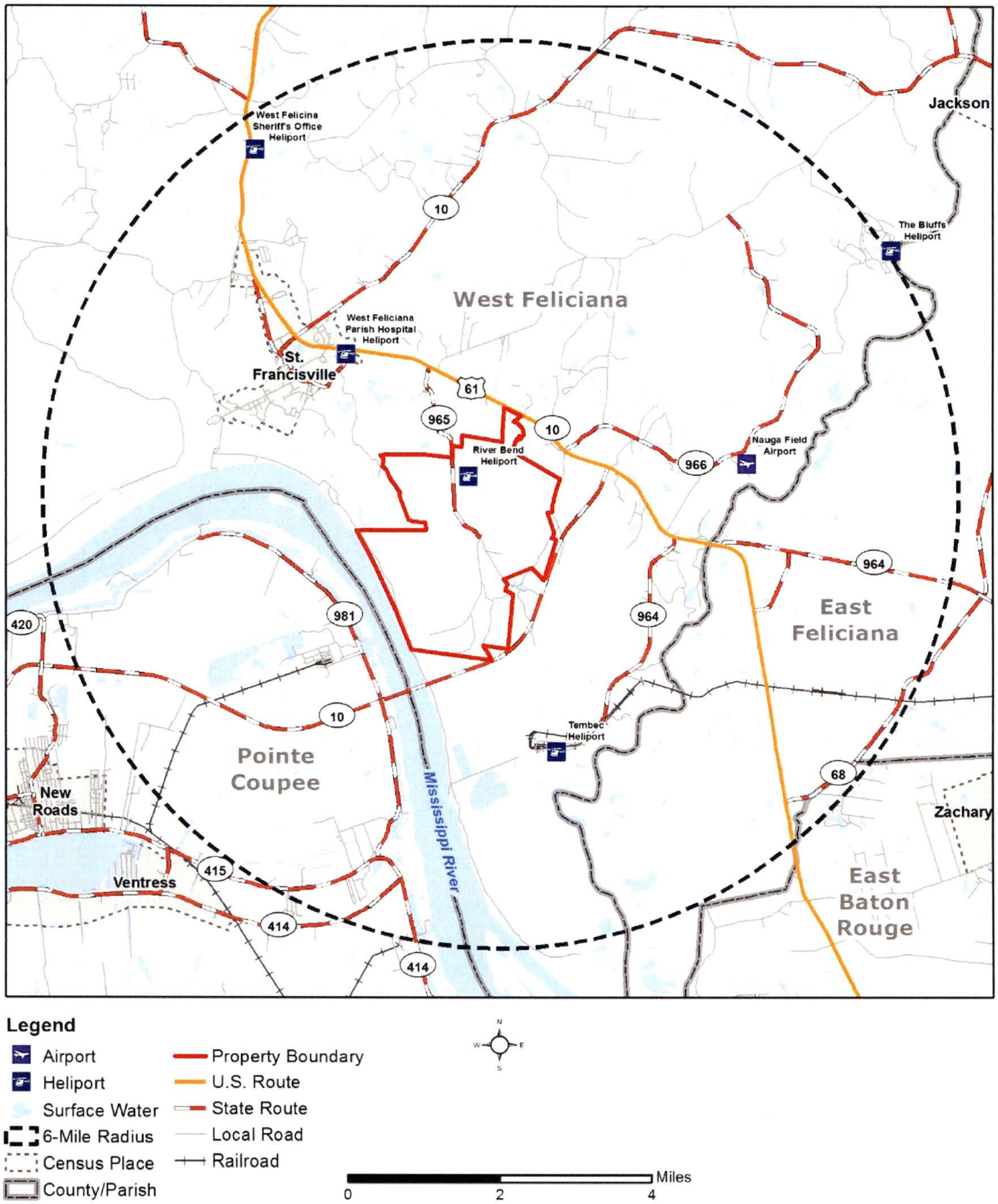
If you have any questions, please contact me at (601) 368-5823 or through my email address at rbuckle@entergy.com.

Rick Buckley

Rick Buckley, CHMM, REM
Sr. Project Manager, Environmental

## Figure 1

## Location of Entergy Property, 6-Mile Radius Map



Entergy Services, Inc
1340 Echelon Parkway
Jackson, Mississippi 39213

June 15, 2016

Ms. Phyliss J. Anderson, Chief
Mississippi Band of Choctaw Indians
Post Office Box 6257
Choctaw, MS 39350

SUBJECT: River Bend Station Unit 1
License Renewal Application

CEO 2016-00048

Dear Ms. Anderson,

In 2017, Entergy Louisiana, LLC and Entergy Operations, Inc. (collectively referred to as "Entergy") plans to apply to the Nuclear Regulatory Commission (NRC) for renewal of the operating license for the River Bend Station Unit 1 (RBS), which is located on the east bank of the Mississippi River in the southern portion of West Feliciana Parish, Louisiana, approximately 24 miles north-northwest of Baton Rouge, Louisiana. The existing operating license for RBS was issued for a 40-year term that expires in 2025. If the NRC approves the application, Entergy will then have the option to continue operating RBS until 2045. In conjunction with this effort, Entergy is gathering information relative to this license renewal project to assist with the preparation of the application.

The NRC requires that the license renewal application for RBS include an environmental report that assesses the potential environmental impacts from operation during the license renewal term. One of these potential environmental impacts would be the effect of license renewal on archaeological resources located on the RBS site, its immediate environs (6-mile radius) as shown in Figure 1, and transmission line corridors constructed for purposes of connecting the plant to the regional transmission grid. Accordingly, the NRC requires that the environmental report for each license renewal application assess such a potential effect (10 CFR 51 .53). Later, during its review of the license renewal environmental report pursuant to the National Environmental Policy

Act, the NRC may request information from your office to ensure compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (16 USC 470), and Federal Advisory Council on Historic Preservation regulations (36 CFR 800).

RBS is located on approximately 3,342 acres of Entergy owned land (Figure 1) that consists primarily of forest, woody wetlands and shrub. The RBS property is zoned as an industrial area by West Feliciana Parish. The land in the vicinity of the RBS site consists primarily of wetlands, forest, pasture, and shrub. Transmission lines that connect RBS to the regional electricity grid which the NRC considers to be within the scope of its environmental review for renewal of the RBS operating license are located entirely within the Entergy property.

Entergy does not expect RBS operations during the license renewal term to adversely affect any historic or archaeological resources since there are no plans to alter current operations during the 20-year license renewal period, and any maintenance activities necessary to support continued operation of RBS would be limited to currently developed areas of the site. Although administrative procedural controls are in place to comply with applicable state and federal laws to preserve cultural resources when facility expansion or land disturbance activities do occur, no expansion is planned or needed in support of license renewal.

After your review of the information provided in this letter, I would appreciate you sending a letter detailing any concerns you may have about potential impacts to historic or archaeological resources on the property where RBS is located, or the immediate environs, or alternatively, confirming our conclusion that the operation of RBS during the license renewal term would have no effect on known historical or archaeological properties. Entergy will include copies of this letter and your response in the environmental report submitted to the NRC as part of the RBS license renewal application.

If you have any questions, please contact me at (601) 368-5823 or through my email address at rbuckle@entergy.com.

Rick Buckley

Rick Buckley, CHMM, REM
Sr. Project Manager, Environmental

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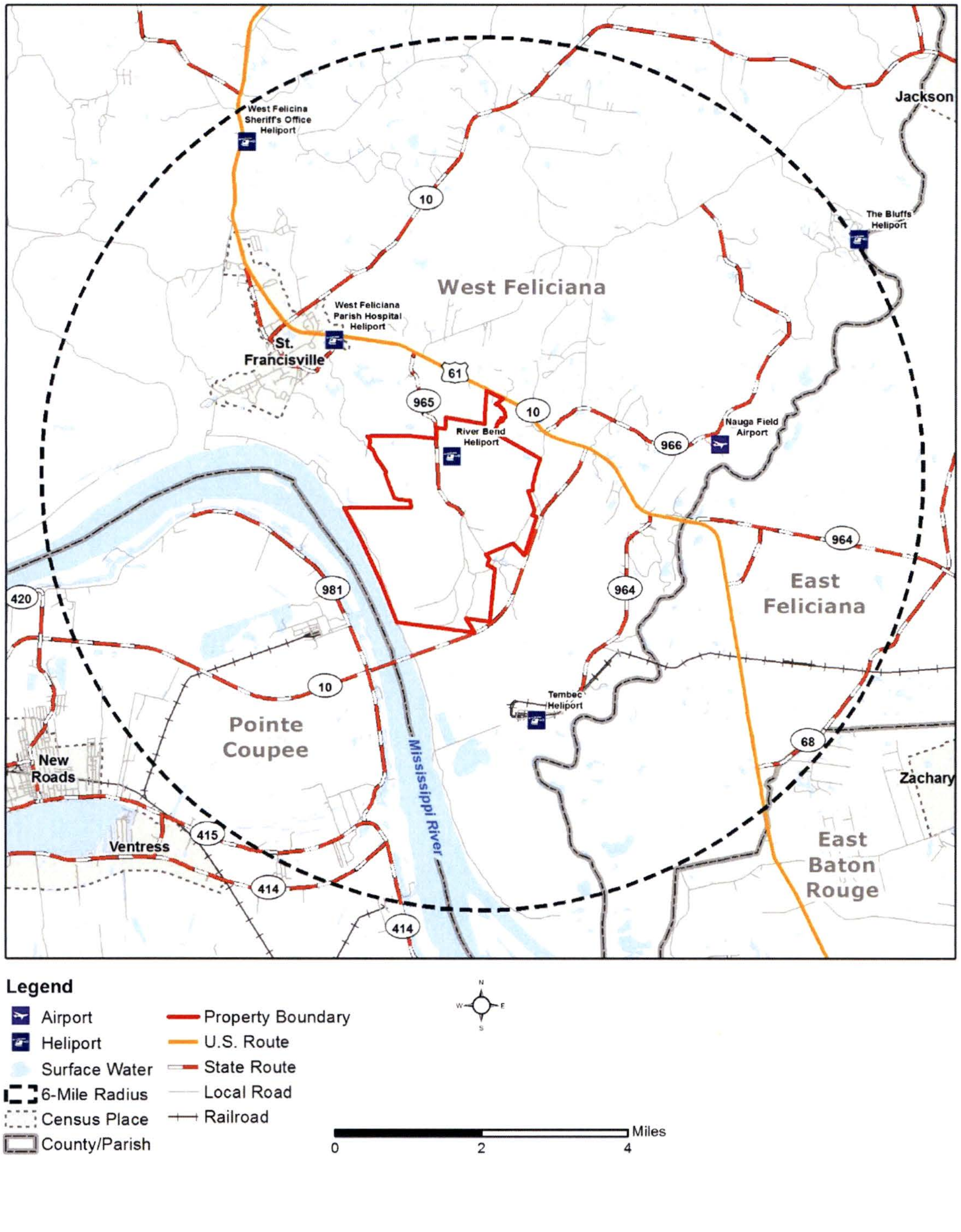

Entergy

**Entergy Services, Inc**
1340 Echelon Parkway
Jackson, Mississippi 39213

June 15, 2016

Mr. Earl J. Barbry, Jr
Tribal Historic Preservation Officer
Tunica-Biloxi Tribe of Louisiana
Post Office Box 1589
Marksville, LA 71351

SUBJECT: River Bend Station Unit 1
License Renewal Application

CEO 2016-00049

Dear Mr. Barbry,

In 2017, Entergy Louisiana, LLC and Entergy Operations, Inc. (collectively referred to as "Entergy") plans to apply to the Nuclear Regulatory Commission (NRC) for renewal of the operating license for the River Bend Station Unit 1 (RBS), which is located on the east bank of the Mississippi River in the southern portion of West Feliciana Parish, Louisiana, approximately 24 miles north-northwest of Baton Rouge, Louisiana. The existing operating license for RBS was issued for a 40-year term that expires in 2025. If the NRC approves the application, Entergy will then have the option to continue operating RBS until 2045. In conjunction with this effort, Entergy is gathering information relative to this license renewal project to assist with the preparation of the application.

The NRC requires that the license renewal application for RBS include an environmental report that assesses the potential environmental impacts from operation during the license renewal term. One of these potential environmental impacts would be the effect of license renewal on archaeological resources located on the RBS site, its immediate environs (6-mile radius) as shown in Figure 1, and transmission line corridors constructed for purposes of connecting the plant to the regional transmission grid. Accordingly, the NRC requires that the environmental report for each license renewal

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RBS is located on approximately 3,342 acres of Entergy owned land (Figure 1) that consists primarily of forest, woody wetlands and shrub. The RBS property is zoned as an industrial area by West Feliciana Parish. The land in the vicinity of the RBS site consists primarily of wetlands, forest, pasture, and shrub. Transmission lines that connect RBS to the regional electricity grid which the NRC considers to be within the scope of its environmental review for renewal of the RBS operating license are located entirely within the Entergy property.

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After your review of the information provided in this letter, I would appreciate you sending a letter detailing any concerns you may have about potential impacts to historic or archaeological resources on the property where RBS is located, or the immediate environs, or alternatively, confirming our conclusion that the operation of RBS during the license renewal term would have no effect on known historical or archaeological properties. Entergy will include copies of this letter and your response in the environmental report submitted to the NRC as part of the RBS license renewal application.

If you have any questions, please contact me at (601) 368-5823 or through my email address at rbuckle@entergy.com.

Rick Buckley

Rick Buckley, CHMM, REM
Sr. Project Manager, Environmental

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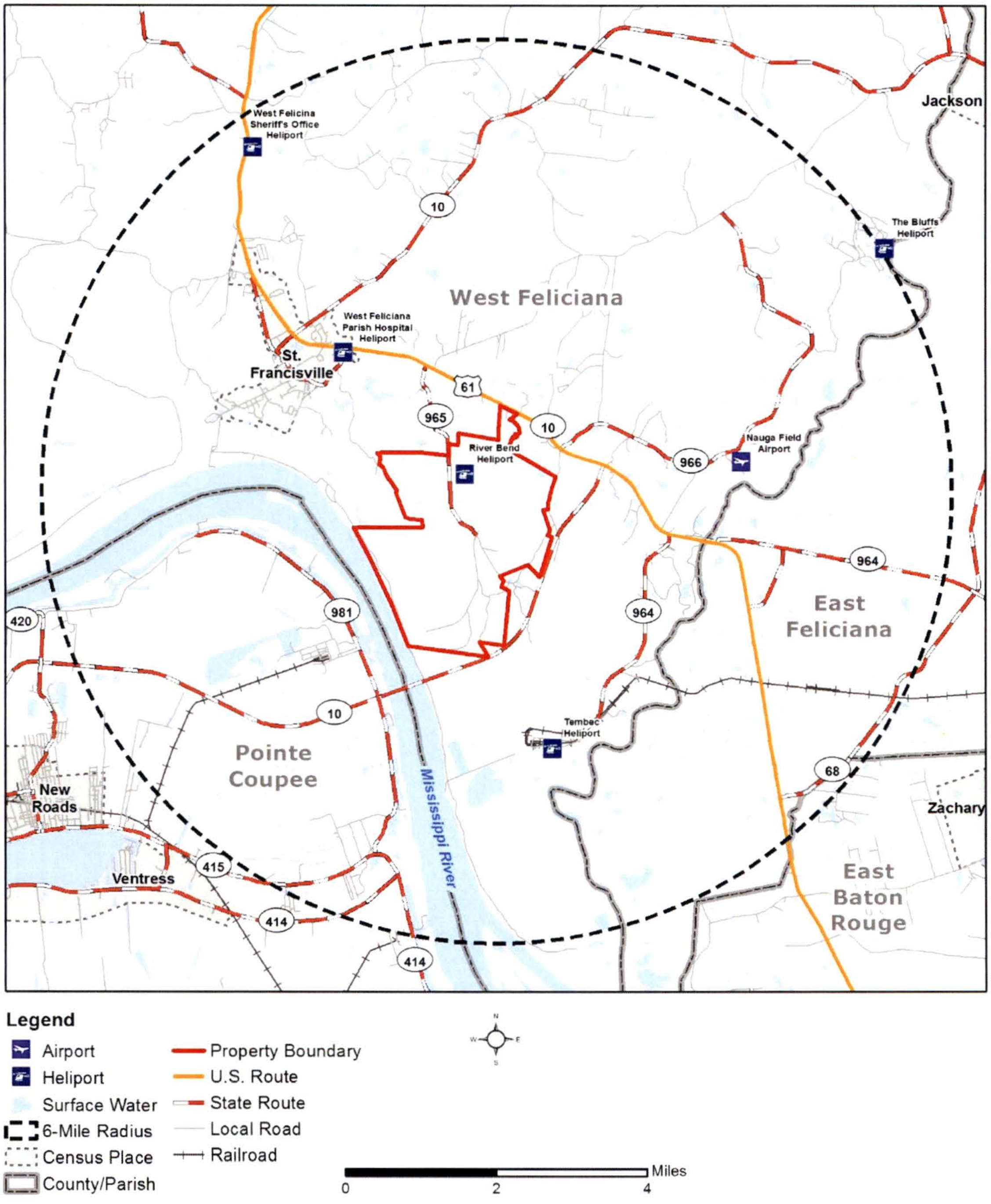

# COUSHATTA TRIBE

## OF LOUISIANA

### HERITAGE DEPARTMENT

July 7, 2016

Rick Buckley
Sr. Project Manager, Environmental
Entergy
1340 Echelon Parkway
Jackson, MS 39213

Subject: River Bend Station Unit 1, License Renewal Application

Dear Mr. Buckley:

The Coushatta Tribe of Louisiana Heritage Department has reviewed the above reference proposed undertaking, and we are in concurrence with your findings of "no historic properties affected".

At this time, I know of no known sacred or ceremonial sites in the immediate area, and do not require further Section 106 consultation on this project. However, if any cultural resources such as, bone, pottery, stone tools, etc., are found subsequently, we may elect to discuss additional mitigation steps, including on-site monitoring. In the event that archaeological properties or human remains are discovered, please stop work and contact us immediately, consistent with Section IX of the Nationwide Programmatic Agreement and applicable laws.

Sincerely,

Jill Crawford

Jill Crawford,
Section 106 Coordinator



337-584-1560 337-584-1616 (FAX) PO BOX 10 ELTON, LA 70532

Entergy

**Entergy Services, Inc**
1340 Echelon Parkway
Jackson, Mississippi 39213

Mr. Phil Boggan
Office of Historic Preservation
Division of Historic Preservation
Post Office Box 44247
Baton Rouge, LA 70804

No known historic properties will be affected by this undertaking. Therefore, our office has no objection to the implementation of this project. This effect determination could change should new information come to our attention.

Phil Boggan
State Historic Preservation Officer

Date
07/15/2016

SUBJECT: River Bend Station Unit 1
License Renewal Application

CEO 2016-00043

Dear Mr. Boggan,

In 2017, Entergy Louisiana, LLC and Entergy Operations, Inc. (collectively referred to as "Entergy") plans to apply to the Nuclear Regulatory Commission (NRC) for renewal of the operating license for the River Bend Station Unit 1 (RBS), which is located on the east bank of the Mississippi River in the southern portion of West Feliciana Parish, Louisiana, approximately 24 miles north-northwest of Baton Rouge, Louisiana. The existing operating license for RBS was issued for a 40-year term that expires in 2025. If the NRC approves the application, Entergy will then have the option to continue operating RBS until 2045. In conjunction with this effort, Entergy is gathering information relative to this license renewal project to assist with the preparation of the application.

The NRC requires that the license renewal application for RBS include an environmental report that assesses the potential environmental impacts from operation during the license renewal term. One of these potential environmental impacts would be the effect of license renewal on archaeological resources located on the RBS property, its immediate environs (6-mile radius) as shown in Figure 1, and transmission line corridors constructed for purposes of connecting the plant to the regional transmission grid. Accordingly, the NRC requires that the environmental report for each license

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renewal application assess such a potential effect (10 CFR 51.53). Later, during its review of the license renewal environmental report pursuant to the National Environmental Policy Act, the NRC may request information from your office to ensure compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (16 USC 470), and Federal Advisory Council on Historic Preservation regulations (36 CFR 800).

RBS is located on approximately 3,342 acres of Entergy owned land (Figure 1) that consists primarily of forest, woody wetlands and shrub. The RBS property is zoned as an industrial area by West Feliciana Parish. The land in the vicinity of the RBS site consists primarily of wetlands, forest, pasture, and shrub. Transmission lines that connect RBS to the regional electricity grid which the NRC considers to be within the scope of its environmental review for renewal of the RBS operating license are located entirely within the Entergy property.

Although not required, Entergy voluntarily contracted with Coastal Environments, Inc. to conduct a Phase 1A literature review and archaeological sensitivity assessment of the Entergy property in August 2015 to supplement RBS's existing administrative controls to ensure that potential resources are properly managed during the license renewal period. Table 1 lists archaeological resources within a 6-mile radius of RBS while Table 2 lists National Register of Historic Places (NRHP) properties within this same radius that were identified by Entergy during our view. This assessment, which is included in Attachment 1, determined that no cultural resources would be impacted as a result of renewal of the RBS operating license.

Entergy does not expect RBS operations during the license renewal term to adversely affect any historic or archaeological resources since there are no plans to alter current operations during the 20-year license renewal period, and any maintenance activities necessary to support continued operation of RBS would be limited to currently developed areas of the site. Although administrative procedural controls are in place to comply with applicable state and federal laws to preserve cultural resources when facility expansion or land disturbance activities do occur, no expansion is planned or needed in support of license renewal.

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If you have any questions, please contact me at (601) 368-5823 or through my email address at rbuckle@entergy.com.

Rick Buckley

Rick Buckley, CHMM, REM
Sr. Project Manager, Environmental

**BUCKLEY, RICKY N**

| | |
|---|---|
| **From:** | Lindsey Bilyeu <lbilyeu@choctawnation.com> |
| **Sent:** | Wednesday, August 24, 2016 12:01 PM |
| **To:** | BUCKLEY, RICKY N |
| **Subject:** | River Bend Station unit 1 License Renewal Application |

## EXTERNAL SENDER. DO NOT click links if sender is unknown. DO NOT provide your user ID or password.

We apologize for the delay of our response on the above referenced project,

The Choctaw Nation of Oklahoma thanks the NRCS for consultation on the above-referenced project. This project is located within a general area of historic interest to the Tribe. Native American archaeological materials encountered in and around the project area may potentially be culturally affiliated with the Choctaw Nation of Oklahoma. Our Office concurs that "operation of RBS during the license renewal term will have no effect on known historical or archaeological properties". In the future if there are any ground disturbing activities please contact our department.

Thank you,

Ryan L. Spring
Director, GIS/GPS Specialist
Historic Preservation Dept.
Choctaw Nation of Oklahoma
(800) 522-6170 Ext. 2137
rspring@choctawnation.com
www.choctawnation.com
www.choctawnationculture.com

# Attachment D

# Severe Accident Mitigation Alternatives Analysis

# Attachment D

## Severe Accident Mitigation Alternatives Analysis

Attachment D contains the following sections:

D.1 – Evaluation of River Bend Station Probabilistic Risk Analysis Model

D.2 – Evaluation of River Bend Station SAMA Candidates

## TABLE OF CONTENTS

## List of Tables

## List of Acronyms

| | |
|---|---|
| AB | Auxiliary Building |
| AC | Alternating Current |
| ACU | Air Conditioning Unit |
| ADS | Automatic Depressurization System |
| ANS | American Nuclear Society |
| AOP | Abnormal Operating Procedure |
| ASME | American Society Of Mechanical Engineers |
| ATWS | Anticipated Transient Without Scram |
| BOC | Break Outside Containment |
| BWR | Boiling Water Reactor |
| BWROG | BWR Owners' Group |
| CCDP | Conditional Core Damage Probability |
| CCF | Common Cause Failure |
| CDF | Core Damage Frequency |
| CET | Containment Event Tree |
| CFC | Containment Fan Coolers |
| CFBVB | Containment Failure Before Vessel Breach |
| CHR | Containment Heat Removal |
| CNS | Condensate Makeup, Storage, and Transfer |
| CRD | Control Rod Drive |
| CST | Condensate Storage Tank |
| DC | Direct Current |
| DCH | Direct Containment Heating |
| DET | Decomposition Event Tree |
| DW | Drywell |
| EAL | Emergency Action Level |
| ECCS | Emergency Core Cooling System |
| EDG | Emergency Diesel Generator |
| ELAP | Extended Loss of AC Power |
| EOP | Emergency Operating Procedure |
| EPRI | Electric Power Research Institute |
| FIVE | Fire-Induced Vulnerability Evaluation |
| FLEX | Diverse and Flexible Strategies (in response to NRC Order EA-12-049) |
| FWLB | Feedwater Line Break |
| FPW | Fire Protection Water |
| GE | General Emergency |
| GMP | Gross Metropolitan Product |
| HCS | Hydrogen Control System |

| | |
|---|---|
| HCTL | Heat Capacity Temperature Limit |
| HEP | Human Error Probability |
| HFE | Human Failure Event |
| HPCS | High Pressure Core Spray |
| HRA | Human Reliability Analysis |
| HVAC | Heating, Ventilation, And Air Conditioning |
| HCOG | Hydrogen Control Owners Group |
| IAS | Instrument Air System |
| IE | Initiating Event |
| IPE | Individual Plant Examination |
| IPEEE | Individual Plant Examination Of External Events |
| ISLOCA | Interfacing Systems Loss Of Coolant Accident |
| LERF | Large Early Release Frequency |
| LOCA | Loss Of Coolant Accident |
| LOSP (or LOOP) | Loss Of Offsite Power (Also Referred To As "LOOP") |
| LPCI | Low Pressure Coolant Injection |
| LPCS | Low Pressure Core Spray |
| MAAP | Modular Accident Analysis Program |
| MACR | Maximum Averted Cost Risk |
| MCCI | Molten Core Concrete Interactions |
| MCR | Model Change Request |
| MMACR | Modified Maximum Averted Cost Risk |
| MOV | Motor Operated Valve |
| MSIV | Main Steam Isolation Valve |
| MSLB | Main Steam Line Break |
| MWS | Makeup Water System |
| NHD | National Hydrography Dataset |
| NPSH | Net Positive Suction Head |
| NRC | Nuclear Regulatory Commission |
| NSW | Normal Service Water |
| PRA | Probabilistic Risk Assessment |
| RBS | River Bend Station |
| RCIC | Reactor Core Isolation Cooling |
| RHR (or RHS) | Residual Heat Removal |
| RLE | Review Level Earthquake |
| RPCCW | Reactor Plant Component Cooling |
| RPS | Reactor Protection System |
| RPT | Recirculation Pump Trip |
| RPV (or RV) | Reactor Pressure Vessel |

| | |
|---|---|
| RRW | Risk Reduction Worth |
| RWST | Refueling Water Storage Tank |
| SAMA | Severe Accident Mitigation Alternative |
| SBO | Station Blackout |
| SCDF | Seismic Core Damage Frequency |
| SLC | Standby Liquid Control |
| SPC | Suppression Pool Cooling |
| SRA | Safety/Risk Assessment |
| SRP | Standard Review Plan |
| SRT | Seismic Review Team |
| SRV | Safety Relief Valve |
| STC | Source Term Category |
| SW | Service Water |
| SSE | Safe Shutdown Earthquake |
| SSW | Standby Service Water |
| SWC | Service Water Cooling |

# ATTACHMENT D.1

## EVALUATION OF THE RIVER BEND STATION PRA MODEL

## D.1 EVALUATION OF RIVER BEND STATION PROBABILISTIC RISK ASSESSMENT MODEL

The severe accident risk for River Bend Station (RBS) was estimated using the RBS Probabilistic Risk Assessment (PRA) model and a Level 3 model developed using Version 3.10.0 of the Windows Interface for MACCS2, MELCOR Accident Consequence Code (WinMACCS) [D.1-2]. The CAFTA suite of codes was used to develop the RBS PRA Level 1 and Level 2 models. The following sections provide descriptions of RBS PRA levels 1 and 2 analyses, Core Damage Frequency (CDF) uncertainty, Individual Plant Examination of External Events (IPEEE) analyses, PRA model revisions and peer review, and the level 3 analysis.

### D.1.1 PRA Model – Level 1 Analysis

The Level 1 PRA model used for the RBS SAMA analysis was the RBS Version 5A PRA model which was approved in May 2015 [D.1-1]. This model is the result of an interim update of RBS Revision 5 (March 2011) model. The Revision 5A model was developed to incorporate findings from the Boiling Water Reactor Owner's Group (BWROG) Peer Review of the RBS PRA [D.1-3] and to incorporate improvements in the service water system modeling.

This model reflects the RBS as-built, as-operated configuration as of April 30, 2009 [D.1-4]. No other planned major plant modifications, which could adversely impact the SAMA analysis results, have been identified.

The RBS internal events baseline at power CDF is 2.79E-06/Reactor-year (Rx-yr) [D.1-1]. These results were obtained by quantifying the models at a truncation frequency of 1E-12/Rx-yr. These results do not include contributions from internal flooding (see Section D.1.3.4). The initiator contribution to CDF is provided in Table D.1-1. The approximate CDF contributions from Anticipated Transient Without Scram (ATWS) and Station Blackout (SBO) are included in Table D.1-1.

The RBS model quantification results were reviewed to identify those potential risk contributors that made a significant contribution to CDF. CDF-based Risk Reduction Worth (RRW) rankings were reviewed down to 1.005. Events below this point would influence the CDF by less than 0.5% and are judged to be highly unlikely contributors for the identification of cost-beneficial enhancements. These basic events, which include component failures, operator actions, and initiating events, were reviewed to determine if additional SAMA actions may need to be considered.

Table D.1-2 provides a listing of Level 1 RRW risk significant events (component failures, operator actions, and initiating events) down to a RRW of 1.005 obtained from the RBS R5A PRA model results and correlates each event to the SAMAs that are applicable to it.

**Table D.1-1 – RBS PRA Model CDF Results by Major Initiators**

| Initiating Event | Initiator CDF (per Rx-yr) | Initiator CDF (per Rx-yr) (1) | % CDF |
|---|---|---|---|
| IE-A | Large Loss of Coolant Accident (LOCA) | 3.93E-11 | 0.00% |
| IE-S1 | Intermediate LOCA | 9.12E-09 | 0.33% |
| IE-S2 | Small LOCA | 1.68E-09 | 0.06% |
| IE-S3 | Small-Small Break LOCA (Recirculation Pump Seal LOCA) | 1.03E-08 | 0.37% |
| IE-SSW55A | Standby Service Water (SSW) Train A Return Line Spuriously Opens | 9.93E-09 | 0.36% |
| IE-SSW55B | SSW Train B Return Line Spuriously Opens | 1.22E-09 | 0.04% |
| IE-T1 | Loss of Offsite Power | 1.92E-06 | 68.93% |
| IE-T2 | Loss of Condenser Heat Sink | 7.28E-08 | 2.61% |
| IE-T3A | Reactor Trip/Turbine Trip | 2.78E-07 | 9.98% |
| IE-T3B | Loss of the Feedwater / Condensate System | 6.84E-08 | 2.46% |
| IE-T3C | Inadvertent Opening of Safety Relief Valve (SRV) | 1.53E-07 | 5.50% |
| IE-TCCP | Loss of the Reactor Plant Component Cooling Water (RPCCW) System | 6.00E-09 | 0.22% |
| IE-TCCS | Failure of The Turbine Plant Closed Cooling Water System | 6.78E-12 | 0.00% |
| IE-TCRD | Loss of Control Rod Drive (CRD) Flow to the Headers | 1.87E-10 | 0.01% |
| IE-TDCI | Loss of 125 V DC Bus A | 7.06E-10 | 0.03% |
| IE-TDCII | Loss of 125 V DC Bus B | 5.86E-10 | 0.02% |
| IE-TIAS | Loss of Instrument Air | 1.70E-08 | 0.61% |
| IE-TMST | Loss of Main Steam Tunnel Cooling | 1.62E-09 | 0.06% |
| IE-TNPS-A | Loss of NPS-SWG1A | 4.05E-09 | 0.14% |
| IE-TNPS-B | Loss of NPS-SWG1B | 2.25E-09 | 0.08% |
| IE-TNSW | Failure of the Normal Service Water (NSW)/Service Water Cooling (SWC) System | 1.19E-07 | 4.27% |
| IE-TRSS1 | Loss of Offsite Power Lead RSS1 | 4.99E-08 | 1.79% |
| IE-TRSS2 | Loss of Offsite Power Lead RSS2 | 4.63E-08 | 1.66% |
| IE-VRUP | Reactor Vessel (RV) Rupture | 1.30E-08 | 0.47% |
| | | | |
| TB | Station Blackout | 1.09E-06 | 39.05% |
| TC | ATWS | 6.59E-09 | 0.24% |

**Table D.1-2 - Correlation of Level 1 Risk Significant Terms to SAMAs (Based on CDF)**

| Event Name | Probability | RRW | Event Description | Disposition |
|---|---|---|---|---|
| IE-T1 | 1.92E-02 | 3.213 | LOSS OF OFFSITE POWER INITIATING EVENT | This item represents a loss of offsite power. SAMAs 14, 15 and 38 address this item. |
| ZRC-XHE-FO-DHRLT | 6.54E-01 | 1.748 | NO RECOVERY OF TW SEQUENCE LONG TERM | This item represents the failure to recover a method of decay heat removal in long term sequences. SAMAs 79, 80, 110, 115, 120 and 201 address this item. |
| ZHE-FO-T12-0RUN | 3.41E-02 | 1.574 | Failure to Recover Offsite Power before 12 Hours (0 run failures) | This item represents the failure to recover offsite power before 12 hours in a SBO. SAMAs 14, 15, and 38 address this item. |
| B21-SRV-OO-1SRV | 3.00E-02 | 1.383 | FAILURE OF ONE SRV TO RECLOSE | This item represents failure of one SRV to reclose after it opened following a reactor SCRAM. SAMAs 108 and 160 address this item. |
| SWP-XHE-FO-RETRN | 1.00E+00 | 1.355 | Operator Fails to open SWP manual isolation valve before containment over-pressurization failure | This item represents failure of the operator to open manual valves downstream of SWP-F055A or F055B to restore decay heat removal. Related to ZHE-FO-SWRETRN. SAMAs 80, 110, 115 and 120 address this item. |
| SWP-XHE-RE-F055A | 8.00E-03 | 1.281 | OPERATOR FAILS TO RESTORE XOV DOWNSTREAM OF F055A | This item represents the failure to restore manual valve downstream of SWP-F055A (SSW Train A Standby Cooling Tower inlet path) following maintenance or testing. SAMAs 80, 110, 115 and 120 address this item. |
| ZHE-FO-DGN1HRS | 7.72E-01 | 1.256 | Failure to Recover Diesel From Hardware Failure within 1 Hour | This item represents the failure to recover an emergency diesel generator following a hardware failure. SAMAs 21, 22, 30, 33, and 204 address this item. |
| LOSP-ECCS | 1.00E-02 | 1.206 | Conditional LOSP given LOCA signal after a plant trip | This item represents a loss of offsite power as a result of plant response to a LOCA event. SAMAs 14, 15, and 38 address this item. |
| E12-MDP-MA-C002A | 4.98E-03 | 1.143 | RHR PUMP A IS UNAVAILABLE DUE TO MAINTENANCE | This item represents the unavailability of RHR A pump because of maintenance. SAMAs 79, 110, 115, 120 and 198 address this item. |
| SWP-MDS-C3-3SWFS | 2.28E-04 | 1.123 | 3 OR MORE SSW PUMPS CCF TO START | This item represents the common cause failure of 3 or more SSW pumps. SAMAs 75 and 80 address this item. |
| FPW-XHE-LO-T2SBO | 5.00E-01 | 1.117 | OPERATOR FAILS TO FOLLOW ATTACHMENT 2 FOR SBO | This item represents the failure of operators to follow Attachment 2 of the SBO procedure (fire water injection to reactor vessel. Same as ZHE-FO-FPWSTARTSB. SAMAs 14, 15 and 38 address this item. |

**Table D.1-2 - Correlation of Level 1 Risk Significant Terms to SAMAs (Based on CDF)**

| Event Name | Probability | RRW | Event Description | Disposition |
|---|---|---|---|---|
| ZHE-FO-FPWSTARTSB | 1.00E-01 | 1.111 | ZHE-FO-FPWSTARTSB | This item represents the failure of operators to follow Attachment 2 of the SBO procedure. Same as FPW-XHE-LO-T2SBO. SAMAs 1, 2, 14, 15 and 38 address this item. |
| IE-T3A | 8.46E-01 | 1.111 | INITIATOR. REACTOR TRIP/TURBINE TRIP | This item represents a reactor trip/turbine due to a general transient. SAMA 197 addresses this item. |
| E12-MDP-MA-C002B | 7.41E-03 | 1.109 | RHR PUMP B IS UNAVAILABLE DUE TO MAINTENANCE | This item represents the unavailability of RHR pump B due to maintenance. SAMAs 79, 110, 115, 120 and 198 address this item. |
| EGS-DGN-FR-EG01A | 2.95E-02 | 1.103 | STANDBY DIESEL GENERATOR 1EGS*EG1A FAILS TO RUN | This event represents the failure of the Division 1 emergency diesel generator to continue to run. SAMAs 21, 22, 30 and 33 address this item. |
| ZHE-FO-T6-0RUN | 1.08E-01 | 1.088 | Failure to Recover Offsite Power before 6 Hours (0 run failures) | This event represents the failure to recover offsite power within 6 hours. SAMAs 1, 2, 14, 15, and 38 address this item. |
| EGS-DGN-FR-EG01B | 2.95E-02 | 1.086 | STANDBY DIESEL GENERATOR 1EGS*EG1B FAILS TO RUN | This event represents the failure of the Division 2 emergency diesel generator to continue to run. SAMAs 21, 22, 30 and 33 address this item. |
| SWP-MDS-MA-SWP2B | 6.50E-03 | 1.086 | STANDBY SERVICE WATER PUMP 1SWP*P2B IS OUT FOR MAINTENANCE | This item represents the unavailability of the Division 2 SSW pump due to maintenance. SAMAs 75 and 80 address this item. |
| SWP-XHE-RE-F055B | 8.00E-03 | 1.079 | OPERATOR FAILS TO RESTORE XOV DOWNSTREAM OF F055B | This item represents the failure to restore manual valve downstream of SWP-F055B (SSW Train B Standby Cooling Tower inlet path) following maintenance or testing. SAMAs 80, 110. 115 and 120 address this item. |
| IE-T3C | 2.11E-02 | 1.058 | INITIATOR. INADVERTENT OPENING OF SRV | This item represents an inadvertent opening of an SRV initiator. SAMAs 108 and 160 address this item. |
| HVR-CLU-MA-UC006 | 2.00E-03 | 1.054 | AUX BLDG UNIT COOLER 1HVR*UC6 OUT FOR MAINTENANCE | This item represents the unavailability of the RCIC room cooler due to maintenance. SAMAs 93, 94 and 97 address this item. |
| SWP-MDS-MA-SWP2D | 4.07E-03 | 1.052 | STANDBY SERVICE WATER PUMP 1SWP*P2D IS OUT FOR MAINTENANCE | This item represents the unavailability of SSW Pump D due to maintenance. SAMAs 75 and 80 address this item. |

**Table D.1-2 - Correlation of Level 1 Risk Significant Terms to SAMAs (Based on CDF)**

| Event Name | Probability | RRW | Event Description | Disposition |
|---|---|---|---|---|
| IE-TNSW | 3.40E-04 | 1.045 | INITIATOR. FAILURE OF THE NSW/SWC SYSTEM | This item represents a transient initiator due to loss of the normal service water system. SAMA 197 addresses this item. |
| E12-MOV-OO-F048A | 1.00E-03 | 1.032 | WATER DIVERTED FROM RHR A HXS BECAUSE BYPASS VALVE MOV F048A FAILS TO CLOSE | This event represents the failure of the Division 1 RHR heat exchanger bypass valve to close. SAMAs 110, 115 and 120 address this item. |
| ZHE-FO-T12-1RUN | 7.98E-03 | 1.032 | Failure to Recover Offsite Power before 12 Hours (1 run failure) | This item represents the failure to restore offsite power following a loss of offsite power. SAMAs 14, 15, and 38 address this item. |
| E12-MOV-CC-F024A | 1.00E-03 | 1.030 | RHR-A Test return to Supp Pool E12MOVF024A FAILS TO OPEN | This item represents the failure of RHR valve E12-MOVF024A to open. SAMAs 110, 115 and 120 address this item. |
| EGS-DGN-MA-EG01B | 1.85E-02 | 1.029 | STANDBY DIESEL GENERATOR 1EGS*EG1B IS OUT FOR MAINTENANCE | This item represents the unavailability of the Division 2 emergency diesel generator due to maintenance. SAMAs 21, 22, 30, 33 and 204 address this item. |
| HVR-CLU-MA-UC009 | 2.00E-03 | 1.027 | UNIT COOLER 1HVR*UC9 OUT FOR MAINTENANCE | This item represents the unavailability of the RHR B and C rooms cooler due to maintenance. SAMAs 93, 94 and 97 address this item. |
| B21-SRV-OO-2SRV | 2.37E-03 | 1.027 | FAILURE OF TWO SRVs TO RECLOSE | This item represents the failure of two SRVs to close after they have opened in response to a transient initiator. SAMAs 108 and 160 address this item. |
| IE-T2 | 2.26E-01 | 1.027 | INITIATOR: LOSS OF CONDENSER HEAT SINK | This item represents a transient initiator due to loss of the condenser. SAMA 197 addresses this item. |
| SWP-MOV-CC-F055A | 1.00E-03 | 1.026 | MOTOR OPERATED VALVE 1SWP*MOV55A FAILS TO OPEN ON DEMAND | This item represents the failure of the SSW Train A Standby Cooling Tower inlet valve to open when demanded. SAMAs 75 and 80 address this item. |
| IE-T3B | 4.79E-02 | 1.025 | INITIATOR: LOSS OF THE FEEDWATER / CONDENSATE SYSTEM | This item represents a transient initiator due to the loss of the feedwater/condensate system. SAMAs 87 and 197 address this item. |

**Table D.1-2 - Correlation of Level 1 Risk Significant Terms to SAMAs (Based on CDF)**

| Event Name | Probability | RRW | Event Description | Disposition |
|---|---|---|---|---|
| ZHE-FO-SWRETRN | 6.00E-02 | 1.024 | Operator Fails to open SWP manual isolation valve before containment over-pressurization failure | This item represents the failure of operator to open manual valves downstream of SWP-F055A or F055B to restore decay heat removal. Related to SWP-XHE-FO-RETRN. SAMAs 80, 110, 115 and 120 address this item. |
| SWP-MOV-C2-FTO55 | 4.46E-05 | 1.023 | SSW COOLING TOWER RETURN VALVES MOVF055A&B CCF TO OPEN | This item represents the common cause failure of SSW valves SWP-F055A&B to open. SAMAs 75, 80, 110, 115, and 120 address this item. |
| ADS-XHE-FO-INDIV | 2.00E-01 | 1.023 | OPERATOR FAILS TO START ADS BY OPENING INDIVIDUAL ADS VALVES OR SRVs | This item represents failure of the operator to depressurize the reactor vessel with SRVs. SAMAs 44, 46 and 59 address this item. |
| EGS-DGN-FS-EG01A | 5.14E-03 | 1.022 | STANDBY DIESEL GENERATOR 1EGS*EG1A FAILS TO START ON DEMAND | This item represents failure of the Division 1 emergency diesel generator to start. SAMAs 21, 22, 30, 33 and 204 address this item. |
| LOSP-EPRI | 1.00E-03 | 1.020 | Conditional LOSP after a plant trip | This item represents a loss of offsite power as a result of a plant trip. SAMAs 14, 15 and 38 address this item. |
| ENB-BAT-PE-LBT4H | 1.00E+00 | 1.020 | BATTERY DEPLETION IN 4 HOURS | This item represents the depletion of safety related batteries in 4 hours in an SBO. SAMAs 1, 2 and 43 address this item. |
| ZHE-FO-T1-0RUN | 5.93E-01 | 1.020 | Failure to Recover Offsite Power before 1 Hour (0 run failures) | This item represents the failure to recover offsite power within one hour after a loss of offsite power. SAMAs 14, 15, and 38 address this item. |
| SWP-MDS-FS-SWP2B | 1.58E-03 | 1.019 | STANDBY SERVICE WATER MOTOR DRIVEN PUMP 1SWP*P2B FAILS TO START | This item represents the failure of the SSW Pump 2B to start. SAMAs 75 and 80 address this item. |
| SWP-MDS-FS-SWP2D | 1.58E-03 | 1.019 | STANDBY SERVICE WATER MOTOR DRIVEN PUMP 1SWP*P2D FAILS TO START | This item represents the failure of the SSW Pump 2D to start. SAMAs 75 and 80 address this item. |
| EGS-DGN-FS-EG01B | 5.14E-03 | 1.019 | STANDBY DIESEL GENERATOR 1EGS*EG1B FAILS TO START ON DEMAND | This item represents the failure of the Division 2 emergency diesel generator to start. SAMAs 21, 22, 30, 33 and 204 address this item. |

**Table D.1-2 - Correlation of Level 1 Risk Significant Terms to SAMAs (Based on CDF)**

| Event Name | Probability | RRW | Event Description | Disposition |
|---|---|---|---|---|
| IE-TRSS1 | 7.74E-02 | 1.018 | LOSS OF OFFSITE POWER LEAD RSS1 | This item represents a transient initiator due to the loss of the RSS1 offsite power lead. SAMAs 14, 15, 38 and 197 address this item. |
| ZHE-FO-T30-0RUN | 7.28E-01 | 1.018 | Failure to Recover Offsite Power before 30 Minutes (0 run failures) | This item represents the failure to recover offsite power within 30 minutes after a loss of offsite power. SAMAs 14, 15, and 38 address this item. |
| IE-TRSS2 | 7.74E-02 | 1.017 | LOSS OF OFFSITE POWER LEAD RSS2 | This item represents a transient initiator due to the loss of the RSS2 offsite power lead. SAMAs 14, 15, 38 and 197 address this item. |
| ZHE-FO-DEPRESS | 1.00E-03 | 1.017 | Failure to Depressurize by Opening Individual ADS Valves or SRVs | This item represents the failure to depressurize the reactor vessel with SRVs. SAMAs 44 and 59 address this item. |
| E12-MOV-OO-F048B | 1.00E-03 | 1.017 | WATER DIVERTED FROM RHR B HX BECAUSE BYPASS VALVE MOV F048B FAILS TO CLOSE | This event represents the failure of the Division 2 RHR heat exchanger bypass valve to close. SAMAs 110, 115 and 120 address this item. |
| E12-MDS-FS-C002A | 5.26E-04 | 1.016 | RHR PUMP A FAILS TO START | This event represents the failure of the Division 1 RHR pump to start. SAMAs 79, 110, 115, 120 and 198 address this item. |
| E12-MOV-CC-F024B | 1.00E-03 | 1.016 | RHR-B Test return to Supp Pool E12MOVF024B FAILS TO OPEN | This item represents the failure of the Division 2 RHR valve E12-F024B to close. SAMAs 110, 115, 120 and 198 address this item. |
| HVK-CHR-MA-CHL1D | 2.25E-01 | 1.014 | CHILLED WATER HVK*CHL1D EVAPORATOR/CONDENSER OUT FOR MAINTENANCE | This item represents the unavailability of Control Building Chiller HVK-CHL1D due to maintenance. SAMAs 93 and 94 address this item. See Note below. |
| SWP-MOV-C3-FTO40 | 3.47E-05 | 1.013 | 3 OR MORE OF 4 SSW PUMP DISCHARGE MOVS CCF TO OPEN | This item represents the common cause failure of 3 or more of 4 SSW pump discharge valves to open. SAMAs 75 and 80 address this item. |
| HVK-CHR-FS-CHL1B | 1.41E-02 | 1.013 | CHILLED WATER HVK*CHL1B EVAPORATOR/CONDENSER FAILS TO START | This item represents the failure of Control Building chiller HVK-CHL1B to start. SAMAs 93 and 94 address this item. See Note below. |

| Table D.1-2 - Correlation of Level 1 Risk Significant Terms to SAMAs (Based on CDF) | | | | |
|---|---|---|---|---|
| **Event Name** | **Probability** | **RRW** | **Event Description** | **Disposition** |
| E12-XHE-FO-SPCAL | 1.00E-01 | 1.012 | OPERATOR FAILS TO PROPERLY ALIGN AND ACTUATE THE SPC MODE OF RHR | This item represents the failure of the operator to align and start the suppression pool cooling mode of RHR. SAMAs 110, 115 and 120 address this item. |
| EGS-DGN-MA-EG01A | 9.68E-03 | 1.013 | STANDBY DIESEL GENERATOR 1EGS*EG1A IS OUT FOR MAINTENANCE | This item represents the unavailability of the Division 1 emergency diesel generator due to maintenance. SAMAs 21, 22, 30, 33 and 204 address this item. |
| SWP-XHE-FO-F055A | 2.00E-01 | 1.011 | OPERATOR FAILS TO OPEN SWP*MOV55A BEFORE AIR DEPLETION TO SWP-AOV599 | This item represents the failure of the operator to open valve SWP-MOV55A before air depletion to valve SWP-AOV599. SAMAs 14, 15, 38, 110, 115 and 120 address this item. |
| MWS-XHE-FO-CSTMU | 1.00E-01 | 1.010 | OPERATOR FAILS TO ALIGN MWS FOR CST WATER MAKE UP | This item represents the failure of the operator to align the makeup water system to the CST which ensures water available for CRD and feedwater/condensate. SAMAs 59 and 87 address this item. |
| ZHE-FO-T4-0RUN | 1.72E-01 | 1.010 | Failure to Recover Offsite Power before 4 Hours (0 run failures) | This item represents the failure to recover offsite power within 4 hours after a loss of offsite power. SAMAs 14, 15 and 38 address this item. |
| SWP-MOV-CC-F068A | 1.00E-03 | 1.010 | MOTOR OPERATED VALVE 1E12*MOV68A FAILS TO OPEN ON DEMAND | This item represents the failure of the service water return valve from the RHR A heat exchange to open. SAMAs 79 and 201 address this item. |
| ZHE-FO-T6-1RUN | 5.15E-02 | 1.009 | Failure to Recover Offsite Power before 6 Hours (1 run failure) | This item represents the failure to recover offsite power within 6 hours after a loss of offsite power. SAMAs 14, 15 and 38 address this item. |
| HVC-CLU-FS-ACU1B | 2.50E-03 | 1.009 | CHILLER EQUIPMENT ROOM A/C UNIT HVC-ACU1B FAILS TO START | This item represents the failure of the Division 2 Control Room air handling unit to start from standby status. SAMAs 93 and 94 address this item. See Note below. |
| HVC-CLU-FS-ACU2B | 2.50E-03 | 1.009 | STBY SWGR AIR HANDLING UNIT HVC*ACU2B FAN FAILS TO START | This item represents the failure of the Division 2 Standby Switchgear Room air handling unit to start from standby. SAMAs 93 and 94 address this item. See Note below. |
| HVC-CLU-FS-ACU3B | 2.50E-03 | 1.009 | CHILLER EQUIPMENT ROOM A/C UNIT HVC*ACU3B FAILS TO START | This item represents the failure of the Division 2 Chiller Equipment Room air handling unit to start from standby. SAMAs 93 and 94 address this item. See Note below. |

**Table D.1-2 - Correlation of Level 1 Risk Significant Terms to SAMAs (Based on CDF)**

| Event Name | Probability | RRW | Event Description | Disposition |
|---|---|---|---|---|
| E22-DGN-MA-EG01C | 8.54E-03 | 1.009 | STANDBY (HPCS) DIESEL GENERATOR 1E22*S001 IS OUT FOR MAINTENANCE | This item represents the unavailability of the Division 3 HPCS emergency diesel generator due to maintenance. SAMAs 21, 22, 30, 33 and 204 address this item. |
| SWP-MOV-CC-F055B | 1.00E-03 | 1.009 | MOTOR OPERATED VALVE 1SWP*MOV55B FAILS TO OPEN ON DEMAND | This item represents the failure of the SSW Train B Standby Cooling Tower inlet valve to open when demanded. SAMAs 75 and 80 address this item. |
| ENS-BAC-NO-SWG1B | 3.72E-05 | 1.009 | FAILURE OF THE 4160KV BUS 1ENS*SWG1B | This item represents the failure of the Division 2 4160 volt bus hardware. SAMA 34 addresses this item. |
| ENB-BAT-PE-LBT2H | 1.00E+00 | 1.009 | BATTERY DEPLETION IN 2 HOURS | This item represents the depletion of normal (non-safety related) batteries in 2 hours. SAMAs 1, 2 and 43 address this item. |
| E12-MDS-F1-C002A | 2.87E-04 | 1.009 | RHR PUMP A FAIL TO RUN DURING 1ST HOUR OF OPERATION | This item represents the fail to run of RHR Pump A in the first hour of operation. SAMAs 79, 110, 115, 120 and 198 address this item. |
| E12-MDS-FS-C002B | 5.26E-04 | 1.009 | RHR PUMP B FAILS TO START | This item represents the failure of RHR Pump B to start. SAMAs 79, 110, 115, 120 and 198 address this item. |
| SWP-MOV-CC-MV40B | 1.00E-03 | 1.008 | MOTOR OPERATED VALVE 1SWP*MOV40B FAILS TO OPEN ON DEMAND | This item represents the failure of the SSW Pump B discharge motor operated valve to open on pump start. SAMAs 75 and 80 address this item. |
| SWP-MOV-CC-MV40D | 1.00E-03 | 1.008 | MOTOR OPERATED VALVE 1SWP*MOV40D FAILS TO OPEN ON DEMAND | This item represents the failure of the SSW Pump D discharge motor operated valve to open on pump start. SAMAs 75 and 80 address this item. |
| EGF-MDS-C3-FOTPS | 2.22E-05 | 1.008 | CCF of all 3 Fuel Oil Tfer Pumps Fail to Start | This item represents the common cause failure of all three emergency diesel generator fuel oil transfer pumps to start. SAMA 30 addresses this item. |
| E22-MDS-FS-C001 | 4.75E-03 | 1.008 | HPCS PUMP FAILS TO START | This item represents the failure of the HPCS pump to start. SAMAs 44, 59 and 71 address this item. |
| SWP-XHE-RE-MRHAC | 8.00E-04 | 1.008 | OPERATOR FAILS TO RESTORE MANUAL VALVE VF014A AFTER RHR HXs A/C MAINTENANCE | This item represents the failure to restore the manual SSW supply valve to the Division 1 RHR heat exchanger. SAMAs 79, 110, 115 and 120 address this item. |
| HVC-CLU-MA-ACU1B | 2.00E-03 | 1.008 | HVC-ACU1B out for maintenance | This item represents the unavailability of the Division 2 Control Room air handling unit due to maintenance. SAMAs 93 and 94 address this item. See Note below. |

**Table D.1-2 - Correlation of Level 1 Risk Significant Terms to SAMAs (Based on CDF)**

| Event Name | Probability | RRW | Event Description | Disposition |
|---|---|---|---|---|
| HVC-CLU-MA-ACU2B | 2.00E-03 | 1.008 | STBY SWGR AIR HDLG UNIT HVC*ACU2B OUT FOR MAINTENANCE | This item represents the unavailability of the Division 2 Standby Switchgear Room air handling unit due to maintenance. SAMAs 93 and 94 address this item. See Note below. |
| HVC-CLU-MA-ACU3B | 2.00E-03 | 1.008 | HVC-ACU3B out for maintenance | This item represents the unavailability of the Division 2 Chiller Equipment Room air handling unit due to maintenance. SAMAs 93 and 94 address this item. See Note below. |
| HVC-FAN-FS-FN2BB | 2.00E-03 | 1.008 | ACU2B RETURN FAN HVC*FN2B FAILS TO START | This item represents the failure of the Division 2 Standby Switchgear return fan to start. SAMAs 93 and 94 address this item. See Note below. |
| E51-TDP-MA-SYSTM | 7.48E-03 | 1.007 | RCIC IN MAINTENANCE | This item represents the unavailability of the RCIC pump due to maintenance. SAMAs 44, 59 and 71 address this item. |
| ZHE-FO-RHRAB | 1.00E-05 | 1.007 | Failure to Align and Actuate Decay Heat Removal System | This item represents the failure to restore decay heat removal via SPC, SDC or containment unit coolers. SAMA 115 addresses this item. |
| E12-MOV-MA-F003A | 8.00E-04 | 1.007 | RHR TRAIN A HX DISCHARGE VALVE F003A IS UNAVAILABLE DUE TO MAINTENANCE | This item represents the unavailability of Division 1 RHR heat exchanger outlet isolation valve due to maintenance SAMAs 110, 115 and 120 address this item. |
| E12-MOV-MA-F047A | 8.00E-04 | 1.007 | RHR TRAIN A HX INLET VALVE F047A IS UNAVAILABLE DUE TO MAINTENANCE | This item represents the unavailability of Division 1 RHR heat exchanger inlet isolation valve due to maintenance. SAMAs 110, 115 and 120 address this item. |
| SWP-MOV-MA-F068A | 8.00E-04 | 1.007 | SSW RETURN FROM RHR HX VALVE E12-MOVF068A UNAVAILABLE DUE TO MAINTENANCE | This item represents the unavailability of the Division 1 SSW return valve from the RHR Division 1 heat exchanger due to maintenance. SAMAs 79, 110, 115 and 120 and 201 address this item. |
| HVK-CHR-MA-CHL1B | 1.10E-01 | 1.007 | CHILLED WATER HVK*CHL1B EVAPORATOR/CONDENSER OUT FOR MAINTENANCE | This item represents the unavailability of chiller HVK-CHL1B due to maintenance. SAMAs 93 and 94 address this item. See Note below. |

**Table D.1-2 - Correlation of Level 1 Risk Significant Terms to SAMAs (Based on CDF)**

| Event Name | Probability | RRW | Event Description | Disposition |
|---|---|---|---|---|
| SWP-XHE-FO-SWSTR | 1.00E-01 | 1.007 | OPERATOR FAILS TO MANUALLY START SSW WHEN AUTOMATIC START SIGNAL FAILS | This item represents the failure of operators to manually start SSW when automatic signals fail. SAMAs 75 and 80 address this item. |
| ZHE-FO-T4-1RUN | 6.48E-02 | 1.007 | Failure to Recover Offsite Power before 4 Hours (1 run failure) | This item represents the failure to recover offsite power within 4 hours after a loss of offsite power. SAMAs 14, 15 and 38 address this item. |
| SWP-XHE-FO-F68AB | 1.00E-01 | 1.007 | OPERATOR FAILS TO OPEN VALVES 1E12*MOV68A & B for SWP flow to RHR HX's | This item represents the failure of operators to open the RHR heat exchangers SSW return valves to establish flow through the heat exchangers. SAMAs 110, 115 and 120 address this item. |
| SWP-PRC-DN-SWSIG | 1.00E-04 | 1.007 | FAILURE OF SIGNAL TO START STANDBY SERVICE WATER SYSTEM | This item represents the failure of signal to start the SSW system. SAMA 75 addresses this item. |
| HVK-CHR-FS-CHL1D | 1.41E-02 | 1.007 | CHILLED WATER HVK*CHL1D EVAPORATOR/CONDENSER FAILS TO START | This item represents the failure of Control Building chiller HVK-CHL1D to start. SAMAs 93 and 94 address this item. See Note below. |
| EGS-DGN-C3-SBDGR | 7.98E-05 | 1.007 | ALL THREE STANDBY DIESEL GENERATORS CCF TO RUN | This item represents the common cause failure of all three emergency diesel generators to run. SAMAs 21, 22, 30 and 33 address this item. |
| E22-DGN-FR-EG01C | 2.95E-02 | 1.007 | STANDBY (HPCS) DIESEL GENERATOR 1E22*S001 FAILS TO RUN | This item represents the failure of the HPCS diesel generator to run. SAMAs 21, 22, 30, 33 and 204 address this item. |
| EGS-DGN-F1-EG01A | 1.58E-03 | 1.007 | STANDBY DIESEL GENERATOR 1EGS*EG1A FAILS TO RUN DURING 1ST HOUR OF OPERATION | This item represents the failure of the Division 1 emergency diesel generator to run in the first hour of operation. SAMAs 21, 22, 30, 33 and 204 address this item. |
| HVP-FAN-C3-FN2FS | 1.77E-05 | 1.007 | CCF OF ALL 3 EDG CONT RM VENT FANS HVP*FN2A,B,3A FAILING TO START | This item represents the common cause failure of all three EDG room ventilation fans to start. SAMAs 100 and 101 address this item. |
| ENB-BCC-MA-CG01A | 2.00E-03 | 1.006 | CHARGER ENB-CHGR01A IN TEST OR MAINTENANCE | This event represents the unavailability of the Division 1 battery charger due to maintenance. SAMAs 1 and 2 address this item. |

| Table D.1-2 - Correlation of Level 1 Risk Significant Terms to SAMAs (Based on CDF) | | | | |
|---|---|---|---|---|
| **Event Name** | **Probability** | **RRW** | **Event Description** | **Disposition** |
| E22-HCI-MA-HPCS | 4.89E-03 | 1.006 | HPCS UNAVAILABLE DUE TO MAINTENANCE | This event represents the unavailability of the HPCS system due to maintenance. SAMAs 44, 59 and 71 address this item. |
| EGF-MDS-FS-P1A | 1.50E-03 | 1.006 | FUEL OIL TRANSFER PUMP EGF-P1A FAIL TO START | This item represents the failure of the Division 1 emergency diesel generator fuel transfer pump to start. SAMAs 30 and 204 address this item. |
| IE-TIAS | 4.55E-03 | 1.006 | INITIATOR. LOSS OF INSTRUMENT AIR | This item represents a transient initiator due to the loss of instrument air. SAMA 197 addresses this item. |
| SWC-PHN-DN-HOTTT | 5.00E-01 | 1.006 | Summer Temperatures require 4 of 5 fans to run to maintain SWC temps | This item represents high summer temperature conditions requiring 4 of 5 service water cooling system fans to maintain cooling water temperature to the normal service water heat exchangers. SAMA 197 and SAMA 206 address this item. |
| ENS-XHE-LO-ALTB | 5.00E-01 | 1.006 | OPERATOR FAILS TO PERFORM ALTERNATE LINEUP FOR ENS-SWG1B | This item represents the failure of operator to align an alternate offsite power source to safety related bus ENS-SWG1B. SAMAs 14, 34 and 38 address this item. |
| EGS-DGN-F1-EG01B | 1.58E-03 | 1.006 | STANDBY DIESEL GENERATOR 1EGS*EG1B FAILS TO RUN DURING 1ST HOUR OF OPERATION | This item represents the failure of the Division 2 emergency diesel generator to run during the first hour of operation. SAMAs 21, 22, 30, 33 and 204 address this item. |
| SWP-XHE-FO-V0599 | 5.00E-01 | 1.006 | FAILURE TO MANUALLY OPEN SWP*AOV599 | This item represents the failure of operator to open air operated valve SWP-AOV599 to allow bypass of SSW valve SWP-MOV055A and operation of the SWP-P2C pump during a station blackout. SAMAs 14, 15, 38, 110, 115 and 120 address this item. |
| EGF-MDS-FS-P1B | 1.50E-03 | 1.005 | FUEL OIL TRANSFER PUMP EGF-P1B FAIL TO START | This item represents the failure of the Division 2 emergency diesel generator fuel oil transfer pump to start. SAMAs 30 and 204 address this item. |
| E51-TDS-FS-TC002 | 4.57E-03 | 1.005 | TURBINE DRIVEN RCIC PUMP E51-PC001/TC002 FAILS TO START | This item represents the failure of the RCIC pump to start. SAMAs 44, 59 and 71 address this item. |
| BYS-DGN-FR-SBODG | 3.47E-02 | 1.005 | THE SBO DIESEL GENERATOR FAILS TO RUN | This item represents the failure of the SBO diesel generator to run and provide power for charging a safety related battery. SAMAs 1, 2 and 43 address this item. |

**Table D.1-2 - Correlation of Level 1 Risk Significant Terms to SAMAs (Based on CDF)**

| Event Name | Probability | RRW | Event Description | Disposition |
|---|---|---|---|---|
| E12-MDS-F1-C002B | 2.87E-04 | 1.005 | RHR PUMP B FAIL TO RUN DURING 1ST HOUR OF OPERATION | This item represents the failure of the RHR B pump to run during the first hour of operation. SAMAs 79, 110, 115, 120 and 198 address this item. |
| E51-CLU-HW-EC002 | 4.32E-03 | 1.005 | RCIC TURBINE LUBE OIL COOLER E51-EC002 HARDWARE FAILURE OR PLUGGED | This item represents the hardware failure of the RCIC lube oil cooler. SAMAs 44, 59, 71 and 202 address this item. |
| ENB-BCC-MA-CG01B | 2.00E-03 | 1.005 | CHARGER ENB-CHGR01B IN TEST OR MAINTENANCE | This item represents the unavailability of charger ENB-CHGR01B due to maintenance. SAMAs 1 and 2 address this item. |
| HVK-CHR-C4-FR1AD | 7.52E-05 | 1.005 | COMMON CAUSE FAILURE OF 4 OF 4 CHILLERS (HVK*CHL1A THROUGH 1D) FAILING TO RUN | This item represents the common cause failure to run of all four safety related chillers. SAMAs 93 and 94 address this item. See Note below. |
| IE-VRUP | 1.30E-08 | 1.005 | Reactor Vessel Rupture Initiator | This item represents the rupture of the reactor pressure vessel as an initiator. No SAMAs were identified for this event. |
| SWP-MDS-F1-SBP2B | 4.00E-04 | 1.005 | STANDBY SERVICE WATER PUMP SWP-P2B FAIL TO RUN DURING 1ST HOUR | This item represents the failure of standby service water pump SWP-P2B to run during the first hour. SAMAs 75 and 80 address this item. |
| SWP-MDS-F1-SBP2D | 4.00E-04 | 1.005 | STANDBY SERVICE WATER PUMP SWP-P2D FAIL TO RUN DURING 1ST HOUR | This item represents the failure of standby service water pump SWP-P2D to run during the first hour. SAMAs 75 and 80 address this item. |
| ZHE-FO-GT4HEP | 1.00E-07 | 1.005 | Minimum default for cutsets with >4 HRA events | This item represents the minimum dependent human error value for cutsets with 4 or more human error events. No SAMAs were identified for this event. |

Note: Recent thermal-hydraulic analyses of the Control Building rooms and HVAC systems, along with evaluations of survivability of electric equipment in the building, have significantly reduced the importance of HVAC in the Control Building.

#### D.1.1.1 CDF Uncertainty

Since an uncertainty analysis was not performed for the Revision 5A PRA model, the uncertainty factor for the Revision 5A PRA model was estimated based on the Revision 5 PRA uncertainty. This is considered acceptable because the Revision 5A CDF is only slightly higher (~7%) than the Revision 5 CDF. The parametric uncertainty analysis was performed using cutsets resulting from quantification at a truncation of 1E-12/Rx-yr and provided the following results.

**Table D.1-3 – RBS CDF Parametric Uncertainty**

| CDF Parameter | RBS Value (/Rx-yr) |
|---|---|
| Mean | 3.06E-06 |
| Median | 1.35E-06 |
| 95% Upper Bound | 9.31E-06 |
| 5% Lower Bound | 3.67E-07 |

The point estimate for the RBS PRA R5 model is 2.60E-06/Rx-yr. The ratio of the 95th percentile CDF to the point estimate CDF of 2.60E-06/Rx-yr is 3.58. As noted above, the RBS PRA R5A model point estimate for CDF (2.79E-06/Rx-yr) is higher than the CDF for the RBS PRA R5 model. Since there is only a small increase in CDF for the R5A model and no significant changes in modeling, an uncertainty factor of 4 was selected for use in the SAMA analysis. This is judged to be reasonable. This factor was used to determine the internal and external benefit with uncertainty as part of the RBS SAMA analysis.

### D.1.2 <u>PRA Model – Level 2 Analysis</u>

#### D.1.2.1 Containment Performance Analysis

The RBS Level 2 PRA model [D.1-5] used for the SAMA analysis was developed specifically for the SAMA analysis since the RBS Rev 5A model does not include a full scope Level 2 model. It was prepared and reviewed by qualified personnel in accordance with existing industry standards. In addition, a team of RBS experts representing various site organizations (e.g. Operations, System Engineering, Mechanical/Safety Analysis, PRA and License Renewal) performed a review of the results to confirm that the model is representative of the plant and the results are reasonable.

A full scope Level 2 model includes two types of considerations: (1) a deterministic analysis of the physical processes for a spectrum of severe accident progressions, and (2) a probabilistic analysis component in which the likelihood of the various outcomes are assessed. The Modular Accident Analysis Program (MAAP) 4.0.7 code was used to simulate the meltdown of the core, the failure of the reactor vessel due to contact with molten core materials, and the transport and interactions of core debris in the containment. Because of the large uncertainties associated with the progression of a core-damage accident, these deterministic calculations were supplemented with assessments that considered the potential for phenomena different from, or more severe, than those treated in the MAAP code. The results of this part of the analysis include an assessment of the potential for a variety of containment failure modes for each type of core-damage sequence, and an estimate of the magnitude of the radionuclide release that would be associated with each core-damage sequence.

The Level 2 analysis examined the dominant accident sequences defined in Level 1. The Level 1 analysis involves the assessment of those scenarios that could lead to core damage. The Level 2 model consists of containment event trees (CETs) with functional nodes that represent phenomenological events and containment protection system status.

Large Early Release Frequency (LERF) is an indicator of containment performance from the Level 2 results because the magnitude and timing of these releases provide the greatest potential for early health effects to the public. The LERF frequency is 2.32E-08/Rx-yr at a truncation of 1E-12/Rx-yr [D.1-5].

LERF represents ~1% of all release end states [D.1-5]. Table D.1-4 provides a correlation between the LERF RRW risk significant events (severe accident phenomenon, initiating events, component failures, and operator actions) down to 1.005 identified from the RBS PRA LERF results. Table D.1-5 provides a similar correlation between additional RRW risk significant events greater than or equal to 1.005 for Large Late release categories.

### D.1.2.2 Containment Event Tree

The severe accident progression sequences are delineated in a CET which is constructed to consider the potential factors in determining whether core damage sequences lead to containment failure and radiological releases. The CET is a logic model drawn in a traditional event tree format, though its solution is performed using fault tree logic in the CAFTA code. The use of fault tree logic to solve the CET allows for direct linking to the Level 1 accident sequences, ensuring that all dependencies between the Level 1 and Level 2 are explicitly captured.

Each Level 1 CDF accident sequence was grouped into one of six groups for use in the Level 2 analysis.

Group 1. Sequences involving loss of decay heat removal, with core damage not occurring until after containment failure has caused the loss of injection.
Group 2. Sequences involving initial success of injection, but followed by loss of all injection later leading to core damage.
Group 3. Sequences involving loss of all injection early in the sequence.
Group 4. ATWS sequences with Standby Liquid Control (SLC) failure.
Group 5. ATWS sequences with successful injection but not decay heat removal; core damage not occurring until after containment failure which has caused the loss of injection
Group 6. All containment bypass sequences.

These groups provide the entry conditions for the Level 2 analysis. A Level 1 sequence group, or a combination of groups, is directly linked to the fault tree logic representing the appropriate CET Level 2 sequence for evaluation.

The top events of the CET represent events that may have a significant impact on the ability of the containment to remain intact and contain the fission products released from the core by the core damage accident. The top events describe either phenomenological events or processes of severe accident response, potential recovery or mitigating actions, or containment system responses which impact the severe accident progression. The CET events and their respective nodal equations are related to additional CAFTA fault tree logic to ensure complete linking of all system-related interactions.

The containment event tree end states represent the source term magnitude and relative timing of the radionuclide release using a discrete set of end states (i.e. source term categories). The assignment of timing to the release bins is dependent on both the Level 1 accident sequence and the status of the CET functional events. Combining the results of the MAAP calculations, the Emergency Action Levels (EALs), and the evacuation leads to the assessment of the timing of the General Emergency (GE) declaration relative to the radionuclide release timing. This evaluation is used to characterize "early" radionuclide releases as any release initiated less than 5.0 hours following the declaration of a GE as well as assign the intermediate and late categories to CET sequences. MAAP calculations are also used to determine the magnitude of release for CET sequences. Each sequence is assigned a release magnitude category based on MAAP evaluations of the sequence or a representative MAAP case.

A list of the CET functional events and their descriptions used for the Level 2 analysis is provided in Table D.1-6 [D.1-5].

| Table D.1-4 - Correlation of LERF Risk Significant Terms to SAMA [1] | | | | |
|---|---|---|---|---|
| **Event Name[1]** | **Probability** | **RRW** | **Event Description** | **Disposition** |
| C71-CRD-CF-CTROD | 2.50E-07 | 1.349 | CCF OF CONTROL ROD DRIVES (33% or more) | This item represents the common cause failure of 33% or more control rod drives. SAMAs 156 and 158 address this issue. |
| L2-PROB-PED-DW-YES | 1.75E-01 | 1.178 | DET BYPOOL - pedestal failure fails drywell - Sup Pool bypass | This item is a split fraction. No SAMAs need to be correlated. |
| L2-PROB-PED-OVERP-HP | 7.30E-02 | 1.178 | DET BYPOOL - pedestal overpressurizes (high press seqs) | This item is a split fraction. No SAMAs need to be correlated. |
| C41-XHE-FO-SLS | 1.00E+00 | 1.143 | OPERATOR FAILS TO INITIATE SLS | This item represents the failure of operators to actuate standby liquid control system. (Screening event corresponding to ZHE-FO-SLC.) SAMAs 121 and 158 address this item. |
| ZHE-FO-SLC | 8.70E-03 | 1.143 | Failure to Initiate Standby Liquid Control (ATWS) | This item represents the failure of operators to actuate standby liquid control system. (Quantified event corresponding to C41-XHE-FO-SLS.) SAMAs 121 and 158 address this item. |
| L2-PROB-BYPOOL-HOLE-SM | 7.46E-01 | 1.128 | DET BYPOOL - Probability that hole in RV is small | This item is a split fraction. No SAMAs need to be correlated. |
| C41-XHE-RE-TEST | 5.30E-03 | 1.082 | OPERATOR FAILS TO RESTORE TEST VALVES F016 & F017 OR F031 AFTER TEST | This item represents failure of operators to restore SLC test tank valves following testing. SAMAs 121 and 158 address this item. |
| L2-PROB-BYPOOL-HOLE-LG | 2.54E-01 | 1.039 | DET BYPOOL - Probability that hole in RV is large | This item is a split fraction. No SAMAs need to be correlated. |
| B21-XHE-FO-LVCTL | 1.00E+00 | 1.019 | OPERATOR FAILS TO CONTROL RX WATER LEVEL AND POWER DURING ATWS | This item represents failure of operators to control reactor water level and power during an ATWS. (Screening event corresponding to ZHE-FO-LVLCNTL.) SAMAs 108 and 121 address this item. |
| ZHE-FO-LVLCNTL | 1.30E-03 | 1.019 | Failure to Perform ATWS Level/Power Control | This item represents failure of operators to control reactor water level and power during an ATWS. (Quantified event corresponding to B21-XHE-FO-LVCTL.) SAMAs 108 and 121 address this item. |

**Table D.1-4 - Correlation of LERF Risk Significant Terms to SAMA [1]**

| Event Name[1] | Probability | RRW | Event Description | Disposition |
|---|---|---|---|---|
| C41-XHE-RE-MNT08 | 1.20E-03 | 1.017 | OPERATOR FAILS TO RESTORE MANUAL VALVE VF008 AFTER MAINTENANCE | This item represents the failure of operators to restore the SLC injection line manual isolation valve, C41-VF008, following maintenance. SAMAs 121 and 158 address this item. |
| ADS-SRV-C6-SRVCC | 1.10E-03 | 1.016 | 6 OR MORE SRVs CCF TO OPEN TO RELIEVE PRESSURE DURING ATWS | This item represents the common cause failure of 6 or more SRVs to open for pressure relief during an ATWS. SAMAs 51 and 108 address this item. |
| B21-XHE-FO-INHIB | 1.00E+00 | 1.008 | OPERATOR FAILS TO INHIBIT ADS | This item represents the failure of operators to inhibit ADS during an ATWS event. (Screening event corresponding to ZHE-FO-INHIBADS.) SAMA 121 addresses this item. |
| ZHE-FO-INHIBADS | 6.00E-04 | 1.008 | inhibit ADS | This item represents the failure of operators to inhibit ADS during an ATWS event. (Quantified event corresponding to B21-XHE-FO-INHIB.) SAMA 121 addresses this item. |
| E22-XHE-FO-INHIB | 1.00E+00 | 1.007 | OPERATOR FAILS TO INHIBIT HPCS | This item represents the failure of operators to inhibit HPCS start during an ATWS event. (Screening event corresponding to ZHE-FO-INHIBHPCS.) SAMA 121 addresses this item. |
| ZHE-FO-INHIBHPCS | 5.00E-04 | 1.007 | inhibit HPCS | This item represents the failure of operators to inhibit HPCS start during an ATWS event. (Quantified event corresponding to E22-XHE-FO-INHIB.) SAMA 121 addresses this item. |
| C71-AOV-CF-126OP | 6.90E-09 | 1.006 | CCF OF SCRAM INLET VALVES (33% or more) | This item represent the common cause failure of 33% or more SCRAM inlet valves. SAMAs 156 and 158 address this issue. |
| C71-AOV-CF-127OP | 6.90E-09 | 1:006 | CCF OF SCRAM OUTLET VALVES (33% or more) | This item represent the common cause failure of 33% or more SCRAM outlet valves. SAMAs 156 and 158 address this issue. |

Note 1: Events that are risk significant for CDF are not repeated in this table since they are listed in Table D.1-2.

| Table D.1-5 - Correlation of Other Level 2 Risk Significant Terms to SAMAs (Late Large Releases) | | | | |
|---|---|---|---|---|
| **Event** | **Probability** | **RRW** | **Event Description** | **Disposition** |
| L2-ABSCRUB-FAIL | 5.00E-01 | 1.9992 | Aux Building scrubbing is not effective | This item is a split fraction. No SAMAs need to be correlated. |
| L2-ABSCRUB-SUCCESS | 5.00E-01 | 1.9992 | Aux Building scrubbing is effective | This item is a split fraction. No SAMAs need to be correlated. |
| L2-PROB-EXVC-F-LL | 8.40E-01 | 1.5686 | Ex-vessel cooling fails, low pressure, low entrainment | This item is a split fraction. No SAMAs need to be correlated. |
| L2-PROB-INJ-PIPE-INT | 6.67E-01 | 1.5252 | DET DEBCOOL - no piping failure to disrupt injection | This item is a split fraction. No SAMAs need to be correlated. |
| L2-PROB-PED-INTACT-LP | 1.00E+00 | 1.31 | DET BYPOOL - pedestal does not overpressurize (low press seqs) | This item is a split fraction. No SAMAs need to be correlated. |
| L2-PROB-INJ-PIPE-FAIL | 3.33E-01 | 1.2663 | DET DEBCOOL - Piping failure disrupts injection | This item is a split fraction. No SAMAs need to be correlated. |
| L2-PROB-PED-INTACT-HP | 9.27E-01 | 1.0448 | DET BYPOOL - pedestal does not overpressurize (high press seqs) | This item is a split fraction. No SAMAs need to be correlated. |
| IE-S3 | 1.50E-03 | 1.031 | SMALL-SMALL BREAK LOCA (RECIRCULATION PUMP SEAL LOCA) | This event represents a recirculation pump seal LOCA initiating event. SAMAs 44 and 197 address this item. |
| PROB-L2-H2-PEN-2-VF | 9.57E-01 | 1.0083 | Prob that H2 effects result in pen cont fail - CD group 2, time of VF | This item is a split fraction. No SAMAs need to be correlated. |
| E51-TDS-FR-LT6HR | 1.30E-02 | 1.0058 | RCIC Pump E51-PC001/TC002 Fails to Run for the first 6 hours | This item represents the failure of RCIC pump to continue to run in the first six hours of a SBO. SAMA 44, 46, 59 and 71 address this item. |
| IE-S1 | 3.55E-04 | 1.0056 | INTERMEDIATE LOCA INITIATING EVENT | This item represents an intermediate LOCA initiating event. SAMA 190 addresses this item. |
| SWC-FAN-C2-FNAE | 5.29E-05 | 1.0051 | CCF of 2 Service Water Cooling Fans 1A-1E | This item represents the common cause failure of the normal service water cooling tower fans to run. SAMA 197 addresses this item. |

Note 1: Events that are risk significant for CDF are not repeated in this table since they are listed in Table D.1-2.

| Table D.1-6 - Level 2 Top Events and Functional Nodes | |
|---|---|
| **CET Top Event** | **CET Top Event Logic Description** |
| CONTMT -- Containment Status at Core Damage | Containment Bypass - L2-CONT-BYPASS<br><br>This branch represents core damage events that are also bypasses of containment. This includes ISLOCA and Break Outside Containment (BOC) core damage sequences. In reality, not all of these events would be large releases, since there is the potential of self-scrubbing (accumulation of water outside the break area could submerge the break and therefore scrub fission products before release) and for fission product retention within the rooms of the breaks (depending on break location). However, given the negligible CDF of these events (~1E-11/rx-yr or lower), all ISLOCA and BOC are conservatively modeled as a direct large release.<br><br>Because of the dynamic pressure loading from Reactor Vessel Rupture, it is also modeled as a containment bypass. All of the Large LOCA core damage sequences result in negligible CDF and are binned as Vessel Rupture.<br><br>ATWS sequences in which reactivity control fails are at a high pressure and a high level of heat generation. Therefore, these sequences also deliver a high heat load into the containment. While ATWS core damage sequences in which SLC, ADS inhibit, and reactor water level control are all successful can lead to a controlled scenario, the RBS ATWS CDF is dominated by sequences in which the power level cannot be controlled, leading to rapid power and pressure transients and significant containment challenges. Therefore, all of the River Bend ATWS core damage sequences have been modeled as a containment bypass. Conservatism from inclusion of controlled ATWS sequences is negligible since the CDF of these sequences is negligible.<br><br>Containment Isolation Failure - L2-CONT-ISO-FAIL<br><br>Containment isolation failure is considered for all core damage sequences. This introduces some conservatism in that SBO sequences with offsite power recovery prior to vessel failure could avoid significant releases if the vessel never fails. However, the contribution to LERF from containment isolation failures is very low, and the conservatism does not warrant separate analysis. Including all Level 1 sequences in the L2-CONT-ISO-FAIL branch creates some double counting of the CDF in that sequences following the other branches are utilized twice, but the double counting is negligible given that the probability of containment isolation failure is < 1E-3. Therefore, any double counting would be less than 0.1% of the overall accident frequency.<br><br>(continued) |

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|---|---|
| CONTMT (cont.) | All of the RBS containment isolation pathways were screened for credible contributions to the isolation failure probability. The remaining pathways were modeled as failure of containment isolation under gate CIS001 in the fault tree. The largest pathway is the containment and drywell purge lines, which are 36" diameter. Although it is conservative to assume that these lines are open in the analysis, conservatism in the containment isolation modeling is acceptable because of the low probability of failure. Therefore, all the containment isolation failures in the RBS Level 2 were conservatively modeled using a 36" release to the atmosphere.<br><br><u>Containment Failure Prior to Core Damage - L2-CONT-FAIL-BVB</u><br><br>A significant portion of the RBS CDF is due to sequences with success of injection but failure of long term containment heat removal. The resulting containment failure can cause failure of the injection systems, which leads to core damage. In these sequences, the containment fails prior to core damage. If the containment has failed prior to core damage, no significant hydrogen build-up in containment is predicted by the MAAP analyses. Therefore, sequences following this branch will not have the potential for hydrogen-induced containment failure.<br><br><u>Intact Containment - L2-CONT-INTACT</u><br><br>The top branch of the CONTMT node in the CET represents those core damage sequences in which there is no containment bypass and the containment is intact at the time of vessel failure. Sequences following this path of the CET are considered for potential containment failure due to hydrogen effects. |
| REC-OSP - Recovery of Offsite Power before Vessel Failure | In the Level 1 analysis, credit is given to offsite power recovery prior to core damage. In the Level 2 analysis, additional credit is taken for the additional time available prior to vessel failure. If offsite power can be recovered prior to vessel failure, many challenges to the containment are avoided. While offsite power recovery itself is not a safe and stable end state to the sequence, successful offsite power recovery restores numerous systems (injection, containment heat removal, etc.) that were only unavailable because of the failure of AC power. There is a small probability that, given offsite power recovery, mitigating systems could still fail. However, each system failure probability is on the order of 1E-2 or less, and given the significant redundancy in injection systems and containment heat removal, the frequency of these sequences is negligible.<br><br>Two branches are considered for this top event. In the upper branch, offsite power recovery prior to vessel failure is successful. Since containment isolation was already questioned in the preceding top event, no further questions are considered, and any fission product releases are negligible (Technical Specification leakage only, scrubbed by the suppression pool).<br><br>In the lower branch of REC-OSP, offsite power is not recovered prior to vessel failure, and the severe accident progression continues. The Level 1 sequences evaluated on this branch are the LOOP and SBO sequences. |

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|---|---|
| IGNITERS - H2 Igniters are Successful | This node addresses the availability of the hydrogen igniter system. The RBS hydrogen igniter system consists of numerous electrically powered glow plugs located throughout the containment and drywell. The igniters are intended to ignite any hydrogen accumulated in the containment or drywell before the concentration is high enough that an ignition would result in sufficient pressure to challenge containment integrity.<br><br>It is assumed that if the hydrogen igniters are available, they will function to prevent containment challenges due to hydrogen deflagrations or detonations. Therefore, for sequences in which the igniters are available, no challenges to the containment from hydrogen deflagrations or detonations are considered. In those sequences the potential for containment failure due to hydrogen burns is prevented and further analysis of the status of the hydrogen in containment is not required.<br><br>For sequences in which the igniters are not available or have failed, the potential for containment overpressure failure due to hydrogen deflagration or detonation is considered. Therefore, placement of this node early in the CET reduces the number of required branches and sequences in the CET. |
| CF-Early - Containment Does Not Fail Early Due to H2 Phenomena | This event is questioned on branches in which the containment is not already failed and the hydrogen igniters are unavailable. Each of those phenomena, failed containment or successful igniters, is assumed to reduce hydrogen concentrations below the level at which they would pose a credible challenge to containment.<br><br>Conditional probabilities of hydrogen-induced containment events for a range of hydrogen and steam concentrations were developed in Reference D.1-43. The calculated pressure spike was a combination of the drywell pressure and the pressure rise due to the hydrogen burn effects. The resulting pressure totals were calculated for times before vessel failure, at vessel failure and after vessel failure. The time before vessel failure is not evaluated in the Level 2 analysis because the containment pressure and hydrogen concentrations before vessel failure are significantly less than those that occur at and after vessel failure, and the radionuclide release fractions are not significantly different if containment fails before versus at vessel failure. Therefore, this analysis evaluates the conditional probability of containment failure due to hydrogen effects at the time of vessel failure and late in the event after MCCI has generated additional hydrogen.<br><br>Multiple MAAP cases were run for representative Level 1 accident sequence Groups 2 and 3 to define the peak containment pressures due to hydrogen combustion. The results were used to develop conditional probabilities of gross containment failure, no containment failure and penetration failure of containment at the time of vessel failure up to MCCI and after MCCI for Groups 2 and 3. The probabilities of containment failure up to the time of MCCI are applied to the L2-CF-EARLY node of CET using the following fault tree gates.<br><br>(continued) |

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|---|---|
| CF-Early (cont.) | L2-CF-EARLY-INTACT – combination of group 2 and group 3 sequences with conditional probabilities of H2-induced intact containment.<br><br>L2-CF-EARLY-RUPT – combination of group 2 and group 3 sequences with conditional probabilities of H2-induced ruptured containment.<br><br>L2-CF-EARLY-PEN - combination of group 2 and group 3 sequences with conditional probabilities of H2-induced penetration failure of containment.<br><br>The probabilities of containment failure after MCCI are discussed in the CF-LATE node. |
| BYPOOL - Suppression Pool Bypass Does Not Occur | For CET sequences in which a large bypass or rupture of containment has not occurred, the question of suppression pool bypass is asked. This node addresses the issue of whether or not the drywell remains intact and the release path from the drywell through the suppression pool remains effective. This issue is important since the scrubbing of fission products in the suppression pool is an important determinant of the source term. If a bypass of the suppression pool occurs, the magnitude of fission products released is larger.<br><br>Bypass of the suppression pool can result from three mechanisms. First, structural failure of the drywell would allow releases directly from the drywell to the containment atmosphere without going through the suppression pool. Structural failure of the drywell is a possible result of the dynamic loads resulting from reactor vessel failure.<br><br>The second potential mechanism of suppression pool bypass is loss of suppression pool inventory due to failure of the containment anchorage. However, the containment anchorage is significantly less sensitive to pressure than the containment dome. The containment vessel is structurally connected to the shield building by concrete fill in the lower 25 feet of the annulus space between the two structures. This concrete fill provides a structural backing to the containment steel vessel in the area of the suppression pool. Therefore, the containment steel vessel would most likely fail on overpressure in an area without the concrete fill backing. Since overpressure would result in containment dome failure before containment anchorage failure, suppression pool bypass due to containment anchorage failure is not considered a likely failure mode and is not considered.<br><br>The third mechanism for suppression pool bypass is excessive leakage through drywell penetrations. The drywell penetrations are normally closed at power operation. The hydrogen mixing system connects the drywell with the containment and is utilized if RPV pressure is below 30 psig and the hydrogen concentration exceeds 0.7%. At higher concentrations, the recombiners and igniters are brought into service. For sequences in which late MCCI occurs and containment pressure reaches venting or failure pressures, the mixing system would no longer be applicable, and the likelihood of pool bypass is negligible. The only other potential leakage path from the drywell that bypasses the suppression pool is the drywell hatch inflatable seals. The probability of the drywell hatch seals failing is also very small and the failure area is small. Therefore, only structural failure of the drywell was considered as a viable means of suppression pool bypass in this analysis.<br><br>(continued) |

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| BYPOOL (cont.) | The potential for suppression pool bypass is evaluated using Decomposition Event Tree (DET) BYPOOL. The bases for evaluation of the branch nodes of DET BYPOOL are discussed below.<br><br><u>BYPOOL Event RV-PRESS - Reactor Vessel Pressure at Vessel Failure</u><br><br>This DET node addresses the issue of whether or not the reactor vessel is depressurized prior to vessel failure. The reactor vessel pressure is important since the pressure when vessel failure occurs will help determine the impact on the pedestal integrity due to blowdown forces. The status of the reactor vessel pressure prior to vessel failure is determined by a combination of the Level 1 sequence characteristics and the potential for emergency depressurization / alternate depressurization.<br><br>Level 1 sequences identified as low pressure are grouped under gate L2-LOW-P-SEQS. High pressure sequences have the potential to be brought to low pressure via emergency depressurization or alternate depressurization, as identified in SAP-0001 [D.1-44]. In SBO sequences, the alternate depressurization methods will not be available, and in the long term, DC power will eventually fail, resulting in re-pressurization of the reactor. Therefore, the depressurization of SBO sequences will not be credited, but emergency depressurization and alternate depressurization are both credited in non-SBO, high pressure sequences.<br><br>The high pressure sequences are modeled under gate L2-HIGH-P-SEQS. The low pressure sequences are modeled under gate L2-LOW-P-SEQS.<br><br>The upper branch of this node means that the reactor vessel is at high pressure at the time of vessel failure. The lower branch means the reactor vessel is at low pressure at the time of vessel failure.<br><br><u>BYPOOL Event HOLESIZE – What is the Size of the RV Breach?</u><br><br>This DET node addresses the issue of size of the breach in the reactor vessel. The breach size is important since it will impact the rate of blowdown from the vessel which in turn will impact the pressurization rate of the pedestal once the vessel fails. Reference D.1-43 documents the basis for the probabilities of a small and large size RV Breach which is based on information in NUREG/CR-4551 [D-1.6]. The probability for a small size failure is given as 0.746, the probability of a large size failure is given as 0.005 and the probability of a bottom head failure is given as 0.249. Since a bottom head failure would be a large hole, the total probability of a large reactor vessel breach is 0.254. These probabilities are assumed to be applicable to the River Bend analysis. Therefore, node HOLESIZE will take on the value of LARGE, representing the occurrence of a large vessel failure, with a probability of 0.254. Node HOLESIZE will take on the value SMALL, representing the occurrence of a small vessel failure, with a probability of 0.746.<br><br>The fault tree gates that model these nodes are L2-BYPOOL-HOLE-LG (for a large hole size) and L2-BYPOOL-HOLE-SM (for a small hole size).<br><br>(continued) |

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| BYPOOL (cont.) | BYPOOL Event PED-OP – Does the Pedestal Overpressurize?<br><br>This DET node addresses the issue of whether or not the pedestal fails structurally on overpressure resulting from the pressurization caused by the reactor vessel failure. The pedestal pressurization is dependent on the pressure of the reactor vessel at the time of failure and the size of the breach in the reactor vessel. These factors were determined by the two previous nodes. NUREG/CR-4551 [D-1.6] provides estimates for the failure probability of the Grand Gulf pedestal for various reactor vessel failure scenarios. The pressure in the pedestal at Grand Gulf from the vessel failure was estimated for various scenarios by an expert panel. They estimated high pressures for the pedestal well in excess of the failure pressure of 189 psi for all cases involving failure of the reactor vessel at high pressure. However, the majority of the pressure rise in the pedestal that the expert panel estimated was due to DCH and steam explosions. Significant research into both DCH and ex-vessel steam explosions since the publication of NUREG/CR-4551 has been performed. As a result, the issues of DCH and steam explosion are not considered to be realistic phenomena for consideration in the RBS analysis. Thus, the remaining issue is the pressure rise due to the blowdown from the vessel failure. This phenomenon results in much lower peak pressures than were assumed to occur in the Grand Gulf analysis. A series of MAAP runs was performed for RBS for station blackout and transient scenarios to determine pedestal pressure due to vessel failure and blowdown.<br><br>The cases with low pressure at core damage will not generate a blowdown force that would challenge the pedestal wall. The limiting high pressure case resulted in a differential pressure across the pedestal of 139 psid. The Grand Gulf pedestal pressure range in NUREG/CR-4551 was estimated to be a uniform distribution with 0.0 probability of failure at 130.5 psid and a probability of 1.0 at 247 psid. Using the Grand Gulf distribution for pedestal wall failure probability, linear interpolation between 130.5 psid and 247 psid yields a probability of failure of 7.3E-2 for 139 psid. For low pressure vessel failure cases, the pressure results in a zero failure probability. Therefore, for all cases in which the vessel is at low pressure at failure, a probability of 0.0 was assigned to this branch point. The fault tree model gates for the high pressure nodes are L2-BYP-PED-OP-Y-HP (for high pressure sequences leading to overpressurization) and L2-BYP-PED-OP-N-HP (for high pressure sequences not leading to overpressurization).<br><br>For the low pressure branches, with an assigned probability of 0.0, no further questions are asked on these DET branches. These low pressure sequences progress directly to non-bypass end states. The model gates for these nodes are L2-BYP-PED-OP-Y-LP (for low pressure sequences leading to overpressurization) and L2-BYP-PED-OP-N-LP (for low pressure sequences not leading to overpressurization).<br><br>(continued) |

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| BYPOOL (cont.) | BYPOOL Event PED-DW - Does Pedestal Failure Fail the Drywell?<br><br>This DET node addresses the issue of whether or not the overpressure failure of the pedestal results in failure of the drywell. Since the pedestal provides the main support of the reactor vessel, failure of the pedestal may result in dislocation of the vessel and possible rupture of associated piping. This may result in the failure of penetrations in the drywell or structural failure of the drywell itself. Therefore, if the pedestal does fail, there is some probability that the drywell will also fail. However, it is not considered likely that such a scenario will occur. NUREG/CR-4551 addresses the issue of whether or not pedestal failure causes failure of the drywell and those results are used for RBS. A probability of 0.175 is assigned to the branch for failure of the pedestal causing drywell failure. A probability of 0.825 is then assigned to the branch for the drywell not failing as the result of pedestal failure.<br><br>The model gates for these nodes are L2-BYPOOL-PED-DW-YES (for pedestal failure failing the drywell) and L2-BYPOOL-PED-DW-NO (for pedestal failure not failing the drywell). |
| DEBCOOL – Core Debris Cooled in Containment | This event in the CET identifies whether or not the molten core debris is cooled after being expelled from the reactor vessel. If a sufficient source of water is available to be injected onto the corium bed and the corium bed is in a favorable geometry, the corium debris bed may be cooled. Ex-vessel cooling is an important issue since successful ex-vessel cooling of the debris bed will reduce the impact of CCI effects including the generation of non-condensable and combustible gases. Successful ex-vessel cooling will also limit the long term generation of hydrogen from corium. It will also impact the generation of aerosols and the fission product source terms, which increase greatly if the debris is not cooled. Issues that affect the likelihood of successful ex-vessel cooling include the availability of water injection and the distribution and geometry of the debris bed.<br><br>To aid in the evaluation of the DEBCOOL event, a DET was generated to delineate the phenomena. The following details the evaluation of DET DEBCOOL.<br><br>The DEBCOOL DET has pathways that lead to an uncooled state with no injection (following the path of L2-LATE-INJ-FAIL or of L2-DEBC-PIPE-FAIL), and that lead to an uncooled state with successful injection (following the path of L2-DEBCOOL-CONT-INT or L2-DEBC-PIPE-INT). Although the presence of water offers the benefit of scrubbing fission product releases, the Level 2 analysis conservatively does not distinguish between these cases for source term category categorization.<br><br>(continued) |

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| DEBCOOL (cont.) | The basis for this conservatism is as follows.<br><br>1. Much of core damage frequency involves sequences with failure of all injection, either due to a long-term SBO or other failures. Combined with the probability of injection piping failing after containment failure, there is a significant portion of the frequency that has no injection.<br><br>2. For injection methods that have a limited source of water, the water would eventually boil away and steam out of containment, leaving debris uncovered. While this would improve the potential for debris cooling, there would also be the potential for a delayed MCCI that could still result in large releases.<br><br>3. Per the CET, the question of DEBCOOL applies only to late releases. Therefore, this conservatism has no impact on the LERF.<br><br>4. A MAAP case was created to examine the impact of late water injection on releases. It was based on the representative MAAP case for STCs 7 through 10, which are the dominant late release STCs with the only difference of adding service water (SW) injection after vessel failure. STC 10 has failure of debris cooling and does not credit Auxiliary Building scrubbing. The fission product releases from the new case after MCCI compared to the STC 10 long term (post-MCCI) releases indicate little change in the gaseous releases between the two cases, but some benefit of fission products for the particulate releases. The particulate releases in SW injection are approximately half to a third of those in the STC-10 case. The CsI release is reduced from 1.4E-1 to 3.8E-2. While this reduction is appreciable, the case would still be designated as a large release.<br><br>Based on the above factors, there is a benefit to containment flooding to scrub fission products. However, the releases would still be categorized as large, and much of the core damage frequency would not have the potential for the long term injection, especially from a source with unlimited water (e.g., SW). Since neither the Large, Early Release Frequency nor the Large Release Frequency is affected, this analysis conservatively does not credit containment flooding on CET nodes were DEBCOOL = NOCOOL, even though containment flooding may be successful in some cases.<br><br>(continued) |

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| DEBCOOL (cont.) | <u>DEBCOOL Event LATE-INJ – Injection Available after Vessel Failure?</u><br><br>This DET node addresses the issue of whether or not a water injection system, either a high pressure or low pressure system, is available to provide injection on the core debris outside of the vessel. If no injection system is available, then ex-vessel cooling of the debris bed cannot be accomplished. If either a high or low pressure injection system is available, then ex-vessel debris bed cooling may succeed.<br><br>Late vessel injection is essentially related to three factors.<br><br>1. For SBO and LOSP core damage sequences, recovery of offsite power after core damage has occurred may result in the recovery of injection systems late in the event. This was addressed in CET top event REC-OSP, which credits offsite power recovery up to the time of vessel failure. The conditional probability of failing to recover offsite power before MCCI, given failure to recover prior to vessel failure will vary depending on the sequence timing. However, given that the RBS CDF is driven by containment failure prior to core damage, this conditional probability is not large. In addition, it would be difficult to defend the ability to successfully recover power once the vessel has failed and potential adverse environmental conditions are present. Therefore, the RBS Level 2 conservatively did not credit offsite power recovery after vessel failure. This conservatism has no impact on the LERF, and is not a major conservatism in the late release calculations given the high probability of power recovery by the time of vessel failure.<br><br>2. Low pressure injection systems may be available but unable to inject to the vessel since the vessel remains at high pressure. In this case, vessel failure will result in depressurization and the low pressure injection systems can then provide injection flow for debris bed cooling.<br><br>3. Some low flow injection systems may be unable to prevent core damage (i.e., CRD for LOCA sequences) but may be able to provide sufficient flow for debris bed cooling once decay heat levels have decreased.<br><br>For sequences in core damage category Group 1 (containment failure prior to core damage), the low pressure injection systems are considered failed after containment fails, which leads to core damage. For other core damage sequences, if there is no containment heat removal system (either suppression pool cooling (SPC) or the containment fan coolers (CFC)), the low pressure injection systems that are taking suction from the suppression pool can continue to operate at saturated conditions until containment failure. Therefore, for the sequences in which containment does not fail prior to core damage, the low pressure injection systems are credited for LATE-INJ. High pressure injection systems, primarily HPCS, are not dependent on cooling of the suppression pool and can operate with the suppression pool at saturation.<br><br>Gate L2-LATE-INJ-FAIL models late injection failure. It consists of an AND gate with inputs of failure of high pressure injection systems (FW, HPCS and CRD) and low pressure injection systems (Firewater, SSW, LPI and LPCS). Low pressure injection is not credited for sequences in which containment failed prior to core damage. Furthermore, containment heat removal is questioned in order to credit LPI.<br><br>(continued) |

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| DEBCOOL (cont.) | DEBCOOL Event CONT-FAILED – Has Containment Failed Earlier?<br><br>This DET node addresses the issue of whether or not the containment is failed due to earlier events (i.e., containment failure prior to core damage or hydrogen-related containment failure). This issue is important to the success or failure of ex-vessel cooling since containment failure can disrupt piping systems and preclude successful injection. For the purpose of potential impact on piping, no distinction is made between gross rupture of the drywell and penetration failures. All containment failures are assumed to have the potential to fail injection piping, except for early containment rupture (CET event CF-EARLY = L2-CF-EARLY-RUPT). Since this branch does not question debris coolability, early containment ruptures are not included in the DEBCOOL evaluation.<br><br>Gate L2-DEBCOOL-CONT-FAILED models earlier failure of the containment, either due to Level 1 sequence binning (containment failed prior to core damage) or due to Level 2 (hydrogen-induced containment failure).<br>Gate L2-DEBCOOL-CONT-INT models intact containment as core damage Groups 2 and 3 and no hydrogen-induced containment failure.<br><br>DEBCOOL Top Event PIPEFAIL – Is Injection Piping Disrupted?<br><br>This DET node addresses the issue of whether or not containment failure or drywell failure results in the failure of injection due to disruption of the injection system piping. NUREG/CR-4551 recognized that there was some impact on the availability of the injection systems from the energetic events occurring as the severe accident progresses. To address this, NUREG/CR-4551 provided estimates of the probability of failing to provide injection late in the event. Estimates were developed for the probability of failing to provide any injection given AC power is available and the injection systems are either already running or are available though not in operation. In both cases, the estimated probability of failing to provide any injection late in the event is 0.333. Therefore, the probability of successfully providing injection is 0.667. These probabilities have been applied in the Level 2 even though the NUREG/CR-4551 analysis includes events that could disrupt injection other that just containment or drywell structural events. Therefore, a probability of 0.333 is assigned to the branch for node PIPEFAIL representing failure of injection late due to some physical impairment including piping disruption if containment failure has occurred or drywell failure has occurred. A probability of 0.667 is then assigned to the branch that represents no disruption of the piping.<br><br>The applicable model gates are L2-DEBC-PIPE-INT (for no failure of piping) and L2-DEBC-PIPE-FAIL (for piping failure).<br><br>There is conservatism in the use of the NUREG-4551 probabilities, since the dominant RBS containment failure mode is leakage at the containment vessel equipment hatch. This would be expected to yield a lower probability of failure than in the NUREG-4551 containment failure calculation. However, given that the NUREG-4551 evaluation was intended to include more than just containment failure (i.e., other energetic phenomena occurring during the course of a severe accident), the 0.333 probability is utilized in the Level 2 PRA.<br><br>(continued) |

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| DEBCOOL (cont.) | DEBCOOL Event RV-PRESS – Reactor Vessel Pressure at Vessel Failure<br><br>This DET node addresses the issue of whether or not the reactor vessel is depressurized prior to vessel failure. The reactor vessel pressure is important since the pressure when vessel failure occurs will help determine the how much of the core debris is entrained from the pedestal into the drywell. If the vessel is at high pressure at the time of vessel failure, more of the debris is likely to be entrained into the drywell and the likelihood of successful ex-vessel debris cooling will be increased. The status of the reactor vessel pressure prior to vessel failure was evaluated for CET top event BYPOOL, under DET event RV-PRESS. The same logic developed for the BYPOOL event is applied here.<br><br>High pressure sequences are modeled under gate L2-HIGH-P-SEQS. Low pressure sequences are modeled under gate L2-LOW-P-SEQS.<br><br>DEBCOOL Event MOBILE – What Fraction of the Debris is Mobile?<br><br>This DET node addresses the issue of how much of the total core mass is molten and, thereby, mobile and available for entrainment at the time of vessel failure. This issue is important since the mobility of the debris will impact how much debris is entrained from the pedestal into the drywell and this will in turn impact the likelihood of successfully accomplishing ex-vessel cooling.<br><br>The amount of core that is molten is defined as either large or small. The definitions of large and small molten volumes are taken from NUREG/CR-4551. The use of values from NUREG/CR-4551 is considered to be acceptable for the RBS analysis. NUREG/CR-4551 (Vol. 6) is an analysis of Grand Gulf which, like RBS, is a BWR6/Mark III design. The reactor design is essentially identical although the size of the core is slightly different. However, because of the similarities in the vessel and core designs, it is not expected that any differences in the severe accident response would fall outside the uncertainty in the values from NUREG/CR-4551.<br><br>In NUREG/CR-4551, a small amount of core being molten was defined as being approximately 10% of the total core mass being molten. This value actually represents a range of zero to 20% of the total core mass. A large amount of the core being molten is defined as approximately 40% of the total core mass but actually represents anything larger than 20% of the total core mass being molten. Whether a large or small amount of the core is molten will be determined by probability for this node. The probabilities are taken from the NUREG/CR-4551 analysis of Grand Gulf [D.1-6]. Estimates of the probability for large and small molten mass are provided for cases in which injection to the vessel is and is not provided before vessel failure. The scenario in which injection is provided before vessel failure is identified as Case 1. For this case the vessel can be at either high or low pressure. The probability estimates are 0.025 for a large amount of the core being molten and 0.975 for a small amount of the core being molten. For the scenario with no injection to the vessel, Case 2 is for the vessel at high pressure and Case 3 is for the vessel at low pressure. However, in both cases, the probability of a large melt is 0.1 and the probability of a small melt is 0.9.<br><br>(continued) |

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| DEBCOOL (cont.) | Therefore, for any case, regardless of the vessel pressure, in which there is no vessel injection, the probability of a large melt is taken as 0.1 and the probability of a small melt is taken as 0.9. These probabilities are used to determine the branching for this DET node. For cases in which some injection is available prior to vessel failure, the probability that the melt will be large is 0.025 and the probability that the melt is small is 0.975. For the cases in which there is no vessel injection, the probability that the melt is large is 0.1 and the probability the melt is small is 0.9.<br><br>If a small fraction of the core is mobile, there will not be sufficient molten material in the vessel for significant ejection of core debris at high pressure or for significant entrainment of debris to the drywell. Therefore, if the fraction of core that is mobile is small, high pressure melt ejection will not occur, regardless of vessel pressure and the amount of material entrained from the pedestal to the drywell will be small.<br><br>The fault tree modeling of the MOBILE event nodes is under the following gates.<br><br>L2-COREDEBRIS-LARGE – Fraction of core melted and mobile in vessel is large (approximately 40% of core mass). This is modeled as an OR gate between the Level 1 sequences (excluding containment bypasses, which follow a different path) that have successful injection before core damage * probability of 0.025 OR sequences with no early injection * 0.1.<br>L2-COREDEBRIS-SMALL - Fraction of core melted and mobile in vessel is small (approximately 10% of core mass). This is modeled as an OR gate between the Level 1 sequences (excluding containment bypasses, which follow a different path) that have successful injection before core damage * probability of 0.975 OR sequences with no early injection * 0.9.<br><br><u>DEBCOOL Event HPME – Does HPME Occur?</u><br><br>This DET node addresses whether or not a high pressure melt ejection occurs if the reactor vessel is at high pressure at the time of vessel failure. The occurrence of HPME is important since it will help determine how much of the core debris is entrained from the pedestal into the drywell. If the HPME occurs, more of the debris is likely to be entrained into the drywell and the likelihood of successful ex-vessel debris cooling will be increased. NUREG/CR-4551 provides an estimate of the probability of occurrence of HPME. The probability that HPME will occur given the vessel is at high pressure at the time of vessel failure is 0.8. The probability that HPME does not occur is 0.2. If the previous node in this DET (MOBILE) has a value of SMALL (indicating that the amount of molten corium at the time of vessel failure is small), then there is no branch at this node since HPME is precluded.<br><br>The gates that model these conditions are as follows.<br><br>L2-HPME-YES – HPME occurs<br>L2-HPME-NO – HPME does not occur<br><br>(continued) |

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| DEBCOOL (cont.) | <u>DEBCOOL Event ENTRAIN – Degree of Debris Entrained to Drywell</u><br>This DET node addresses how much of the core debris is entrained out of the pedestal and into the drywell. This factor is important since the more core debris that is entrained out of the drywell, the more likely ex-vessel debris bed cooling will be successful. In order for entrainment to occur, the reactor vessel must be at high pressure at the time of vessel failure to provide a driving force for moving the debris out of the pedestal and a large amount of the core must be mobile to provide sufficient core debris for transport to the drywell. Additionally, a path must exist for the flow from the pedestal to the drywell. At RBS, there are openings between the pedestal and the drywell for the CRD tubes, allowing communication between the regions. Therefore, if the reactor vessel is at high pressure, entrainment is assumed to be possible. However, if the reactor vessel is at low pressure at the time of vessel failure, there may not be sufficient pressure to entrain the debris to the drywell region. If the vessel is at high pressure at failure, the amount of entrainment to the drywell will also depend on the amount of the core that is mobile at the time of failure. If a large portion of the core is mobile, more core debris is available to be transported to the drywell.<br>For the purposes of this analysis, the amount of debris entrained from the pedestal is considered HIGH if it represents approximately 40% of the total debris mass. It is considered LOW if it represents approximately 10%. For quantification, it is assumed that if the reactor vessel is at high pressure at the time of vessel failure, a large fraction of the core is mobile at the time of vessel failure, and HPME occurs, then a HIGH degree of entrainment from the pedestal to the drywell will occur with a probability of 1.0. If any of these conditions is not met (i.e, vessel pressure is low, the fraction of core debris mobile is small or HPME does not occur), entrainment is precluded. In this case, the ENTRAIN event is assigned a value of LOW with a probability of 1.0. Therefore, no CAFTA fault tree logic is developed for this, but the information is provided on the DET.<br><br><u>DEBCOOL Event EXVCOOL – Is Debris Cooled Ex-Vessel?</u><br>This DET node addresses whether or not ex-vessel debris bed cooling is successful. If ex-vessel cooling is successful it is assumed that concrete ablation is prevented. This reduces the generation of non-condensables and combustible gases. Provided that an injection source is available to supply cooling water to the debris bed in the pedestal, the probability of successful ex-vessel cooling is determined by how much of the debris is entrained out of the pedestal. NUREG/CR-4551 provides estimates of successful ex-vessel cooling for cases with vessel failure at high pressure and high and low degrees of entrainment and with vessel failure at low pressure and a low degree of entrainment. For the case of high vessel pressure at the time of failure and a small amount of entrainment, the probability of successful ex-vessel cooling is 0.6 and the probability of failure of ex-vessel cooling is 0.4. For the case of high reactor vessel pressure at the time of failure and a high degree of entrainment, the probability of successful ex-vessel cooling is 0.8 and the probability of failure of ex-vessel cooling is 0.2.<br>(continued) |

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| DEBCOOL (cont.) | Finally, for the case of low pressure in the vessel at time of failure and small degree of entrainment, the probability of successful ex-vessel cooling is 0.16 and the probability of failure is 0.84. For all other cases, ex-vessel cooling is assumed to be failed.<br>The gates that model these conditions are as follows.<br>L2-EXVCOOL-H-H – ex-vessel cooling successful, high pressure, high entrainment<br>L2-NO-EXVCOOL-H-H – ex-vessel cooling fails, high pressure, high entrainment<br>L2-EXVCOOL-H-L – ex-vessel cooling successful, high pressure, low entrainment<br>L2-NO-EXVCOOL-H-L – ex-vessel cooling fail, high pressure, low entrainment<br>L2-EXVCOOL-L-L – ex-vessel cooling successful, low pressure, low entrainment<br>L2-NO-EXVCOOL-L-L – ex-vessel cooling fails, low pressure, low entrainment |
| CF-LATE – Containment Does Not Fail Late Due to H2 Phenomena | For CET sequences in which the CET did not fail early due to hydrogen burns, no suppression pool bypass and a failure to cool the core debris ex-vessel, CET event CF-LATE considers the potential for the containment to fail late due to extra hydrogen generated by MCCI. The evaluation of this event is essentially identical to the evaluation of hydrogen-induced containment failure at the approximate time of vessel failure, which was presented in the discussion of CET event CF-EARLY. The only significant difference is that the late evaluation takes into account additional hydrogen generated from MCCI, which results in a significantly larger probability of containment failure from the hydrogen effects.<br>The evaluation of the late hydrogen-induced containment failure probabilities was discussed in the CET event CF-EARLY section with the evaluation of the early effects.<br>Three gates in the fault tree model are used for the solution of the CF-LATE node.<br>L2-CF-LATE-INTACT – combination of group 2 and group 3 sequences with their conditional probabilities of H2-induced intact containment.<br>L2-CF-LATE-RUPT – combination of group 2 and group 3 sequences with their conditional probabilities of H2-induced ruptured containment.<br>L2-CF-LATE-PEN - combination of group 2 and group 3 sequences with their conditional probabilities of H2-induced penetration failure of containment. |

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| CHR – Containment Heat Removal is Available | For sequences in which there is no earlier failure of containment (i.e., not sequences with containment failure before vessel failure, no hydrogen-induced containment failure and not suppression pool bypass), and there is successful cooling of core debris ex-vessel, the CHR top event is questioned. Success of containment heat removal in these instances will result in an intact containment, and radionuclide releases will be negligible.<br><br>The fault tree gates used to assess this event are as follows.<br><br>CONT-HT-REMOVAL – RHS suppression pool cooling (gate W1), SPC (gate W5) and containment fans (gate W4) fail to remove containment heat loads<br>CONT-HT-REM-SUCC – containment heat removal is successful |
| AB-SCRUB – Aux Building Scrub of Releases | Failures of secondary containment into the Auxiliary Building are not direct releases into the environment. The RBS MAAP model does not consider the Auxiliary Building, but rather models all releases as direct to the environment. In reality, releases to the Auxiliary Building offer the potential for fission product deposition on walls, equipment, floors, etc., which would reduce the releases to the environment. This node of the CET is created to credit this potential for reduction in the fission product release fractions.<br><br>For large failures of containment (i.e., rupture due to hydrogen effects, ATWS, RV rupture, suppression pool bypass due to structural failure, containment bypass events, and containment isolation failures); no credit was given to possible source term attenuation in the Auxiliary Building. However, for smaller, penetration failures of containment, some credit was given.<br><br>RBS is a Mark III containment design. As such, the Auxiliary Building encloses the containment. Some particulate releases from containment would deposit on equipment and structures within the Auxiliary Building, rather than transit directly to the environment. This reduction in particulate release is a scrubbing benefit that cannot be precisely quantified as there is no MAAP model of the RBS Auxiliary Building. Since a definitive basis is not available to credit the Auxiliary Building scrubbing effects, no credit will be taken for its ability to reduce the LERF. However, based on engineering judgment, there is a clear benefit that a best-estimate Level 2 analysis should credit. For non-LERF releases, a probability of 0.5 is estimated for successful reduction in fission product releases to the environment due to Auxiliary Building attenuation. This probability is applied to the sequences with penetration failures of containment, with successful attenuation assumed to reduce the fission product release fractions by 50% (except for noble gases, for which no attenuation is credited). The 50% probability of a 50% reduction is based solely on engineering judgment. The exact probability and percentage of fission products retained in the Auxiliary Building is indeterminate. Without a solid basis, 50% is selected as being the midpoint between zero benefit and 100% success.<br><br>The fault tree gates that model scrubbing are as follows.<br><br>L2-AB-SCRUB-SUCC – Aux Building attenuation of fission products reduces particulate release by 50%<br>L2-AB-SCRUB-FAIL – Aux Building is not effective at reducing fission product releases |

### D.1.2.3 Radionuclide Analysis

This section describes the characterization of fission-product releases for the RBS PRA. Based on an examination of the results of MAAP calculations and on consideration of the nature and frequency of the scenarios involving containment failures of various types, a set of release categories was defined.

#### D.1.2.3.1 Estimation of Release Fractions

The major factors impacting the radioactive releases were as follows:

(1) Whether or not the sequence bypasses containment
(2) Whether or not containment isolation is successful
(3) The status of containment at the time of vessel failure
(4) Mechanism of containment failure (penetration failures, gross rupture, suppression pool bypass)
(5) Whether or not the molten debris is cooled ex-vessel (i.e., prior to Molten Core Concrete Interactions (MCCI))

Each of these factors was dependent on particular accident sequences which established the systems available to cool the core and the containment, which in turn determined the available time for fission product removal processes to become effective in reducing radioactive releases. The accident sequences were analyzed using an integrated computer analysis code, the Modular Accident Analysis Program (MAAP). MAAP was designed to provide realistic assessments of core-damage and the accident progression in containment, including calculations of fission-product release, transport, removal, and deposition.

Many different accident sequences were analyzed using MAAP, primarily focused on the significant (top 95% of CDF and any sequence that individually contributes at least 1% to the total CDF) core damage sequences. This definition of "significant" sequences is consistent with the ASME PRA Standard [D.1-11].

MAAP categorizes the release fractions into the following 12 radionuclide groups:

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| GROUP 1 | Noble gases (Xe + Kr) |
| GROUP 2 | CsI + RbI |
| GROUP 3 | $TeO_2$ |
| GROUP 4 | SrO |
| GROUP 5 | $MoO_2 + RuO_2 + TcO_2 + RhO_2$ |
| GROUP 6 | CsOH + RbOH |
| GROUP 7 | BaO |
| GROUP 8 | $La_2O_3 + Pr_2O_3 + Nd_2O_3 + Sm_2O_3 + Y_2O_3 + ZrO_2 + NbO_2 + AmO_2 + CmO_2$ |
| GROUP 9 | $CeO_2 + NpO_2 + PuO_2$ |
| GROUP 10 | Sb |
| GROUP 11 | $Te_2$ |
| GROUP 12 | $UO_2$ (fuel, not fission products) |

In MAAP, the following are considered to be the volatile fission product groups:

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| GROUP 1 | Noble gases (Xe + Kr) |
| GROUP 2 | CsI + RbI |
| GROUP 3 | $TeO_2$ |
| GROUP 6 | CsOH + RbOH |
| GROUP 11 | $Te_2$ |

The fission products in the remaining groups are less volatile and are considered to be the non-volatiles:

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| GROUP 4 | SrO |
| GROUP 5 | $MoO_2 + RuO_2 + TcO_2 + RhO_2$ |
| GROUP 7 | BaO |
| GROUP 8 | $La_2O_3 + Pr_2O_3 + Nd_2O_3 + Sm_2O_3 + Y_2O_3 + ZrO_2 + NbO_2 + AmO_2 + CmO_2$ |
| GROUP 9 | $CeO_2 + NpO_2 + PuO_2$ |
| GROUP 10 | Sb |
| GROUP 12 | $UO_2$ (fuel, not fission products) |

The time and duration of release for each STC were also estimated based on the MAAP analyses. In general, cases were run to a minimum of 140 hours to ensure that any late MCCI effects are understood. The exact run duration of each case is described in Attachment A of Reference D.1-5. The results demonstrate that occurrence of late MCCI significantly increases the release magnitudes, as presented in Table D.1-7.

The following numbering scheme was used for the major release categories:

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| STC 1 | Intact Containment (releases are minimal) |
| STC 2 | Suppression pool bypass |
| STC 3 | Containment isolation failure |
| STC 4 | Containment bypass events |
| STC 5 | Large, early containment rupture due to hydrogen effects |
| STC 6 | Large, late containment rupture due to hydrogen effects |
| STC 7 | Penetration failures of containment – containment failed prior to core damage, debris cooling is successful (no MCCI), and Auxiliary Building (AB) scrubbing is successful |
| STC 8 | Penetration failures of containment – containment failed prior to core damage, debris cooling is successful (no MCCI), and no AB scrubbing |
| STC 9 | Penetration failures of containment – containment failed prior to core damage, debris cooling is unsuccessful (MCCI occurs), and AB scrubbing is successful |
| STC 10 | Penetration failures of containment – containment failed prior to core damage, debris cooling is unsuccessful (MCCI occurs), and no AB scrubbing |
| STC 11 | Penetration failures of containment – containment intact at core damage, debris cooling is successful (no MCCI), containment heat removal fails, and AB scrubbing is successful |
| STC 12 | Penetration failures of containment – containment intact at core damage, |

debris cooling is successful (no MCCI), containment heat removal fails, and no AB scrubbing

STC 13 Penetration failures of containment – containment intact at core damage, debris cooling is unsuccessful (MCCI occurs), penetration failure due to hydrogen phenomena or containment heat removal failure, and AB scrubbing is successful

STC 14 Penetration failures of containment – containment intact at core damage, debris cooling is unsuccessful (MCCI occurs), penetration failure due to hydrogen phenomena or containment heat removal failure, and no AB scrubbing

The representative MAAP cases for each were determined as follows:

STC 1 – Intact Containment – MAAP case T-51-NF was performed for intact containment. Releases are negligible, limited to Technical Specification leakage rates.

STC 2 – Suppression pool bypass – MAAP case T-51-SPB was selected to represent the suppression pool bypass releases. The case was chosen because sequence T-51 is at high pressure and involves a rapid progression to core damage, therefore maximizing the releases to represent this category. The releases occur early before evacuation is complete.

STC 3 – Containment isolation failure – MAAP case T-51-CIF was developed to evaluate the releases from failure of containment isolation. The case was chosen because sequence T-51 is at high pressure and involves a rapid progression to core damage, therefore maximizing the releases to represent this category. The releases occur early before evacuation is complete.

STC 4 – Containment bypass sequences – the containment bypass category includes a variety of Level 1 sequences, including ISLOCA, Breaks Outside Containment (BOC), RV rupture and ATWS. The ISLOCA and BOC sequences have the potential for scrubbing of fission products, depending on the break locations, but the frequencies of ISLOCA and BOC are very small. The ATWS and RV rupture sequences have a much higher CDF, and therefore are better representations of the releases for STC 4. Limitations of the MAAP code inhibit accurate modeling of the ATWS and RV rupture accident progressions, but they are assumed to result in a rapid containment overpressurization failure. Therefore, the releases for STC 4 are approximated by the MAAP case VRUP-CF. In this case, a large break of the vessel occurs at time zero, and a large failure of the drywell occurs at the same time. The releases occur early, before evacuation is complete.

STC 5 – This category represents sequences with an early (approximately the time of vessel failure) rupture of containment. The size of the "gross" containment failure at RBS was not specified in the containment fragility analysis [D.1-41]. However, the failure would be significant, and is approximated by the large releases calculated for the suppression pool bypass MAAP analysis, T-51-SPB. The releases occur early, before evacuation is complete. While it is conservative to model the early containment rupture as releases from a suppression pool bypass, given the uncertainty of the impacts of a large hydrogen detonation and the negligible frequency of STC 5, a conservative representation is acceptable.

STC 6 – This category represents sequences with a large, late containment rupture due to hydrogen effects. The size of the "gross" containment failure at RBS was not specified in the containment fragility analysis [D.1-41]. However, the failure would be significant, and is approximated by a large (25 $ft^2$) opening in containment modeled at 45 hours into the event. The representative case is T-TB-3-D-R, which is identical to T-TB-3, except with the containment rupture at 45 hours. The releases occur in the late time frame.

STC 7 - Penetration failure of containment, containment failed prior to core damage, debris cooling is successful (no MCCI), and AB scrubbing is successful. The fission product results of the containment failure before core damage sequences (S2A-6, T-TB-1, T-TB-2, T-14 and T1-4) have very similar release profiles. Of these, the CsI release fraction from T-14 is slightly larger than the others. Therefore, it is conservatively chosen to be representative of this STC. The release fraction of the noble gases is as calculated in the T-14 case. From the attenuation of fission products from AB scrubbing, the other fission product release fractions are reduced by 50%.

STC 8 - Penetration failures of containment, containment failed prior to core damage, debris cooling is successful (no MCCI), and AB scrubbing is not successful. The fission product results of the containment failure before core damage sequences (S2A-6, T-TB-1, T-TB-2, T-14 and T1-4) have very similar release profiles. Of these, the CsI release fraction from T-14 is slightly larger than the others. Therefore, it is conservatively chosen to be representative of this STC.

STC 9 – Penetration failure of containment, containment failed prior to core damage, debris cooling is unsuccessful (MCCI occurs), and AB scrubbing is successful. The fission product results of the containment failure before core damage sequences (S2A-6, T-TB-1, T-TB-2, T-14 and T1-4) have very similar release profiles. Of these, the CsI release fraction from T-14 is slightly larger than the others. Therefore, it is conservatively chosen to be representative of this STC. The release fraction of the noble gases is as calculated in the T-14 case. From the attenuation of fission products from AB scrubbing, the other fission product release fractions are reduced by 50%.

STC 10 – Penetration failures of containment, containment failed prior to core damage, debris cooling is unsuccessful (MCCI occurs), and AB scrubbing is not successful. The fission product results of the containment failure before core damage sequences (S2A-6, T-TB-1, T-TB-2, T-14 and T1-4) have very similar release profiles. Of these, the CsI release fraction from T-14 is slightly larger than the others. Therefore, it is conservatively chosen to be representative of this STC.

STC 11 - Penetration failure of containment – containment intact at the time of core damage and vessel failure, debris cooling is successful (no MCCI), and AB scrubbing is successful. The category 2 core damage sequences are represented by MAAP cases T-TB-3 and RCIC-Inj. In these two cases, the CsI releases prior to MCCI are low (<0.1%), and the CsI releases at the end of the run are similar (8.1% vs. 5.6%). The Group 3 core damage sequences are represented by MAAP cases T-TB-6, T-TB-9, T-51 and T-51-CV. In each of these cases, the CsI releases prior to MCCI are also low (<0.1%), and the CsI releases at the end of the run are of the same magnitude (1.9%, 1.9%, 6.8%, and 5.1%). Given that the release magnitudes of the Group 2 and Group 3 sequences are all fairly similar, the highest of these (case T-TB-3) was taken as representative of all of them. There is some conservatism in that the lowest release of these is approximately a factor of four lower in CsI fraction (cases with MCCI have 8.1% vs. 1.9%), but this difference is not considered significant, and within the uncertainty bounds of the Level 2 analysis. Considering the small variations in release magnitudes due to the sensitivity cases (no HCTL depressurization, successful containment venting, etc.), all of these Group 2 and Group 3 cases with MCCI were categorized as large, late releases. Conservatism in this assessment does not impact the LERF, and given that the releases are very close to the delineation of large vs. small release, it is appropriate to categorize them as large. Therefore, MAAP case T-TB-3 is conservatively chosen to be representative of STC 11 (no MCCI) and 13 (with MCCI). The release fraction of the noble gases is as calculated in the T-TB-3 case. From the attenuation of fission products from AB scrubbing, the other fission product release fractions are reduced by 50%.

STC 12 – Similar to STC 11, this category is represented by the T-TB-3 (no MCCI) MAAP case, but there is no attenuation from AB scrubbing.

STC 13 – As described above for STC 11, this category is represented by T-TB-3 (with MCCI), and AB scrubbing reduces the fission product release fractions (other than noble gases) by 50%.

STC 14 – Identical to STC 13, except that there is no attenuation of fission products from AB scrubbing.

The representative fission product release fractions from MAAP are provided in Table D.1-7 for each of the 14 STCs.

## Table D.1-7 – STC Fission Product Release Fractions (MAAP)

| STC | Description | FREL(1) Nobles | FREL (2) CsI | FREL (3) TeO2 | FREL (4) SrO | FREL(5) MoO2 | FREL(6) CsOH | FREL(7) BaO | FREL(8) La2O3 | FREL(9) CeO2 | FREL(10) Sb | FREL(11) Te2 | FREL(12) UO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STC 1 | Intact Containment | 3.5E-1 | 2.7E-4 | 1.2E-4 | 6.5E-7 | 3.4E-6 | 2.7E-4 | 1.2E-6 | 2.1E-7 | 1.3E-6 | 7.4E-4 | 1.5E-5 | 3.6E-8 |
| STC 2 | Suppression Pool bypass | 1.0E+00 | 3.0E-01 | 6.3E-02 | 4.1E-04 | 3.6E-04 | 2.6E-01 | 3.9E-04 | 2.6E-04 | 5.8E-04 | 6.0E-02 | 1.1E-03 | 4.5E-05 |
| STC 3 | Containment Isolation Failure | 9.9E-01 | 1.4E-01 | 8.7E-02 | 6.5E-03 | 1.6E-02 | 1.5E-01 | 7.6E-03 | 2.3E-03 | 9.0E-03 | 4.7E-01 | 2.4E-03 | 1.7E-04 |
| STC 4 | Containment Bypass | 9.9E-01 | 2.2E-01 | 5.6E-02 | 3.6E-03 | 3.6E-03 | 2.3E-01 | 2.2E-03 | 6.3E-04 | 6.4E-03 | 1.2E-01 | 3.2E-03 | 1.3E-04 |
| STC 5 | H2-induced early containment rupture | 1.0E+00 | 3.0E-01 | 6.3E-02 | 4.1E-04 | 3.6E-04 | 2.6E-01 | 3.9E-04 | 2.6E-04 | 5.8E-04 | 6.0E-02 | 1.1E-03 | 4.5E-05 |
| STC 6 | H2-induced late cont rupture | 1.0E+00 | 1.4E-01 | 9.5E-03 | 1.6E-03 | 1.5E-03 | 1.6E-01 | 1.1E-03 | 2.0E-04 | 2.9E-03 | 2.0E-01 | 8.6E-05 | 7.6E-05 |
| STC 7 | Containment failure before vessel breach (CFBVB), no MCCI, AB scrub | 1.0E+00 | 2.6E-03 | 2.3E-03 | 5.5E-06 | 1.6E-04 | 2.7E-03 | 2.8E-05 | 4.7E-06 | 5.0E-06 | 2.7E-03 | 2.2E-05 | 0.0E+00 |
| STC 8 | CFBVB, no MCCI, no AB scrub | 1.0E+00 | 5.2E-03 | 4.5E-03 | 1.1E-05 | 3.2E-04 | 5.4E-03 | 5.6E-05 | 9.4E-06 | 1.0E-05 | 5.3E-03 | 4.5E-05 | 0.0E+00 |
| STC 9 | CFBVB, late MCCI, AB scrub | 1.0E+00 | 7.0E-02 | 1.8E-02 | 1.3E-04 | 2.1E-04 | 6.5E-02 | 1.1E-04 | 5.5E-05 | 2.1E-04 | 3.1E-02 | 6.0E-05 | 7.5E-06 |
| STC 10 | CFBVB, late MCCI, no AB scrub | 1.0E+00 | 1.4E-01 | 3.5E-02 | 2.5E-04 | 4.1E-04 | 1.3E-01 | 2.2E-04 | 1.1E-04 | 4.1E-04 | 6.2E-02 | 1.2E-04 | 1.5E-05 |
| STC 11 | No CFBVB, no MCCI, AB scrub | 1.8E-02 | 3.7E-05 | 5.5E-06 | 4.6E-07 | 4.7E-06 | 5.5E-05 | 2.4E-06 | 2.3E-08 | 6.5E-08 | 1.1E-04 | 0.00E+0 | 0.00E+0 |
| STC 12 | No CFBVB, no MCCI, no AB scrub | 1.8E-02 | 7.5E-05 | 1.1E-05 | 9.1E-07 | 9.3E-06 | 1.1E-04 | 4.7E-06 | 4.6E-08 | 1.3E-07 | 2.2E-04 | 0.0E+0 | 0.0E+00 |
| STC 13 | No CFBVB, late MCCI, AB scrub | 1.0E+00 | 4.1E-02 | 1.4E-03 | 6.5E-05 | 3.6E-05 | 4.4E-02 | 4.4E-05 | 1.2E-05 | 1.7E-04 | 4.5E-02 | 7.5E-05 | 8.0E-06 |
| STC 14 | No CFBVB, late MCCI, no AB scrub | 1.0E+00 | 8.1E-02 | 2.8E-03 | 1.3E-04 | 7.1E-05 | 8.8E-02 | 8.7E-05 | 2.3E-05 | 3.4E-04 | 8.9E-02 | 1.5E-04 | 1.6E-05 |

D.1.2.3.2 Categorization of Releases into Large/Small and Early/Late

The release categories are defined to delineate CET end states that have sufficiently varying release profiles. In addition to the specific release category definitions, it is also useful to more broadly group the results into five general release groups:

- No release (intact containment)
- Large, Early Release
- Small, Early Release
- Large, Late Release
- Small, Late Release

For the RBS Level 2, a release is categorized as large if the Cesium, Iodine or Tellurium radionuclide release fraction is ≥ 2.5% of the core inventory. In accordance with the ASME/ANS PRA Standard, early is defined as a release to the environment occurring before the effective implementation of off-site emergency response and protective actions such that there is a potential for early health effects. A successful evacuation requires 5 hours after a general emergency is declared (loss of two fission product barrier and potential loss of a third). Thus, early releases are those that occur within 5 hours of the declaration of a general emergency. MAAP results are utilized to determine the timing of a general emergency for representative sequences for each category.

Based on these definitions of large vs. small and early vs. late releases, the RBS CET sequences are grouped as follows:

- Intact containment – STC 1
- Large, early releases – STCs 2, 3, 4, 5. These STCs do not show CsI releases exceeding the criterion for large until after evacuation would have been successful. However, summing the volatile releases (CsI, $Te_2$, $TeO_2$ and CsOH) does yield a total of greater than 2.5% before the time of successful evacuation. For conservatism, these STCs are binned as large, early releases, with the large release fractions at the end of the cases being conservatively considered in the early time frame. While this may be conservative for some scenarios, the ATWS and RV rupture scenarios dominate the LERF, and these should be categorized as large and early, so the conservatism has very little impact on the total LERF.
- Small, early releases – none
- Large, late releases – STCs 6, 9, 10, 13, 14
- Small, late releases – STCs 7, 8, 11, 12

Table D.1-8 provides the CET quantification results for all source term categories and Table D.1-9 provides the results in source term groups. Note that the frequency for STC 1, Intact Containment, has been increased to account for the difference between the Level 1 core damage frequency and the total calculated Level 2 frequency. Because of the CET methodology for the Level 2 analysis, the Level 1 sequences are split through the accident progression, and each Level 1 sequence (except for containment bypass) has the potential to go along different paths of the CET. Progress along each path has a series of probabilities associated with it, and as a consequence, some core damage cutsets that were above the 1E-12/Rx-yr CDF truncation will be below the 1E-12/Rx-yr Level 2 truncation. Therefore, the total Level 2 frequency is slightly less than the Level 1 frequency when the same truncation is used.

**Table D.1-8 - Source Term Category Frequency Results**

| STC | Description | Frequency (/Rx-yr) | Percent |
|---|---|---|---|
| 1 | Intact Containment (minimal releases) | 5.58E-07 | 20.0% |
| 2 | Suppression pool bypass | 3.83E-09 | 0.1% |
| 3 | Containment isolation failures | 2.31E-10 | 0.0% |
| 4 | Containment bypass (including RV rupture & ATWS) | 1.97E-08 | 0.7% |
| 5 | Large, early rupture of containment from H2 effects | 8.28E-11 | 0.0% |
| 6 | Large, late rupture of containment from H2 effects | 8.68E-10 | 0.0% |
| 7 | Penetration failures of containment – containment failed prior to core damage, debris cooling is successful (no MCCI), and AB scrubbing successful | 6.42E-08 | 2.3% |
| 8 | Penetration failures of containment – containment failed prior to core damage, debris cooling is successful (no MCCI), and no AB scrubbing | 6.42E-08 | 2.3% |
| 9 | Penetration failures of containment – containment failed prior to core damage, debris cooling is unsuccessful (MCCI occurs), and AB scrubbing successful | 9.04E-07 | 32.4% |
| 10 | Penetration failures of containment – containment failed prior to core damage, debris cooling is unsuccessful (MCCI occurs), and no AB scrubbing | 9.04E-07 | 32.4% |
| 11 | Penetration failures of containment – containment intact at core damage, debris cooling is successful (no MCCI), and AB scrubbing successful | 2.99E-10 | 0.0% |
| 12 | Penetration failures of containment – containment intact at core damage, debris cooling is successful (no MCCI), and no AB scrubbing | 2.99E-10 | 0.0% |
| 13 | Penetration failures of containment – containment intact at core damage, debris cooling is unsuccessful (MCCI occurs), and AB scrubbing successful | 1.35E-07 | 4.8% |
| 14 | Penetration failures of containment – containment intact at core damage, debris cooling is unsuccessful (MCCI occurs), and no AB scrubbing | 1.35E-07 | 4.8% |
| Total | | 2.79E-06 | |

**Table D.1-9 - Summary of Release Category Groups**

| Source Term Group | STCs | Frequency (/yr) | % of Total |
|---|---|---|---|
| Intact Containment | 1 | 5.58E-7 | 13.5% |
| Large Early | 2, 3, 4, 5 | 2.32E-8 | 0.9% |
| Large Late | 6, 9, 10, 13, 14 | 2.08E-6 | 80.6% |
| Small Early | None | 0 | 0 |
| Small Late | 7, 8, 11, 12 | 1.29E-7 | 5.0% |
| Total | STCs 1-14 | 2.79E-6 | 100% |

## D.1.3 IPEEE Analysis

The purpose of this section is to summarize the plant external events analyses and document their acceptability for use in the SAMA analysis. The RBS IPEEE analysis was submitted to the Nuclear Regulatory Commission (NRC) on June 30, 1996 [D.1-15]. It was supplemented by responses to NRC requests for additional information on February 26, 1998 [D.1-18], October 18, 1999 [D.1-19] and May 9, 2000 [D.1-20].

### D.1.3.1 Seismic Analysis

RBS was classified in NUREG-1407 [D.1-8] as a reduced-scope plant based on low seismicity. Therefore, emphasis was placed on conducting detailed seismic walkdowns. Guidelines and procedures documented in EPRI Report NP-6041-SL [D.1-9] were used in performing the work. Since RBS is a reduced-scope plant, the Safe Shutdown Earthquake (SSE) ground response spectra and corresponding in-structure response spectra were used as the Review Level Earthquake (RLE) input for the walkdown and evaluation as requested by NUREG-1407.

The conclusions of the RBS IPEEE seismic walkdowns are as follows:

> "The seismic walkdowns found River Bend Station is seismically rugged and all components in the SPLD [Success Path Logic Diagrams] adequately consider the seismic input. All the SPLD equipment was screened out and there were no outliers requiring further evaluation. All anchorage was found to be rugged.
>
> The SRT [Seismic Review Team] inspected the control room ceiling and found the ceiling to be seismically adequate with numerous wire tie-offs. All equipment above the ceiling (e.g., ducting and conduits) have rugged supports including a domestic water storage header supported on a frame consisting of large tube sections.
>
> Based on a review of USAR [Updated Safety Analysis Report] the SRT performed an engineering evaluation which concluded that stress corrosion cracking is not a concern at River Bend. Review of design criteria for piping indicated that piping penetrations crossing buildings are properly designed to accommodate differential thermal and seismic

movements of the buildings and relative settlement between the buildings.

The walkdowns also confirmed that there are no system spatial interaction concerns. No masonry or concrete block walls are located near any of the equipment and vibration isolation devices are not utilized except for a small pump for which neoprene pads are used. These pads do not affect the pump seismic ruggedness. All structures that house success path equipment or structures that could fail, fall and impact any success path equipment were screened out based on the EPRI NP-6041 screening Table 2-3 and verification of the screening assumptions.

All the concerns raised by the SRT during the walkdown were resolved either during the walkdown or afterwards based on reviewing additional information (i.e., calculations, specifications and drawings). There are no components which require further evaluation."

#### D.1.3.2 Fire Analysis

ENTERGY performed a Fire PRA to meet the objectives of the IPEEE. The methodology was based on a combination of EPRI FIVE [D.1-16] methods and the PRA methods in the EPRI draft "Fire Risk Implementation Guide [D.1-17]. Overall the method was a progressive screening analysis. If at any time in the screening a fire area dropped below 1E-06/Rx-yr the fire area was screened. Conservatism was removed progressively in steps and areas were screened from further analysis when they could be shown to be of low risk significance. This methodology allowed resources to be focused on the more risk significant areas. The models and methods used in the internal events Individual Plant Examination (IPE) served as the basis for quantification of the Conditional Core Damage Probabilities (CCDPs). The event trees and fault trees were modified slightly to account for equipment for which cable location information was available. The CDF of the areas that did not screen totaled 2.25E-05/Rx-yr in the original IPEEE submittal [D.1-15].

No internal fire vulnerabilities were identified as a result of the fire IPEEE. However, insights were gained in the process of performing the analysis. The insights primarily related to the selection of equipment credited in the RBS Safe Shutdown Analysis [D.1-31]. These insights were provided to the Fire Protection Manager for further consideration. A review of the Safe Shutdown Analysis, the procedure for fires outside the main control room [D.1-30], and the procedure for fires in the control room [D.1-32] indicates that these insights have been addressed.

**Table D.1-10 – RBS Fire IPEEE**

| Fire Areas Included in Final Phase of Screening | | |
|---|---|---|
| **Fire Area** | **Description** | **Total Compartment CDF (Rx/yr)** |
| C-25 | Control Room | 4.87E-06 |
| C-15 | Division 1 Standby Switchgear Room | 4.75E-06 |
| C-17 | Control Room Ventilation Room EL. 116' | 4.56E-06 |
| C-4 | Air Conditioning Unit (ACU) West Room | 3.31E-06 |
| AB-2/Z-2 | HPCS & HPCS Hatch Area | 2.23E-06 |
| ET-1 | B-Tunnel East | 1.48E-06 |
| AB-1/Z-4 | Auxiliary Building: West Side Crescent Area | 1.26E-06 |
| | **Total Fire CDF** | 2.25E-05 |

### D.1.3.3 Other External Hazards

The RBS IPEEE submittal, in addition to the internal fires and seismic events, examined a number of other external hazards:

- high winds and tornadoes;
- external flooding; and
- transportation, and nearby facility incidents

RBS performed the screening described in Supplement 4 to General Letter 88-20 and NUREG-1407 to address the other external hazards. The first step in the screening approach was to determine if the criteria of the 1975 Standard Review Plan (SRP) are met. In general, the information contained in the Updated Safety Analysis Report and relevant design basis documents was reviewed for each of the applicable hazards. Hardware and procedural changes were also reviewed to determine any resultant significant vulnerabilities. This information was used to judge whether RBS met the criteria contained in the 1975 SRP. The site review and design comparison relative to the 1975 SRP determined that the criteria of the 1975 SRP were met by RBS. No vulnerabilities unique to other external events were identified [D.1-15].

### D.1.3.4 Internal Flooding Analysis

The RBS Level 1 model does not include contributions from internal flooding hazards. RBS has a separate internal flooding analysis that was revised and updated in 2012. It was performed using the FRANC code [D.1-21] to quantify more than 500 flooding scenarios identified in the analysis [D.1-22]. FRANC is a code developed for use with fire PRA but which can also be applied to spatial risk assessments such as internal flooding. The results of the internal flooding quantification [D.1-23] are provided in Table D.1-11.

**Table D.1-11 – Internal Flooding CDF by Building**

| Building | CDF |
|---|---|
| Auxiliary Building | 2.91E-06 |
| Control Building | 6.34E-07 |
| Diesel Building | 7.95E-07 |
| Fuel Building | 4.08E-08 |
| Radwaste Building | 3.65E-10 |
| Turbine Building | 4.25E-08 |
| Tunnels | 5.46E-07 |
| **TOTAL** | 4.97E-06 |

### D.1.3.5 SAMA External Events Multiplier

Since up to date quantitative external events models do not exist for RBS, a multiplier was developed and applied to the internal events PRA results to account for the risk contribution from external events in SAMA evaluations.

As indicated above, the RBS "other" external events were addressed by demonstrating compliance with the 1975 SRP. Compliance with the SRP and no adverse findings from walkdowns, justifies the conclusion that the hazard's contribution to CDF is less than 1E-06/Rx-yr. Therefore, these events are not significant contributors to external event risk and since quantitative analysis of these events is not practical, the external event multiplier will be developed based on seismic and fire risk. This is consistent with the guidance of NEI 05-01 [D.1-10].

Since RBS was a reduced scope seismic plant, the method to address seismic risk focused on walk downs of success path equipment and systems. Thus, no seismic core damage estimate was developed. However, a relatively current estimate for the seismic risk for RBS was developed by Entergy in response the NRC's Safety/Risk Assessment (SRA) for GI-199, "Implications of Updated Probabilistic Seismic Hazard Estimated in Central and Eastern United States on Existing Plants" [D.1-24]. These results are provided in a safety/risk assessment that the NRC performed to address GI-199 [D.1-25]. The NRC assessment conservatively determined that the weakest link model seismic core damage frequency (SCDF) for RBS is 2.5E-05/Rx-yr. Entergy estimated the seismic risk using the same methods and hazard curves (2008 USGS, 1989 EPRI, and 1994 LLNL) as the NRC used, with the exception of using more realistic plant specific fragility values instead of the more conservative values used by the NRC. Entergy's more realistic SCDF was determined to be 2.5E-06/Rx-yr [D.1-26]. This estimate is also considered conservative since the SCDF would be 8.3E-07/Rx-yr if the 2010 EPRI seismic hazard curves were used. The more realistic SCDF of 2.5E-06/Rx-yr was used in the SAMA analysis.

The conclusion of the RBS fire PRA analysis was that there are no fire-induced vulnerabilities associated with the continued operation of the RBS. However, the core damage estimates for the areas in the final phase of screening are typically used to represent the fire risk. Table D.1-10Table D.1-9provides a listing of those areas and their associated CDF which totals to 2.25E-05/Rx-yr. However, as indicated in NEI 05-01, the EPRI FIVE methodology results are conservative and are not comparable to internal events core damage frequencies. This is especially true when considering that the original fire analysis used the RBS IPE as the basis for the core damage assessments used in the analysis. The IPE model has been updated many times and the current internal events CDF is 2.79E-06/Rx-yr compared to the IPE CDF of 1.55-05/Rx-yr. This is more than a factor of five less than original IPE CDF and it could be reasonably assumed that an update of the fire PRA analysis with this model would result in a fire CDF one-fifth of the original fire CDF (4.5E-06/Rx-yr). This would account for updated modeling of the internal events portion of the model that was used in the fire analysis, but not necessarily address all of the conservatisms inherent to the FIVE methodology. Even though a reduction by a factor of 5 in the fire CDF may be justifiable, the RBS fire CDF was reduced by a factor of 2.5 to 9.0E-06/Rx-yr for the SAMA analysis. This is well within the range suggested in NEI 05-01 and the same method was used in the Fermi 2 SAMA analysis [D.1-40].

Therefore, the external event multiplier for RBS was determined as follows:

EE Multiplier = (Internal Event CDF + Seismic CDF + Fire CDF + Internal Flooding CDF)

/Internal Event CDF

= (2.79E-06 + 2.5E-06 + 9.0E-06 + 4.97E-06)/2.79E-06

= 6.9

Therefore, an external event multiplier of 7 was used for the SAMA analysis.

### D.1.4 PRA Model Revisions and Peer Review Summary

A summary of the RBS PRA models CDF and LERF is presented in Table D.1-12 below.

**Table D.1-12 – PRA Revision History**

| Model | Description | CDF (/Rx-yr) | LERF (/Rx-yr) |
|---|---|---|---|
| IPE (1993) | Model developed in response to NRC Generic Letter 88-20. | 1.55E-05(2) | 1.8E-06(1) |
| RBS PRA R2 | Incorporation of plant modifications implemented between April 1, 1992 and August 30, 1994. | 3.55E-06(4) | Not updated |
| RBS PRA R2A,B,C (1997) | Selective revision to incorporate major model changes from August 30, 1994 through October 1, 1997. | 1.95E-06(4) | Not updated |
| RBS PRA R2D | Selective revision of the PRA model to incorporate the major model changes from October 1, 1997 through May 31, 1999. | 2.68E-06(2) | Not updated |
| RBS PRA R3 | A comprehensive revision of the PRA model to incorporate major model change from May 31, 1999 to November 1, 2000. The model changes are due to changes in documentation. No plant modifications or procedure changes were made that impacted the model. | 9.44E-06(2) | Not updated |
| RBS R3A (2002) | Revision to incorporate changes associated with the approved license amendment to extend the EDG Technical Specification allowed outage time. | 3.39E-06(3) | Not updated |
| RBS R4 | Major revision of the PRA to incorporate Interfacing Systems Loss of Coolant Accident (ISLOCA) and update of ATWS, Human Reliability Analysis (HRA), failure rates, LOOP analysis, improved common cause analysis and support system initiating event fault trees. | 1.94E-06(4) | Not updated |
| RBS R4A | Interim revision to document the inclusion of modeling for the control building electrical switchgear room cooling. | 3.55E-06(5) | 2.53E-08 |
| RBS R5 | Update to make the model consistent with Capability Category 2 of the ASME PRA Standard. | 2.60E-06(6) | 2.47E-08(7) |
| RBS R5A | Revision to incorporate selected Findings from the BWROG Peer Review of the RBS PRA and to incorporate improvements in the Service Water model. | 2.79E-06(6) | 2.30E-08(7) |

(Notes:
1. Frequency of gross containment failure
2. Truncation of 1E-09/yr
3. Truncation of 1.3E-09/yr due to software limitations
4. Truncation of 1E-10/yr
5. Truncation of 1E-11/yr
6. Truncation of 1E-12/yr
7. Truncation of 1E-14/yr

### D.1.4.1 Major Differences between the IPE Model and the Revision 2 Model

- Added new SBO diesel that provides backup power to Division 1 or 2 Emergency DC power during station blackout events.
- Removed check valve disk between Fire Protection Water (FPW) system and the service water system. This change allows for a more timely alignment of the FPW system for injection into the vessel.
- The FPW injection path was modified from injecting through Low Pressure Core Injection (LPCI) line to injecting through the shutdown cooling line based on changes to the SBO abnormal operating procedure. The change was made to use a path with a valve located outside of containment which can be manually opened during a SBO.
- Various enhancements to the model, including addition of High Pressure Core Spray (HPCS) room cooler as a failure of HPCS, addition of safety-related 480 VAC power models and additional detail to system models.

### D.1.4.2 Major Differences between the Revision 2 Model and the Revision 2c Model

- Modified Instrument Air System modeling to separate service air from instrument air and removed cooling from the instrument air compressors and aftercoolers since new instrument air components are air cooled.
- Removed standby switchgear room dependence on Control Building HVAC based on new calculation which showed that the switchgear would not fail within the PRA mission time.
- Incorporated the new Suppression Pool Cooling and Cleanup system into the model.
- Added partial loss of offsite power logic to the non-safety related systems. This change was incorporated by adding the gates for loss of RSS#1 and loss of RSS#2 230KV power feeds to the pumps and compressors served by that offsite power source. This change means that partial loss of power initiating events will be a larger impact on core damage frequency.
- The HPCS and Reactor Core Isolation Cooling (RCIC) models were updated to allow for the likelihood that the system is initially aligned to the suppression pool.
- The electric power model was extended to include the 230KV system. The 230KV system was modeled back to the North and South buses.
- The Reactor Heat Removal (RHR) pump seal failure due to loss of Reactor Plant Component Cooling Water (RPCCW) was removed from the suppression pool cooling fault tree because suppression pool cooling is not expected to fail due to this mechanism.

### D.1.4.3 Major Differences between the Revision 2c and the Revision 2d Model

- Revised RCIC modeling to reflect the re-routing of the RCIC injection from the RPV spray nozzle to the Feedwater A injection line. Also included RCIC modifications that locked open the RCIC turbine lube oil cooler valve and removed the check valve internals from the turbine exhaust check valve.
- Incorporated procedure changes that allow bypass of RCIC high temperature trip and swapping RCIC suction flow back to the CST during a station blackout if the RCIC setpoint for high suppression pool level swap is met.
- Updated selected plant specific data.
- Added additional detail to the modeling of offsite power supplies.
- Incorporated modeling of alternate power sources for the safety related 4160VAC buses.

#### D.1.4.4 Major Differences between the Revision 2d Model and the Revision 3 Model

- Model event trees were modified as a result of an analysis that shows containment failure occurs sooner on loss of all decay heat removal than previously assumed in Revision 2D. Additional analysis confirmed that containment failure caused over pressurization and failure ductwork in the Auxiliary Building. This results in failure of power supplies to ECCS pump room coolers and control power to the SRVs. This results in the failure of the pump motors and the ability to depressurize the vessel for injection by SSW or firewater.
- The probability for the non-recovery action recover loss of decay heat removal was revised because of the shorter containment failure time (14 hours) compared to the previous failure time of 26 hours.
- The probability of non-recovery of offsite power was changed to include additional industry data accumulated since Revision 2D. This resulted in an increase in the probability of non-recovery of offsite power.
- A recovery action was added to the model to represent non-recovery of a diesel generator when a diesel generator failed to start, failed to run, or the auto start signal failed to start and load the diesel.
- The instrument air fault tree was expanded to include the service air system as backup.

#### D.1.4.5 Major Differences between the Revision 3 Model and the Revision 3A Model

- The probability of non-recovery of offsite power was updated using the convolution method and the Revision 3 curve for non-recovery of offsite power. This resulted in a reduction in CDF of approximately 25%.
- Added recovery action to align the Division III EDG to the Division I or II bus in accordance with a revision to the SBO procedure.
- Two new diesel recoveries were added for revision 3A. In revision 3 there was only one diesel recovery and it was failure to recover a diesel in 1 hour. The two additional recovery actions in revision 3A are failure to recover a diesel in 6 hours and 12 hours. The new diesel recoveries represent the probability that plant personnel will not align the Division III diesel generator to either the Division I or Division II emergency buses in 6 or 12 hours
- A human error event was added to the model to represent the operator action for verifying the SBO bypass valve, SWP-AOV599, opened during a station blackout.

#### D.1.4.6 Major Differences between the Revision 3A Model and the Revision 4 Model

- Included Interfacing System Loss of Coolant Accident (ISLOCA)
- Updated Anticipated Transient Without Scram (ATWS)
- Updated Human Reliability Analysis
- Updated Generic and Plant Failure Rates
- Updated Loss of Offsite Power (LOOP) Analysis
- Improved Common Cause Failure Analysis
- Developed Initiating Event Fault Trees

#### D.1.4.7 Major Differences between the Revision 4 Model and the Revision 4A Model

- Added interim modeling of the control building electrical switchgear room cooling, modeled as a single basic event.

#### D.1.4.8 Major Differences between the Revision 4A Model and the Revision 5 Model

- Updated plant specific data (06/01/2003 to 04/30/2009) and adopted NUREG/CR-6928 ("Industry Average Performance for Components and Initiating Events at U.S.

Commercial Nuclear Power Plants," February 2007) as the basis for generic component data.

- Updated plant specific (thru May 2009) and generic initiating event frequencies including for Loss of Offsite Power event frequency and recovery factors. Also, modeling was expanded to account for the possibility of a conditional Loss of Offsite Power which may occur subsequent to a plant transient.
- Loss of Offsite Power modeling was updated to incorporate more recent industry data on frequency and recovery from LOOP events.
- Updated common cause analysis based on NUREG/CR-5497 ("CCF Parameter Estimations 2007 Update," September 2008) and NUREG/CR-6268, "Common-Cause Failure Database and Analysis System, Sept. 2007, including Volumes 2 and 4 (June 2008)). More detailed modeling of common cause failure is incorporated, extending the components within the scope of potential common cause failures.
- Incorporated the impact of the RBS transition to a 24 month cycle time starting with Cycle 17 in February 2011.
- Times to core damage for LOCA and transient scenarios were updated based on extensive new MAAP severe accident code thermal-hydraulic analyses.
- The RBS definition of core damage was revised to be aligned with that of the ASME/ANS PRA standard.
- Containment venting removed as a contributor to success paths for preventing containment overpressurization. Review of thermal-hydraulic calculations has determined that the 3 inch containment vent path reduces the rate of containment pressurization but will not prevent containment failure.
- Adjusted the timing for Suppression Pool heatup, assuming no Suppression Pool Cooling is available, based on extensive and detailed review of existing applicable thermal hydraulic calculations.
- The human reliability analysis (HRA) was updated based upon refined times to core damage or other milestone events, based upon updated MAAP analyses of system response or upon more rigorous review of thermal-hydraulic accident scenario calculations for room heatup, etc. The HRA also accounted for changes in plant procedures since the last PRA revision.
- Added Break Outside Containment (BOC) modeling, i.e., modeling of Main Steam Line Breaks (MSLB's) or Feedwater Line Breaks (FWLB's) outside containment with a failure to isolate the break.
- Added Vessel Rupture initiating event to the PRA analysis.
- A major revision to the Control Building HVAC model was incorporated.
- The diesel fuel oil transfer system has been explicitly modeled in the PRA rather than included as part of the modeling of the diesel generators themselves.
- Increased level of detail in system models, consistent with requirements of the ASME/ANS PRA standard. Particularly, the level of detail was increased for modeling of electrical power supplies, including Non-safety AC power systems, and for power conversion systems (Main Steam and Feedwater).
- RCIC depressurization for small break LOCA scenarios has been accounted for. Due to the presence of the break, vessel pressure will slowly decrease and it is assumed that subsequent low pressure injection will be required in the long-term to prevent core damage.
- Based upon information received from Grand Gulf and evaluation of room heatup calculations, the HPCS pump is assumed capable of running for six hours without room cooling. Previously one hour was assumed.

- Added significant level of detail to information in System Analysis workbooks, consistent with the requirements of the ANS/ASME PRA Standard.
- Credit for Auxiliary Building and Condenser scrubbing of fission product releases was removed from the LERF model, in response to a comment from the PRA Self-Assessment performed against RG 1.200 Rev. 1.
- Incorporation of Model change Requests (MCR's) generated under EN-DC-151 since issue of Revision 4. Roughly 200 MCR's had been generated on refinements and minor changes needed to specific events in the RBS model which have been addressed as part of PRA Rev. 5.
- Resolved comments from the RBS PRA Self-Assessment against RG 1.200 Rev. 1 and the ASME/ANS PRA Standard from February 2009.

#### D.1.4.9 Major Differences between the Revision 5 Model and the Revision 5A Model

- Enhanced and increased rigor in the modeling of long-term loss of decay heat removal recovery. This resulted in an increase in the long-term decay heat removal (DHRLT) non-recovery probability but allowed for application of procedural recoveries for certain circumstances.
- Enhanced and increased rigor in the modeling of the loss of Normal Service Water initiating event, by crediting the fact that successful initiation of Standby Service Water would prevent a plant scram.
- Incorporated selected Findings from the RBS PRA Peer Review into the model.
- Captured changes to the Service Water Cooling (SWC) fan and heat exchanger success criteria, which had previously been incorporated into the fault tree used in the online risk model under EC41039, in the quantification of Revision 5A.
- Constructed a single CAFTA fault tree for quantification of both CDF and LERF.

#### D.1.4.10 PRA Model Peer Review

Regulatory Guide 1.174, Section 2.2.3, states that the quality of a PRA analysis used to support an application is measured in terms of its appropriateness with respect to scope, level of detail, and technical acceptability, and that these are to be commensurate with the application for which it is intended.

The RBS BWROG PRA Peer Review was performed in July 2011 consistent with the RG 1.200 (Rev. 2) and NEI PRA Peer Review Process Guidance. The purpose of this review was to provide a method for establishing the technical adequacy of the PRA for the spectrum of potential risk-informed plant licensing applications for which the PRA may be used. The 2011 RBS PRA Peer Review was a full-scope review of the Technical Elements of the internal events and flooding, at-power PRA. The RBS LERF model was also reviewed.

The ASME PRA standards used for the RBS peer reviews contained a total of 325 numbered supporting requirements. A number of the supporting requirements were determined to be not applicable to the RBS PRA (e.g., PWR related, multi-site related). Of the applicable supporting requirements, more than 85% were satisfied at Capability Category II or greater for RBS with the majority of the supporting requirements not meeting Supporting Requirements related to the Internal Flooding elements. The Peer Review Team generated a total of 59 Findings which are provided in the peer review report [D.1-3]. Seven of these Findings were against LERF-related Supporting

Requirements, as the River Bend LERF model was developed as a NUREG/CR-6595 simplified LERF model, which is defined as meeting Capability Category I of the Standard. The River Bend Internal Flooding Analysis was subsequently revised in 2012 to fulfill a commitment established via Entergy letter RBG-47029 dated 5/14/2010 to update the basis to PRA Revision 5 and to resolve many of the Findings related to Internal Flooding elements of the Standard.

Table D.1-13 lists the remaining open peer review findings, which were not closed in the internal events model used for the SAMA analysis. Resolution of these items is not expected to significantly change the total internal events CDF for RBS. Thus, the remaining open peer review findings have no impact on the conclusions of the SAMA analysis.

Table D.1-13 – RBS PRA Peer Review Open Findings

| Finding | SR and Assessment | Basis for Peer Review Finding | Peer Review Comment | Disposition and Impact on SAMA |
|---|---|---|---|---|
| 1 / Open | DA-C8<br><br>(Cat. I) | This is a finding since the technical requirements of the SR were not met for Capability Category II. | Table C-2A of PRA-RB-01-002S05 discusses the rationale used to determine run times. While a few components (e.g., SW pumps) appear to be collect actual run vs. standby time in the supporting spreadsheets, the standby time for most components in running systems was estimated (e.g., 1/2, 1/3, etc.). Therefore Category I is met. | Use of actual vice estimated availability for other components would be expected to have very small impact on PRA results. Actual availabilities are used for components for which this information is tracked, including those components monitored by MSPI, which tend to have higher PRA importance (e.g., diesel generators, RHR pumps, Standby Service Water pumps). This finding is considered an enhancement and will be addressed as a possible enhancement to the next periodic PRA model update.<br><br>This finding has no impact on the RBS SAMA analysis. |
| 2 / Open | AS-B3<br><br>(Not Met) | This is a finding because the requirements of the SR are not met. | There is not a specific discussion of the phenomenological impacts of each initiator upon the mitigating systems in the AS notebook (PRA-RB-01-002S01). One specific exception to this is the impacts of debris entrainment for ECCS following LOCA, which is discussed for the Large and Intermediate LOCA event trees. It appears that phenomenological impacts are addressed in the AS logic for all initiators. However, documentation of other impacts (or noting the absence of any impacts) should be provided. | This is considered a documentation issue, as noted in the review comment. For the example of the MSPI application, Table G.5 of NEI 99-02 provides comments to focus on credit for injection post-venting (NPSH issues, environmental survivability) which are thoroughly addressed for the RBS PRA. The environmental effects of containment failure are explicitly considered to result in failure of Auxiliary Building equipment credited for core damage mitigation. As discussed in the PRA Success Criteria calculation PRA-RB-01-002S14, debris effects are considered for Medium Break LOCA and Large Break LOCA resulting in a more restrictive success criteria for those events. This is accounted for via the PRA Event Tree and through recovery rules. Environmental phenomena are thoroughly considered, as documented for the case of internal flooding in Att. 2 to letter RBG-46944 dated August 11, 2009. Systems credited for BOC scenarios are unaffected by those breaks. Room heatup effects are fully considered, as documented in PRA-RB-01-002S14.<br><br>This finding has no impact on the RBS SAMA analysis. |

Table D.1-13 – RBS PRA Peer Review Open Findings

| Finding | SR and Assessment | Basis for Peer Review Finding | Peer Review Comment | Disposition and Impact on SAMA |
|---|---|---|---|---|
| 6 / Open | HR-D3<br><br>(Cat.I) | This is a finding since the technical requirements of this SR are not met. | Since HLR-HR-D concerns pre-initiating events, No evidence of an evaluation process for the quality of pre-initiator written procedures and the quality of the pre-initiator human-machine interface could be found anywhere in the River Bend PRA documentation.<br><br>Note that Post Initiator procedures have been evaluated for quality (Section 1.4.1) as well as the quality of the man machine interface (Section 1.4.3.) in the RBS HRA/Rule Recovery Work Package, Calculation PRA-RB-01-002S03 | This is considered to be primarily an issue of increasing the robustness of PRA model documentation. Only negligible or very slight changes in PRA results would be expected as a result of the review of pre-initiator procedures. Any inadequacy in the procedures associated with pre-initiator human failure events would be evidenced during the construction of the detailed spreadsheet calculations for these probabilities. These spreadsheets include documentation and review of the procedure references for each individual pre-initiator event, as well as review of the procedures and nature of indications for the calculation of the basic human error probability. The man-machine interface quality discussion of section 1.4.3 is also generally applicable to pre-accident initiator actions as well as post-accident actions. No procedural inadequacies were noted during the development of these HRA calculations. Procedure RBNP-001, "Development and Control of RBS Procedures," governs plant operations procedures. RBNP-001 includes requirements for Technical Verification and Validation of procedures to ensure procedure quality. Thus, the intent of the SR is fulfilled through the HRA calculation process.<br><br>This Finding remains open as a documentation enhancement to consider for the next PRA update.<br><br>This finding has no impact on the SAMA analysis. |

Table D.1-13 – RBS PRA Peer Review Open Findings

| Finding | SR and Assessment | Basis for Peer Review Finding | Peer Review Comment | Disposition and Impact on SAMA |
|---|---|---|---|---|
| 11 / Open | DA-C10<br><br>(Cat.I) | This is a finding since the Category II requirements for this SR are not met.<br><br>This was judged to meet Category I of the Standard:<br><br>"When using surveillance test data, REVIEW the test procedure to determine whether a test should be credited for each possible failure mode. COUNT only completed tests or unplanned operational demands as success for component operations." | Surveillance tests are not decomposed into sub-elements. | Only slight or negligible changes to plant specific data would be expected to result from consideration of sub-elements of surveillance test procedures. The River Bend PRA does not decompose failure modes into sub-elements. This element was judged as acceptably meeting the PRA Standard (Category I). Documentation to address this finding will be added to the Data Analysis workbook as part of the next periodic PRA Revision update.<br><br>This finding has no impact on the SAMA analysis. |

Table D.1-13 – RBS PRA Peer Review Open Findings

| Finding | SR and Assessment | Basis for Peer Review Finding | Peer Review Comment | Disposition and Impact on SAMA |
|---|---|---|---|---|
| 13 / Open | MU-C1<br><br>(Met) | This is a finding because the guideline being used is not mandatory and the cumulative impact of pending model changes is not tracked or measured for their impact on each specific applications. | In Engineering Guide EN-NE-G-026, Revision 0, 'Probabilistic Safety Assessment Applications', all open F&Os, MCRs, and gaps impacting an application are reviewed against a specific application. Justification is provided as to why open items in the model are acceptable for the application or why they do not impact the results. However, it is not mandatory to follow this guideline; this needs to be made mandatory.<br><br>In accordance with EN-DC-151 Revision 2, the cumulative impact of pending model changes is not tracked. Per the guidance, only when a model change request for an implemented change is graded A, or there are over 25 open model change requests that are graded B for a particular model will an interim PRA update be implemented.<br><br>However, a method to measure the cumulative impact of pending changes particularly on the particular applications of concern should be implemented to fully meet the intent of this SR. | This finding is against the engineering guide of performing PRA applications and does not directly impact the PRA model. The SAMA analysis uses Revision 5A of the RBS PRA. This table addresses the PRA peer review findings and provides justification that open findings are acceptable for the SAMA application.<br><br>Note the applicable Supporting Requirement from the Standard was judged to be Met.<br><br>This finding has no impact on the SAMA analysis. |

Table D.1-13 – RBS PRA Peer Review Open Findings

| Finding | SR and Assessment | Basis for Peer Review Finding | Peer Review Comment | Disposition and Impact on SAMA |
|---|---|---|---|---|
| 15 / Open | SC-A3<br><br>(Not Met) | This is a finding since the requirements of the SR are not met for all initiating events. | Based on information in PRA-RBS-01-002S14, Although Section 4.0 provide success criteria relevant to the equipment needed for all key safety functions that involve LOCAs and general transients, success criteria for support system initiators, LOCAs outside containment, and ISLOCAs are missing. | This finding is considered to involve documentation of success criteria. Scenario specific success criteria have been considered in the development of RBS Accident Sequence and Success Criteria calculations, PRA-RB-01-002S01 and PRA-RB-01-002S14. Much of the discussion of success criteria is implicit and included under discussion of Success Criteria for individual top events in the RBS Event Trees. Success criteria have been explicitly considered in the development of the Event Trees and in treatment of the support systems for the Event Tree top events. Support system initiating events have the same success criteria as other RBS transients.<br><br>Specifically, conservative assumptions regarding potential environmental and inventory effects are included in the treatment of Interfacing Systems LOCA (ISLOCA) and Breaks Outside Containment (BOC), which are only small contributors to RBS CDF. The success criteria for each event tree top for BOC is documented in Tables 5 and 6 of PRA-RB-01-002S15. Success criteria for ISLOCA are the same as for LOCA, except only limited top gates (depressurization and Standby Service Water cross-tie through RHR) are credited to prevent core damage for ISLOCA.<br><br>Documentation in this area will be enhanced as part of the next periodic PRA update (Rev. 6) for River Bend.<br><br>This finding has no impact on the SAMA analysis. |

Table D.1-13 – RBS PRA Peer Review Open Findings

| Finding | SR and Assessment | Basis for Peer Review Finding | Peer Review Comment | Disposition and Impact on SAMA |
|---|---|---|---|---|
| 16 / Open | SY-A4<br><br>(Met) | This is a finding because the intent of this SR was not met, since the degree of documentation is insufficient. | PRA-RB-01-002S11, Based on information provided by the PSA group, plant walkdowns have been conducted to ensure the system model correctly reflects the as-built, as-operated plant. However, limited evidence exists that interviews have been conducted to ensure the system model correctly reflects the as-built, as-operated plant. | This finding is documentation in nature and resolution does not impact PRA results. System engineers were consulted during development of System Notebooks. Inputs from System Engineering have been documented in the system analysis notebook, PRA-RB-01-002S11 Attachment B. System engineers participated in the Expert Panel review documented in PRA-RB-01-002S02, Integration & Quantification package. The PRA model is continually subject to discussion with system engineers as part of the Maintenance Rule Expert Panel and as periodic plant issues arise. System Engineering also reviews risk information related to PRA model revisions (e.g., EC30303 documenting risk ranking for Revision 5). The site PRA engineer also reviews the Maintenance Rule Basis Documents which have been prepared for a number of Maintenance Rule systems, providing further interaction between PRA and System Engineers on PRA assumptions for plant systems. Thus, numerous opportunities exist and have been utilized for review of the RBS PRA by knowledgeable plant personnel, including system engineers.<br><br>Documentation in this area will be enhanced as part of the next periodic PRA update (Rev. 6) for River Bend.<br><br>Note the applicable Supporting Requirement from the Standard was judged to be Met.<br><br>This documentation related finding has no impact on the SAMA analysis. |

Table D.1-13 – RBS PRA Peer Review Open Findings

| Finding | SR and Assessment | Basis for Peer Review Finding | Peer Review Comment | Disposition and Impact on SAMA |
|---|---|---|---|---|
| 17 / Open | SY-A4 (Met)<br><br>SY-B8 (Not Met) | This is a finding because information gathered from the system walkdowns are not reflected in the system notebooks documentation. Hence, a review of spatial dependencies and harsh environment operation with a potential to impact system PSA function cannot be adequately ascertained. | PRA-RB-01-002S11 R1 states that plant walkdowns were used to identify spatial and environmental hazards. Attachment A of that document contains a set of completed walkdown forms. A sample of those forms were reviewed; many of the forms indicated the existence of some kind of spatial or environmental hazard for the walkdown area. Review of several system notebooks did not reveal any indication that the identified spatial and environmental hazards identified in the walkdowns were reviewed for inclusion in or exclusion from the system models. No evidence was found that identified hazards were accounted for in the system or integrated fault tree model.<br><br>(SY-A4) PRA-RB-01-002S11, Based on documentation provided by the PSA group during the Peer Review, walkdowns have been performed; however, these walkdowns do not discussed spatial and environmental hazards that may impact multiple systems or redundant components in the same system in the system notebooks. | Spatial and environmental hazards that may impact multiple systems or redundant components are addressed in the Internal Flooding PRA. There are no impacts of this documentation issue upon the results of the Internal Events PRA. Additional walkdown information is documented in the Internal Flooding Analysis document. Also, SR SY-A4 was addressed for RBS in the 11 August 2009 submittal of supplementary information for adoption of ASME code case N-716 for Risk-Informed In-Service Inspection.<br><br>Many of the environmental conditions documented in the walkdown notes in the Systems Analysis package are conditions which do not impact equipment operation and/or would be accounted for in any HRA calculations. For example, high temperatures were noted for many locations, but these would have been temperatures in the 90's since the walkdowns were conducted in the summer; these temperatures do not impact equipment performance and are considered in the overall assessment of HRA calculations.<br><br>This finding is concluded to be a documentation issue. Documentation will be enhanced to address this as part of the next periodic update of the RBS PRA.<br><br>This documentation finding has no impact on the SAMA analysis. |

Table D.1-13 – RBS PRA Peer Review Open Findings

| Finding | SR and Assessment | Basis for Peer Review Finding | Peer Review Comment | Disposition and Impact on SAMA |
|---|---|---|---|---|
| 18 / Open | LE-A5<br><br>(Not Met) | This is a finding because use of NUREG/CR-6595 methodology is used to transfer results from Level 1 directly into the LERF model. This method is adequate for Capability Category I. | Plant damage states are not defined in a manner which accounts for both physical and sequence characteristics. The interface between the Level 1 and containment event tree is based on NUREG/CR-6595 and does not adequately account for all potential dependencies between the systems. | This finding is documentation in nature and has no impact on LERF results. While the RBS LERF model does not define Plant Damage States, this does not impact the calculation of LERF. This only results in increased difficulty in extracting LERF-related risk insights from the model. SR's LE-A1 through LE-A4 which provide the input for SR LE-A5 were all characterized as "Met" for the RBS PRA Peer Review.<br><br>RBS plans to document Plant Damage States as part of the LERF calculation for the next regular PRA update.<br><br>This documentation finding has no impact on the SAMA analysis. |

Table D.1-13 – RBS PRA Peer Review Open Findings

| Finding | SR and Assessment | Basis for Peer Review Finding | Peer Review Comment | Disposition and Impact on SAMA |
|---|---|---|---|---|
| 27 / Open | IE-A2 (Met)<br><br>IE-A5 (Met) | IE-A2:<br>Based on information in PRA-RB-01-002S06, Section 4.0, Appendix C, D, E, F, G, H, K, and I general spectrum of internal-event challenges have been considered as potential initiating events.<br><br>The IE notebook includes: (a) transients, except LOSP, (b) (1) Small, (2) Medium, (3) Large LOCAs, (4) vessel rupture, and (e) special initiators including loss of RPCCW, TPCCW, NSW, loss of a single DC bus, loss of a single non-safety bus. (a) LOSP is included in a notebook specific to that initiator. (b)(5) LOCAs outside containment are included in a notebook specific to breaks outside containment. (c) SGTR is not applicable.<br><br>The spectrum of LOOP events is broken down into the four generally accepted subsets consistent with NUREG-6890 (grid centered, plant centered, switchyard centered, and weather related). Consequential LOOP initiating events are also assessed.<br><br>(PRA-RB-01-002S09 revision 1). Therefore this SR is met.<br><br>(continued) | This is a finding because there is at least one case of a unique initiating event not being considered.<br><br>The systematic process by which plant systems are reviewed for potential to cause an initiating event is not described. Some of the results of the system screening do not appear to be complete. LPCS pipe break would constitute a unique type of LOCA with failure of a mitigating system. | As noted in the recommendations related to this finding, resolution of this finding is considered to be documentation in nature.<br><br>The specific example cited of a LPCS pipe break inside containment is a scenario that has a negligible risk impact. LPCS piping subject to vessel pressure is already considered in determination of LOCA initiating event frequencies. The behavior of LPCS piping maintained at low pressure standby conditions would be similar to that of a LPCS discharge line break in the auxiliary building, which has been assessed in the Internal Flooding Analysis, section 4.2.1.12 of PRA-RB-01-004. This line is above the level of the suppression pool and would result in a maximum sustained leak rate of 50 gpm, the capacity of the LPCS keep-fill pump, prior to operator action to terminate the event. This would not be expected to be a challenge to plant operation. LPCS pipe failures in containment would be expected to have a frequency in the E-06/year range based on EPRI pipe failure frequencies and thus would be negligible contributors to plant risk.<br><br>Note the applicable Supporting Requirements from the Standard were judged to be Met.<br><br>Documentation will be enhanced to address this finding as part of the next periodic PRA update (Revision 6).<br><br>This documentation related finding has no impact on the SAMA analysis. |

Table D.1-13 – RBS PRA Peer Review Open Findings

| Finding | SR and Assessment | Basis for Peer Review Finding | Peer Review Comment | Disposition and Impact on SAMA |
|---|---|---|---|---|
| 27 (cont.) | | IE-A5:<br>Calculation PRA-RB-01-002S06, Appendix I provides a system-by-system evaluation to determine possible support system IE's.<br><br>However, details of the screening process are not provided. In addition, some systems were screened for one failure mode (for example, LPCS inadvertent start) but no other failure modes (for example, LPCS pipe break inside containment). | | |

Table D.1-13 – RBS PRA Peer Review Open Findings

| Finding | SR and Assessment | Basis for Peer Review Finding | Peer Review Comment | Disposition and Impact on SAMA |
|---|---|---|---|---|
| 28 / Open | IE-A6<br><br>(Met) | Calculation PRA-RB-01-002S06, Section 4.9, Table 5, examines common cause failure of multiple AC or DC buses and eliminates them from consideration. System-by-system screening in Appendix I, considers system level multiple failures. Initiating event fault trees considered multiple failures by design. | There is no evidence presented in the IE notebook that multiple failures (for CCF) were considered in the development of the IE list. | Common Cause events are included in calculating Initiating Event frequencies (e.g., event SWP-MDP-C2-NSWRA for CCF of Normal Service Water pumps; event CCP-MDP-C2-FTRA for CCF of Primary Component Cooling Water pumps). Such events are relatively minor contributors to Initiating Event frequencies. Plant alignments are also considered in the evaluation of Initiating Event fault trees; the appendices in IE calculation PRA-RB-01-002S06 provide quantification of initiating event fault trees based on various system alignments. The impact of these plant alignments on IE frequency is also captured in the EOOS on-line risk assessment monitor.<br><br>Thus, resolution of this finding is expected to result in only negligible or slight changes to PRA results. This finding remains open to address as an enhancement to the next full PRA model update.<br><br>Note the applicable Supporting Requirement from the Standard was judged to be Met.<br><br>This finding has no impact on the SAMA analysis. |

Table D.1-13 – RBS PRA Peer Review Open Findings

| Finding | SR and Assessment | Basis for Peer Review Finding | Peer Review Comment | Disposition and Impact on SAMA |
|---|---|---|---|---|
| 33 / Open | AS-A3<br><br>(Met) | The AS discussion in PRA-RB-01-002S03 and the related notebooks for ISLOCA, ATWS, and Breaks outside containment discuss the success criteria for each event tree node at a relative high level. The specific criteria for each node is more specifically discussed in the Success Criteria Notebook (PRA-RB-01-002S14).<br><br>The ATWS event analyses, documented in PRA-RB-01-002S07 revision 1, table 1 identifies the systems associated with each safety function. That table also identifies safety function success criteria in most cases. The success criteria for RPS-mechanical was found in a notebook assumption. However, there is at least one instance in which success criteria is not documented in table 1. An example is SLC. | The ATWS event analyses, documented in PRA-RB-01-002S07 revision 1, table 1 identifies the systems associated with each safety function. That table also identifies safety function success criteria in most cases. The success criteria for RPS-mechanical was found in a notebook assumption. However, there is at least one instance in which success criteria is not documented in table 1. An example is SLC. | As discussed in the associated recommendation, this finding is documentation in nature and its resolution does not impact RBS PRA results. Appropriate system related success criteria are documented in System Notebooks in PRA-RB-01-002S11. Documentation in the success criteria notebook for the Rev. 6 PRA update will be expanded to include success criteria specific to ATWS, ISLOCA, and BOC events, which are the only events for which accident sequences are developed in notebooks separate from the Accident Sequence notebook, PRA-RB-01-002S01.<br><br>Note the applicable Supporting Requirement from the Standard was judged to be Met.<br><br>This documentation related finding has no impact on the SAMA analysis. |

Table D.1-13 – RBS PRA Peer Review Open Findings

| Finding | SR and Assessment | Basis for Peer Review Finding | Peer Review Comment | Disposition and Impact on SAMA |
|---|---|---|---|---|
| 34 / Open | SY-A19<br><br>(Met) | This is a finding because one instance was identified in which the requirement is not met. | PRA-RB-01-002S11, LPCI and CCP system models contain basic events for unavailability of the RHR pumps and CCP pumps at the component level. Basic events for maintenance unavailability are indicated by 'MA' in the basic event name.<br><br>Section 1.7 of the system notebooks documents the review of test and maintenance applicability associated with a given system/train/component. PRA-RB-01-002S11 R1 documents the feedwater and condensate system analysis.<br><br>PRA-RB-01-002S11 R1 documents the feedwater and condensate system analysis. Unavailability of a feedwater or condensate pump due to maintenance is not included in the analysis. There are 3 40% feedwater pumps and 3 50% condensate pumps. Therefore, maintenance of a single feedwater pump or a single condensate pump during power operations is possible. | Consideration of unavailability of feedwater and condensate systems would be expected to result in only very slight changes to RBS PRA results, since only one of three pumps for each system is required to meet system success criteria for event mitigation. This is consistent with risk ranking results for the Feedwater and Condensate pumps from Summary Calculation PRA-RB-01-002; no events associated with the feedwater pumps appear in the cutsets generated at an E-13 truncation limit for the risk ranking; the maximum RAW of 1.016 and maximum FV of 3.21E-05 for the individual Condensate pumps demonstrate very low risk significance. Thus, only very small if any impact on PRA results would be expected associated with resolution of this finding. This finding remains open for consideration as an enhancement to add to the model for the next full model update, Revision 6.<br><br>Note the applicable Supporting Requirement from the Standard was judged to be Met.<br><br>This finding has negligible impact on the SAMA analysis. |

Table D.1-13 – RBS PRA Peer Review Open Findings

| Finding | SR and Assessment | Basis for Peer Review Finding | Peer Review Comment | Disposition and Impact on SAMA |
|---|---|---|---|---|
| 36 / Open | HR-E4<br><br>(Cat.I) | This is considered to be a finding as validation/input has not been obtained to validate proper modeling and timing of operator response. | No documentation of simulator observations were identified. While Appendix C to PRA-RB-01-002S03 documents operator input for the HRA analysis, no documented talk throughs or review by either Operations Staff or Operations Training Staff with respect to the response modeling (accident sequence progression) was identified. | There has been extensive discussion regarding operator actions modeled in the RBS PRA over the years. Discussions regarding operator actions arise during Expert Panel meetings, PRA training for operations, and regular observations of simulator training and scenarios by PRA staff. Scenarios are also discussed as part of routine support for on-line maintenance issues and when risk assessments are performed for plant conditions. More explicit documentation of interactions between the RBS PRA staff and Operations will be incorporated in the next PRA update. Thus, this finding is by nature a documentation issue.<br><br>This finding has no impact on the SAMA analysis. |

Table D.1-13 – RBS PRA Peer Review Open Findings

| Finding | SR and Assessment | Basis for Peer Review Finding | Peer Review Comment | Disposition and Impact on SAMA |
|---|---|---|---|---|
| 41 / Open | QU-D4 (Met)<br><br>LE-F2 (Met) | QU-D4:<br>This is considered a finding as an opportunity for a checks and balances may be missed. While this SR is administratively met, further depth in understanding the differences would help in strengthening the model.<br><br>LE-F2:<br>PRA-RB-01-002S12 revision 1, Attachment 10 documents meeting minutes/notes associated with LERF cutset reviews. Attachment 11 also captures review comments and resolution. A comparison among the various BWR/6 designs was also provided, albeit at an administrative level. An approach similar to that recommended for QU-D4 for CDF should be used for the LERF as well. | A comparison among the BWR/6 population was conducted and is documented in PRA-RB-01-002 revision 1. Observations of differences were noted, however, additional depth as to the differences may be required establish more credible explanations. For example, the loss of the power conversion system differences may to more attributable to the additional containment heat removal capability at RB verses high pressure injection when compared to Plant "B" (Plant B also has a motor driven feedwater pump). Additionally, higher SBO contributions were attributed to the dependence upon electrical switchgear room cooling (RCIC is not dependent upon electrical switchgear room cooling). This SR is marked as met, however, a finding has been given to establish more credible explanations of the deltas. An in-depth comparison may also provide feedback insights. | While additional insights would be obtained from a deeper and more detailed review of differences between plants, the level of detail at which River Bend has performed this comparison is judged to be better than average. RBS participates in the monthly BWR6 PRA conference call, which includes discussions of the various plant system models to allow for understanding of differences due to plant designs and modeling. Additional insights have been gained through participation of Entergy PRA engineers in the Perry Level 2 focused scope peer review and through support work for the Grand Gulf PRA Revision 4. The additional insights would be of value but would not result in changes to the results of the plant PRA, thus this finding is considered to be documentation in nature and will be closed as part of the future Revision 6 PRA update.<br><br>Note the applicable Supporting Requirements from the Standard was judged to be Met.<br><br>This documentation related finding has no impact on the SAMA analysis. |

Table D.1-13 – RBS PRA Peer Review Open Findings

| Finding | SR and Assessment | Basis for Peer Review Finding | Peer Review Comment | Disposition and Impact on SAMA |
|---|---|---|---|---|
| 49 / Open | IFEV-B3<br>IFPP-B3<br>IFQU-B3<br>IFSN-B3<br>IFSO-B3<br>(Not Met) | This is a finding since an assessment of the sources of uncertainty is required by the standard. | No assessment of the sources of uncertainty was documented. | This finding is considered documentation in nature, since performance of an uncertainty study would not impact CDF results. All of the SR's associated with this finding are considered Documentation requirements in the Standard.<br><br>The Revision of the Internal Flooding PRA subsequent to the peer review did review the results to obtain insights into importance of system and location contributors to the Internal Flooding risk, which does permit judgments concerning the impact of uncertainties.<br><br>This finding does not impact the SAMA analysis. |
| 51 / Open | IFSO-A4<br><br>(Not Met) | This is a finding since the requirements of this SR are not met. Identification of mechanisms is required by the SR. Missing failure mechanisms could impact the overall results. | Flooding mechanisms are not identified in the analysis. Although calculation PRA-RB-01-004 Rev. 0 states in Section 3.4 that all mechanisms were considered, this does not appear to be the case [D.1-22]. For example, section 4.2.5.8 states that the area is not considered because the only source is a pre-action fire system. However, inadvertent actuation of this system should be addressed. Other instances exist. | This finding is considered primarily documentation in nature, as discussed in the finding and recommendation. The EPRI pipe failure data used in this analysis encompasses all pipe failure mechanisms; there is no readily available data that allows distinguishing between different failure mechanisms. Since the failure rate data used in the analysis encompasses the various failure mechanisms, there would be no change to the results associated with identifying specific failure mechanisms.<br><br>Thus, this documentation related finding has no impact on the SAMA analysis. |

Table D.1-13 – RBS PRA Peer Review Open Findings

| Finding | SR and Assessment | Basis for Peer Review Finding | Peer Review Comment | Disposition and Impact on SAMA |
|---|---|---|---|---|
| 52 / Open | IFSO-A5<br><br>(Met) | Inclusion of this information is required by the SR; hence this is a finding. | The characteristics of each source are documented for each scenario developed in Section 4.2 of Calculation PRA-RB-01-004 Rev. 0 [D.1-22]. These scenarios identify the flow rate by evaluating a complete rupture of the line analyzed. The capacity of the source is considered for finite-volume systems, however, no volume information for these systems was identified in the documentation. Pressure and temperature were not identified in the documentation. | Characterization of failures and flow rates are included in the scenario descriptions in the revision to Internal Flooding Analysis calculation PRA-RB-01-004, including documentation for the scenario in Appendix D [D.1-22]. As stated, source capacities have been considered in detailed scenario development. System information, including volumes and pump flow, has been added to new section 4.1.4 as part of the subsequent Rev. 1 to the calculation. System pressures are used to calculate flow rates using spreadsheets attached to EC14168. Systems which are potential HELB sources are identified. Much of this information had been included in the original EC14618 with PRA-RB-01-004 but was not well organized. Since failure flow rates have been appropriately developed and other characteristics documented through the documentation would not impact the results, this documentation finding does not impact IFPRA results.<br><br>Note the applicable Supporting Requirement from the Standard was judged to be Met.<br><br>This documentation finding has no impact on the SAMA analysis. |

### D.1.4.11 PRA Maintenance and Update

The Entergy risk management process ensures that the applicable PRA model is an accurate reflection of the as-built and as-operated plant. This process is defined in the Entergy fleet procedure EN-DC-151, "PSA Maintenance and Update" [D.1-29]. This procedure delineates the responsibilities and guidelines for updating the full power internal events PRA models at all operating Entergy nuclear power plants. In addition, the procedure also defines the process for implementing regularly scheduled and interim PRA model updates, and for tracking issues identified as potentially affecting the PRA models (e.g., due to changes in the plant, industry operating experience, etc.). To ensure that the current PRA model remains an accurate reflection of the as-built, as-operated plant, the following activities are routinely performed:

- Design changes and procedure changes are reviewed for their impact on the PRA model. Potential PRA model changes resulting from these reviews are entered into the Model Change Request (MCR) database, and a determination is made regarding the significance of the change with respect to the current PRA model.
- New procedures and revisions to existing procedures that are relevant to the PRA are reviewed for their impact on the PRA model.
- New engineering calculations and revisions to existing calculations are reviewed for their impact on the PRA model.
- Plant specific initiating event frequencies, failure rates, and maintenance unavailabilities are updated regularly. EN-DC-151 suggests an update frequency of approximately every four years.
- Industry standards, experience, and technologies are periodically reviewed to ensure that any changes are appropriately incorporated into the models.

In addition, following each periodic PRA model update, Entergy performs a self-assessment to assure that the PRA quality and expectations for all current applications are met. The Entergy PRA maintenance and update procedure requires updating of all risk informed applications that may have been impacted by the model update.

## D.1.5 The WinMACCS Model – Level 3 Analysis

### D.1.5.1 Introduction

The RBS Level 3 analysis was performed using the WinMACCS code (Windows Interface for MACCS2, MELCOR Accident Consequence Code System, Version 3.10.0) [D.1-14]. The Level 3 model, which requires inputs related to site-specific meteorological, population, and economic data in addition to frequency and characteristics of each release category from the Level 2, estimates the consequences in terms of population dose and offsite economic cost. Risks in terms of population dose risk (PDR) and offsite economic cost risk (OECR) were also estimated in this analysis. Risk is defined as the product of consequence and frequency of an accidental release.

### D.1.5.2 Input

The following sections describe the site-specific input parameters used to obtain the off-site dose and economic impacts for cost-benefit analyses.

#### D.1.5.2.1 Projected Total Population

The total population within a 50-mile radius of RBS was estimated for the year 2045 [D.1-37]. This estimate includes permanent and transient populations. Block data for Louisiana parishes and Mississippi counties were scaled to 2045 using state population projection estimates. For counties that showed a projected decline in population at any time between 2010 and 2045 the population estimate for 2045 was conservatively based on the maximum value. The scaled population estimate was then summed by spatial sector. Populations in blocks in the blocks split between sectors were area-weighted, assuming an even distribution of people within the block. Transient population was estimated from Louisiana and Mississippi transient data. The total projected population of the 50-mile zone of analysis is 1,475,914, and the distribution of the 2045 total population is summarized in Table D.1-14.

**Table D.1-14 – Estimated Population Distribution within a 50-Mile Radius**

| Wind Direction | 0 - 1 mile | 1- 2 miles | 2 - 3 miles | 3 - 4 miles | 4 - 5 miles | 5 - 6 miles | 6 - 7 miles | 7 - 8 miles | 8 - 9 miles | 9 - 10 miles | 10 - 20 miles | 20 - 30 miles | 30 - 40 miles | 40 - 50 miles | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N | 15 | 186 | 229 | 119 | 133 | 195 | 118 | 172 | 450 | 183 | 1,110 | 4,600 | 846 | 3,002 | 11,358 |
| NNE | 6 | 88 | 80 | 49 | 98 | 142 | 59 | 101 | 103 | 50 | 436 | 1,972 | 2,649 | 1,164 | 6,997 |
| NE | 5 | 49 | 75 | 19 | 65 | 256 | 137 | 74 | 1,371 | 1,216 | 2,562 | 2,589 | 2,482 | 3,220 | 14,120 |
| ENE | 4 | 39 | 44 | 47 | 64 | 116 | 29 | 44 | 1,237 | 443 | 4,317 | 3,474 | 1,983 | 4,746 | 16,587 |
| E | 2 | 20 | 50 | 10 | 2 | 5 | 39 | 45 | 48 | 77 | 3,576 | 3,090 | 4,634 | 24,869 | 36,467 |
| ESE | 3 | 14 | 36 | 3 | 14 | 57 | 151 | 199 | 295 | 492 | 15,868 | 59,434 | 61,954 | 52,331 | 190,851 |
| SE | 3 | 12 | 24 | 6 | 52 | 309 | 675 | 818 | 693 | 429 | 51,115 | 224,972 | 224,575 | 125,569 | 629,252 |
| SSE | 2 | 5 | 29 | 29 | 4 | 25 | 111 | 45 | 29 | 84 | 25,541 | 214,280 | 61,897 | 42,298 | 344,379 |
| S | 5 | 3 | 17 | 15 | 1 | 0 | 2 | 285 | 362 | 181 | 3,769 | 8,181 | 13,866 | 2,474 | 29,161 |
| SSW | 1 | 0 | 0 | 10 | 154 | 413 | 436 | 41 | 32 | 131 | 4,724 | 4,184 | 229 | 4,956 | 15,311 |
| SW | 0 | 0 | 3 | 6 | 24 | 83 | 1,474 | 1,573 | 407 | 240 | 4,490 | 1,262 | 2,618 | 60,990 | 73,170 |
| WSW | 1 | 0 | 4 | 19 | 29 | 54 | 1,038 | 1,481 | 974 | 867 | 620 | 2,633 | 3,857 | 47,525 | 59,102 |
| W | 1 | 2 | 0 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 1,231 | 1,395 | 2,010 | 3,221 | 7,865 |
| WNW | 5 | 5 | 399 | 850 | 105 | 14 | 57 | 54 | 3 | 1 | 183 | 1,762 | 5,538 | 17,697 | 26,673 |
| NW | 18 | 20 | 216 | 890 | 660 | 136 | 304 | 518 | 117 | 70 | 842 | 201 | 482 | 745 | 5,219 |
| NNW | 25 | 68 | 78 | 116 | 165 | 209 | 146 | 181 | 104 | 207 | 7,260 | 699 | 64 | 80 | 9,402 |
| Totals | 96 | 511 | 1,284 | 2,192 | 1,571 | 2,014 | 4,776 | 5,631 | 6,225 | 4,671 | 127,644 | 534,728 | 389,684 | 394,887 | 1,475,914 |

D.1.5.2.2 Land Fraction

The National Hydrography Dataset (NHD) for the watersheds and the area within the 50-mile region was used to calculate the ratio of land to surface water coverage. Swampland was included as land, rather than water, so that WinMACCS habitability and farmability decisions would be applied to the swampland, resulting in a conservative estimate of the costs for decontamination, interdiction, and condemnation. Calculated values ranged from 0.00 to 1.00. A value of 1.00 indicates the spatial element area is all land, with no significant surface water [D.1-38].

D.1.5.2.3 Watershed Class

Watershed Index is defined in NUREG/CR-4551, Volume 2 [D.1-6] as areas drained by rivers (Class 1) or large water bodies (Class 2). Class 2 is intended only for use with a very large lake, similar in size to Lake Michigan. For RBS, a watershed class of 1 (drained by rivers) was used for all spatial elements.

D.1.5.2.4 Region Economic Data

Regional Economic data for each region was developed from the US Census of Agriculture (2012), SECPOP 2013 and gross metropolitan product (GMP) from the Office of Management and Budget.

D.1.5.2.4.1 Region Index

Each spatial element was assigned to an economic region (parish/county). When a spatial element was comprised of more than one parish/county, it was assigned to the parish/county that had the most area in that spatial element. Five parishes in Louisiana (Assumption, Catahoula, Iberia, Lafayette, and Tangipahoa) and one county in Mississippi (Pike) were not assigned due to their small representation in any one spatial element.

D.1.5.2.4.2 ASFP – Total Annual Farm Sales

US Census of Agriculture item *market value of agricultural products sold* was used to develop the 2012 value for annual farm sales per hectare of farmland in each region index. The value was then scaled to 2016 values by multiplying by the ratio of the 2012 CPI for All Urban Consumers, U.S. City Average (CPI-U, U.S. Bureau of Labor Statistics series CUUR0000SA0) and the estimated CPI-U value for 2016 based on the annual data from 2000 through 2015.

D.1.5.2.4.3 VFRM – Farmland Property Value

US Census of Agriculture items *estimated market value of land and buildings* and *estimated market value of all machinery and equipment* was used to develop the 2012 value for farmland property in dollars per hectare in each region index. The value was then scaled to 2016 values by the ratio of the 2016 to 2012 CPI-U values.

D.1.5.2.4.4 VNFRM – Non-Farm Property Value

Non-farm property values for 2013 were the sum of the parish/county non-farm property values in SECPOP 2013 and GMP based on metropolitan statistical areas defined by the Office of Management and Budget for each region index. The value was then scaled to 2016 values by the ratio of the 2016 to 2013 CPI-U values.

D.1.5.2.4.5 VALWF – Value of Farm Wealth

The value of farm wealth was calculated by converting each parish's and county's VFRM to dollars per parish/county using U.S. Census of Agriculture item *approximate land area* (acres, 2012) converted to hectare. These values are then weighted by the portion of area for each of the 23 parishes/counties in the RBS 50-mile area. The resultant values are then summed, producing a dollar value for the region, and divided by the total number of hectares with the region. The resulting value is $8,158.13/hectare.

D.1.5.2.4.6 VALWNF – Value of Non-farm Wealth

This value was calculated by first multiplying the VNFRM by the 2010 parish or county permanent population, and then weighting by the portion of area each of the 23 parishes/counties in the RBS 50-mile region. These resultant values are then summed, producing a dollar value for the region, and divided by 2010 permanent population within the 50-mile region. The 2010 permanent population within the region was obtained from the U.S. Census Bureau. The regional value of non-farm wealth using the VNFRM values described above is $424,083.66/person.

D.1.5.2.4.7 Other Economic Parameters

Economic costs for evacuation, relocation and decontamination were scaled from the 2006 values in the starting sample MACCS input file to 2016 by the ratio of the 2016 to 2006 CPI-U values. The values used for these costs are in Table D.1-15. For costs of decontamination of farmland (CDFRM) and non-farmland (CDNFRM) the two values represent two different levels of decontamination as calculated by the WinMACCS code.

**Table D.1-15 - Evacuation, Relocation and Decontamination Costs**

| Variable | Description | 2006 $ | 2016 $ |
|---|---|---|---|
| EVACST | Daily cost for a person who has been evacuated ($/person/day) | 172 | 210 |
| RELCST | Daily cost for a person who is relocated ($/person/day) | 172 | 210 |
| CDFRM | Cost of farm decontamination for the various levels of decontamination ($/hectare) | 1,500 | 1,835 |
| | | 5,000 | 6,117 |
| CDNFRM | Cost of non-farm decontamination for the various levels of decontamination ($/person) | 10,000 | 12,234 |
| | | 25,000 | 30,586 |
| POPCST | Population relocation cost ($/person) | 13,000 | 15,905 |
| DLBCST | Average cost of decontamination labor ($/person-year) | 85,000 | 103,993 |

D.1.5.2.5 Agricultural Data

The source of the regional crop information is the 2012 US Census of Agriculture. The crops listed for each county within the 50-mile area were summed and mapped into the seven WinMACCS crop categories.

D.1.5.2.6 Meteorological Data

The WinMACCS model requires meteorological data for wind speed, wind direction, atmospheric stability, accumulated precipitation, and atmospheric mixing heights. The required data was obtained from the RBS meteorological monitoring system and from National Climatic Data Center (NCDC) data.

Meteorological data collected from calendar years 2008 through 2014 were compiled for the WinMACCS input file. For 2008 and 2009 the mixing height inputs were available and standard WinMACCS inputs were produced [D.1-2]. Mixing height is defined as the height of the atmosphere above ground level within which a released contaminant will become mixed (from turbulence) within approximately one hour. The mixing height inputs for the years 2010-2014 rely on the maximum and minimum mixing height averages from previous years. All meteorological data sets were used to determine the impact on the MACR. Results in the calculation are based on the most conservative data set (2013 data using the minimum mixing height averages from previous years) [D.1-2].

D.1.5.2.7 Emergency Response Assumptions

A detailed analysis of evacuation scenarios in the 10-mile emergency planning zone (EPZ) were addressed in the RBS Development of Evacuation Times Estimates [D.1-13].

D.1.5.2.7.1 Evacuation Delay Time

The RBS Evacuation Times Estimates report [D.1-13] gives a time of 120 minutes for 100% of the population to complete the trip home during the evacuation time period. Therefore, 120 minutes was used for the start of the sheltering period (WinMACCS variable DLTSHL). The report also gives a time of 195 minutes for 100% of the population to complete other mobilization activities such as preparing the home. Therefore, 195 – 120 = 75 minutes was used as the delay from the beginning of the sheltering period to the beginning of evacuation (WinMACCS variable DLTEVA). Section D.1.5.5 provides additional discussion of evacuation sensitivities.

D.1.5.2.7.2 Evacuation Speed

The RBS Development of Evacuation Times Estimates report estimated that the network-wide average speeds for the 12 evacuation scenarios would be 27.2 mph (12.2 m/s). Conservatively, a 22.4 mph (10 m/s) evacuation speed was used for the base case. This assumed speed is conservative with respect to 11 of the evacuation scenarios except the evacuation scenario considering a special event that occurs on one weekend day annually. This scenario has a slower average evacuation speed (18.5 mph or 8.3 m/s). A sensitivity case with an evacuation speed of 5 m/s that is conservative to the special event evacuation scenario was performed for comparison to the base case. Section D.1.5.5 provides additional discussion of evacuation sensitivities.

D.1.5.2.8 Core Inventory

The RBS core inventory is shown in Table D.1-16 [D.1-2]. These values are based on an ORIGEN 2.1 evaluation in support of a 24-month operating cycle for a reactor power level of 3100 MWth, consistent with a rated power level of 3091 MWth with an uncertainty of 0.3%.

**Table D.1-16 - RBS Core Inventory**

| Isotope | Bq | Isotope | Bq | Isotope | Bq | Isotope | Bq |
|---|---|---|---|---|---|---|---|
| Co-58 | 2.99E+16 | Cs-137 | 4.53E+17 | Te-132 | 4.40E+18 | Ce-143 | 4.76E+18 |
| Co-60 | 5.16E+16 | Rb-86 | 7.24E+15 | Sb-127 | 3.35E+17 | Ce-144 | 4.23E+18 |
| Kr-85 | 4.20E+16 | Y-90 | 3.53E+17 | Sb-129 | 1.01E+18 | Pu-238 | 1.26E+16 |
| Kr-85m | 8.05E+17 | Y-91 | 3.76E+18 | Sr-89 | 2.91E+18 | Pu-239 | 1.47E+15 |
| Kr-87 | 1.55E+18 | Y-92 | 4.00E+18 | Sr-90 | 3.34E+17 | Pu-240 | 1.90E+15 |
| Kr-88 | 2.17E+18 | Y-93 | 4.63E+18 | Sr-91 | 3.67E+18 | Pu-241 | 6.03E+17 |
| Xe-133 | 6.03E+18 | Zr-95 | 5.48E+18 | Sr-92 | 3.98E+18 | Np-239 | 6.22E+19 |
| Xe-135 | 2.28E+18 | Zr-97 | 5.71E+18 | Ba-139 | 5.64E+18 | La-140 | 5.60E+18 |
| I-131 | 3.10E+18 | Nb-95 | 5.51E+18 | Ba-140 | 5.44E+18 | La-141 | 5.15E+18 |
| I-132 | 4.50E+18 | Mo-99 | 5.88E+18 | Ru-103 | 4.81E+18 | La-142 | 4.97E+18 |
| I-133 | 6.33E+18 | Te-127 | 3.38E+17 | Ru-105 | 3.33E+18 | Nd-147 | 2.06E+18 |
| I-134 | 6.95E+18 | Te-127m | 4.50E+16 | Ru-106 | 1.85E+18 | Pr-143 | 4.66E+18 |
| I-135 | 5.93E+18 | Te-129 | 9.89E+17 | Rh-105 | 3.06E+18 | Am-241 | 7.51E+14 |
| Cs-134 | 7.01E+17 | Te-129m | 1.47E+17 | Tc-99m | 5.17E+18 | Cm-242 | 1.73E+17 |
| Cs-136 | 2.29E+17 | Te-131m | 4.50E+17 | Ce-141 | 5.15E+18 | Cm-244 | 8.74E+15 |

D.1.5.2.9 Source Terms

From the respective MAAP cases for each source term category (STC), source term release fractions and timing of the various release plumes were developed. The MAAP cases provide the releases for 12 radioisotope groups defined in Table D.1-17. Table D.1-7 summarizes the releases from each of these 12 radioisotope groups for the 14 STCs. The methodology of determining individual plume timing and release fractions preserved the total fission product releases in Table D.1-7, while conservatively moving the small fraction of the release that occurs at the "tail end" of each plume into the predominant portion of the plume that is modeled as a linear release in WinMACCS. WinMACCS uses the nine radioisotope groups shown in Table D.1-18. The 12 MAAP groups were mapped to the nine WinMACCS groups as shown in Table D.1-19. When multiple MAAP groups are assigned to a

WinMACCS group, the largest release fraction of the MAAP groups is used for the WinMACCS group on a plume basis.

**Table D.1-17 - MAAP 4.0.7 Radioisotope Groupings**

| Group # | Description |
|---|---|
| 1 | Noble (Xe, Kr) and Inert aerosols |
| 2 | CsI, RbI |
| 3 | $TeO_2$ |
| 4 | SrO |
| 5 | $MoO_2$, $RuO_2$, $TcO_2$ |
| 6 | CsOH, RbOH |
| 7 | BaO |
| 8 | $La_2O_3$, $Pr_2O_3$, $Nd_2O_3$, $Sm_2O_3$, $Y_2O_3$, $ZrO_2$, $NbO_2$ |
| 9 | $CeO_2$, $NpO_2$, $PuO_2$ |
| 10 | Sb |
| 11 | $Te_2$ |
| 12 | $UO_2$ |

**Table D.1-18 - WinMACCS Radioisotope Groupings**

| Group # | Description |
|---|---|
| 1 | Xe, Kr |
| 2 | I |
| 3 | Cs, Rb |
| 4 | Te, Sb |
| 5 | Sr |
| 6 | Ru, Co, Mo, Tc, Rh |
| 7 | La, Y, Zr, Nb, Pr, Nd, Am, Cm |
| 8 | Ce, Np, Pu |
| 9 | Ba |

**Table D.1-19 - MAAP 4.0.7 to WinMACCS Radioisotope Binning**

| WinMACCS Group # | MAAP Group # |
|---|---|
| 1 | 1 |
| 2 | 2 |
| 3 | 2, 6 |
| 4 | 3, 10, 11 |
| 5 | 4 |
| 6 | 5 |
| 7 | 8 |
| 8 | 9, 12 |
| 9 | 7 |

Table D.1-20 gives the WinMACCS release fractions that were input into the ATMOS file for each of the release categories. For cases with multiple plumes, the release fractions for each plume are given. For STC 2 and 5 the release fractions and timing are identical as they have the same representative MAAP case.

**Table D.1-20 – WinMACCS Release Fractions for RBS**

| Release Category | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Group 6 | Group 7 | Group 8 | Group 9 |
|---|---|---|---|---|---|---|---|---|---|
| STC-1 | 5.3E-02 | 4.1E-06 | 1.9E-05 | 1.1E-05 | 6.0E-08 | 2.8E-06 | 3.4E-08 | 4.3E-08 | 7.3E-07 |
| | 3.0E-01 | 2.7E-04 | 2.7E-04 | 7.3E-04 | 5.9E-07 | 6.0E-07 | 1.7E-07 | 1.3E-06 | 5.1E-07 |
| STC-2&5 | 9.3E-01 | 8.5E-03 | 1.3E-02 | 7.3E-03 | 1.6E-05 | 5.5E-05 | 1.5E-05 | 1.6E-05 | 2.7E-05 |
| | 2.0E-02 | 2.6E-02 | 2.6E-02 | 1.5E-02 | 6.4E-07 | 7.7E-07 | 6.2E-07 | 6.3E-07 | 7.1E-07 |
| | 4.7E-02 | 2.7E-01 | 2.7E-01 | 4.1E-02 | 3.9E-04 | 3.0E-04 | 2.4E-04 | 5.6E-04 | 3.6E-04 |
| STC-3 | 9.0E-01 | 1.4E-02 | 2.1E-02 | 2.4E-02 | 3.1E-05 | 1.7E-05 | 3.1E-05 | 3.1E-05 | 3.0E-05 |
| | 2.1E-02 | 7.5E-02 | 7.5E-02 | 9.8E-02 | 0.0E+00 | 3.8E-09 | 0.0E+00 | 0.0E+00 | 1.8E-06 |
| | 6.6E-02 | 5.3E-02 | 5.6E-02 | 3.5E-01 | 6.4E-03 | 1.6E-02 | 2.3E-03 | 8.9E-03 | 7.6E-03 |
| STC-4 | 4.2E-03 | 3.5E-04 | 3.5E-04 | 3.6E-04 | 2.5E-06 | 8.4E-05 | 1.3E-07 | 3.7E-07 | 1.2E-05 |
| | 9.5E-01 | 2.6E-02 | 2.6E-02 | 9.3E-02 | 9.0E-04 | 1.9E-03 | 1.4E-04 | 1.4E-03 | 6.9E-04 |
| | 3.8E-02 | 2.0E-01 | 2.0E-01 | 4.4E-02 | 2.7E-03 | 1.5E-03 | 4.9E-04 | 5.0E-03 | 1.5E-03 |
| STC-6 | 3.3E-02 | 1.2E-04 | 2.1E-04 | 3.3E-04 | 8.1E-07 | 8.9E-06 | 4.3E-08 | 9.7E-08 | 4.4E-06 |
| | 9.7E-01 | 3.5E-04 | 6.3E-04 | 4.5E-04 | 1.5E-06 | 1.6E-05 | 8.2E-08 | 1.8E-07 | 8.1E-06 |
| | 1.9E-04 | 1.4E-01 | 1.6E-01 | 2.0E-01 | 1.6E-03 | 1.5E-03 | 2.0E-04 | 2.9E-03 | 1.1E-03 |
| STC-7 | 1.0E+00 | 2.6E-03 | 2.7E-03 | 2.7E-03 | 5.5E-06 | 1.6E-04 | 4.7E-06 | 5.0E-06 | 2.8E-05 |
| STC-8 | 1.0E+00 | 5.2E-03 | 5.4E-03 | 5.3E-03 | 1.1E-05 | 3.2E-04 | 9.4E-06 | 1.0E-05 | 5.6E-05 |
| STC-9 | 1.0E+00 | 2.6E-03 | 2.7E-03 | 2.7E-03 | 5.5E-06 | 1.6E-04 | 4.7E-06 | 5.0E-06 | 2.8E-05 |
| | 0.0E+00 | 6.9E-02 | 6.9E-02 | 2.8E-02 | 1.2E-04 | 4.3E-05 | 4.9E-05 | 2.0E-04 | 8.2E-05 |
| STC-10 | 1.0E+00 | 5.2E-03 | 5.4E-03 | 5.3E-03 | 1.1E-05 | 3.2E-04 | 9.4E-06 | 1.0E-05 | 5.6E-05 |
| | 0.0E+00 | 1.4E-01 | 1.4E-01 | 5.7E-02 | 2.4E-04 | 8.5E-05 | 9.8E-05 | 4.0E-04 | 1.6E-04 |
| STC-11 | 1.8E-02 | 3.8E-05 | 5.5E-05 | 1.1E-04 | 4.6E-07 | 4.6E-06 | 2.3E-08 | 6.4E-08 | 2.4E-06 |
| STC-12 | 1.8E-02 | 7.5E-05 | 1.1E-04 | 2.2E-04 | 9.1E-07 | 9.3E-06 | 4.6E-08 | 1.3E-07 | 4.7E-06 |
| STC-13 | 1.8E-02 | 3.8E-05 | 5.5E-05 | 1.1E-04 | 4.6E-07 | 4.6E-06 | 2.3E-08 | 6.4E-08 | 2.4E-06 |
| | 9.8E-01 | 1.5E-04 | 2.9E-04 | 2.9E-04 | 1.3E-06 | 1.3E-05 | 7.2E-08 | 1.9E-07 | 7.1E-06 |
| | 1.3E-04 | 4.0E-02 | 4.4E-02 | 4.4E-02 | 6.3E-05 | 1.7E-05 | 1.2E-05 | 1.7E-04 | 3.4E-05 |
| STC-14 | 1.8E-02 | 7.5E-05 | 1.1E-04 | 2.2E-04 | 9.1E-07 | 9.3E-06 | 4.6E-08 | 1.3E-07 | 4.7E-06 |
| | 9.8E-01 | 3.1E-04 | 5.7E-04 | 5.7E-04 | 2.7E-06 | 2.7E-05 | 1.4E-07 | 3.7E-07 | 1.4E-05 |
| | 1.3E-04 | 8.1E-02 | 8.7E-02 | 8.8E-02 | 1.3E-04 | 3.5E-05 | 2.3E-05 | 3.4E-04 | 6.8E-05 |

Table D.1-21 gives the release details and timing for each of the plumes in a STC. The plume release height is estimated as one half of the Reactor Building height, consistent with NEI 05-01 guidance [D.1-10]. Buoyant plume rise is modeled assuming a thermal plume heat content of 1.0E+7 watts for all releases except intact containment (where zero heat content is assumed). A value of 1.0E+7 watts bounds typical values of NUREG/CR-4551 [D.1-6].

**Table D.1-21 - Timing, Heat and Height Release Characteristics**

| Release Category | Alarm (s) | Number of Plumes | Plume Heat (Watts/sec) | Plume Release Height (m) | Plume Duration (s) | Plume Delay (s) |
|---|---|---|---|---|---|---|
| STC-1 | N/A | 2 | 0 | 26.33 | 28800 | 1800 |
| | | | 0 | 26.33 | 36000 | 90000 |
| STC-2&5 | 10692 | 3 | 1.00E+07 | 26.33 | 27000 | 1800 |
| | | | 1.00E+07 | 26.33 | 14400 | 66600 |
| | | | 1.00E+07 | 26.33 | 18000 | 84600 |
| STC-3 | 10656 | 3 | 1.00E+07 | 26.33 | 16200 | 1800 |
| | | | 1.00E+07 | 26.33 | 10800 | 325800 |
| | | | 1.00E+07 | 26.33 | 10800 | 352800 |
| STC-4 | 4 | 3 | 1.00E+07 | 26.33 | 7200 | 0 |
| | | | 1.00E+07 | 26.33 | 9000 | 9900 |
| | | | 1.00E+07 | 26.33 | 8100 | 63900 |
| STC-6 | 60840 | 3 | 1.00E+07 | 26.33 | 14400 | 29520 |
| | | | 1.00E+07 | 26.33 | 27000 | 82800 |
| | | | 1.00E+07 | 26.33 | 21600 | 147600 |
| STC-7 | 105264 | 1 | 1.00E+07 | 26.33 | 36000 | 108000 |
| STC-8 | 105264 | 1 | 1.00E+07 | 26.33 | 36000 | 108000 |
| STC-9 | 105264 | 2 | 1.00E+07 | 26.33 | 36000 | 108000 |
| | | | 1.00E+07 | 26.33 | 37800 | 226800 |
| STC-10 | 105264 | 2 | 1.00E+07 | 26.33 | 36000 | 108000 |
| | | | 1.00E+07 | 26.33 | 37800 | 226800 |
| STC-11 | 61920 | 1 | 1.00E+07 | 26.33 | 14400 | 29700 |
| STC-12 | 61920 | 1 | 1.00E+07 | 26.33 | 14400 | 29700 |
| STC-13 | 61920 | 3 | 1.00E+07 | 26.33 | 14400 | 29700 |
| | | | 1.00E+07 | 26.33 | 46800 | 63000 |
| | | | 1.00E+07 | 26.33 | 50400 | 149400 |
| STC-14 | 61920 | 3 | 1.00E+07 | 26.33 | 14400 | 29700 |
| | | | 1.00E+07 | 26.33 | 46800 | 63000 |
| | | | 1.00E+07 | 26.33 | 50400 | 149400 |

The base case population dose risk and economic risk results from the Level 3 analysis are shown in Table D.1-22.

PDR was estimated by summing over all releases the product of population dose and frequency for each accidental release. Similarly, OECR was estimated by summing over all releases the product of offsite economic cost and frequency for each accidental release. Offsite economic cost includes costs that could be incurred during the emergency response phase and costs that could be incurred through long-term protective actions.

### D.1.5.3 Results

Risk estimates for one base case were analyzed with WinMACCS. Table D.1-22 shows the base case mean risk values for each release mode for RBS. The estimated mean values of population dose risk and offsite economic cost risk for RBS are 1.21 person-rem/yr and $7,340/yr, respectively.

**Table D.1-22 - RBS Base Case Population Dose and Economic Risk (2013min MET data)**

| Release Category | Population Dose | Economic Cost | Likelihood | Population Dose Risk | Economic Risk |
|---|---|---|---|---|---|
| | (person-rem) | ($) | (events/yr) | (person-rem/yr) | ($/yr) |
| STC-1 | 1.82E+04 | 6.43E+06 | 5.58E-07 | 1.02E-02 | 3.59E+00 |
| STC-2 | 1.03E+06 | 6.42E+09 | 3.83E-09 | 3.94E-03 | 2.46E+01 |
| STC-3 | 1.02E+06 | 6.21E+09 | 2.31E-10 | 2.36E-04 | 1.43E+00 |
| STC-4 | 1.06E+06 | 6.40E+09 | 1.97E-08 | 2.09E-02 | 1.26E+02 |
| STC-5 | 1.03E+06 | 6.42E+09 | 8.28E-11 | 8.53E-05 | 5.32E-01 |
| STC-6 | 5.24E+05 | 3.94E+09 | 8.68E-10 | 4.55E-04 | 3.42E+00 |
| STC-7 | 1.22E+05 | 9.04E+07 | 6.42E-08 | 7.83E-03 | 5.80E+00 |
| STC-8 | 1.87E+05 | 2.81E+08 | 6.42E-08 | 1.20E-02 | 1.80E+01 |
| STC-9 | 5.19E+05 | 2.79E+09 | 9.04E-07 | 4.69E-01 | 2.52E+03 |
| STC-10 | 6.10E+05 | 4.28E+09 | 9.04E-07 | 5.51E-01 | 3.87E+03 |
| STC-11 | 4.16E+03 | 3.32E+06 | 2.99E-10 | 1.24E-06 | 9.93E-04 |
| STC-12 | 7.95E+03 | 3.54E+06 | 2.99E-10 | 2.38E-06 | 1.06E-03 |
| STC-13 | 4.48E+05 | 2.16E+09 | 1.35E-07 | 6.05E-02 | 2.92E+02 |
| STC-14 | 5.11E+05 | 3.48E+09 | 1.35E-07 | 6.90E-02 | 4.70E+02 |
| **Total** | | | **2.79E-06** | **1.21E+00** | **7.34E+03** |

### D.1.5.4 Baseline Risk Monetization

#### D.1.5.4.1 Off-Site Exposure Cost

The annual off-site exposure risk was converted to dollars using the conversion factor of $5,500 per person-rem, and discounted to present value using the following standard formula [D.1-35]. The monetary equivalent of dose of $5,500 per person-rem was determined using methodology in NUREG-1530, Rev. 1 [D.1-39].

$$W_{PHA} = R \times D_{PA}\left(\frac{1 - e^{-rt_f}}{r}\right)$$

Where:

- $W_{PHA}$ is the monetary value of off-site exposure cost after discounting ($);
- R is the monetary equivalent of dose ($5,500 per person-rem);
- $D_{PA}$ is the avoided public dose (person-rem/yr);
- r is the real discount rate (7% or 3%); and
- $t_f$ is the years remaining until end of facility life (29 years).

Using the population dose risk from Table D.1-22, and the two discounting rates, $W_{PHA}$ is calculated in Table D.1-23 for RBS.

**Table D.1-23 – Off-Site Exposure Cost for RBS**

| | RBS | |
|---|---|---|
| $D_{PA}$ (person-rem/yr) | 1.21E+00 | |
| R ($/person-rem) | 5,500 | |
| $t_f$ (yr) | 29 | |
| r (%/yr) | 0.07 | 0.03 |
| **$W_{PHA}$ ($)** | **82,585** | **128,896** |

#### D.1.5.4.2 Off-Site Economic Cost

The annual off-site economic risk was calculated and discounted to present value using the following standard formula [D.1-35]:

$$W_{EA} = Z_{EA}\left(\frac{1 - e^{-rt_f}}{r}\right)$$

Where:

- $W_{EA}$ is the monetary value of economic risk after discounting ($);
- $Z_{EA}$ is the monetary value of economic (accident) risk per year before discounting ($/yr);
- r is the real discount rate (7% or 3%); and
- $t_f$ is the years remaining until end of facility life (29 years).

Using the monetary value of economic (accident) risk per year before discounting ($Z_{EA}$) from Table D.1-22, and the two discounting factors, $W_{EA}$ is calculated in Table D.1-24 for RBS.

**Table D.1-24 – Off-Site Economic Cost for RBS**

| | RBS | |
|---|---|---|
| $Z_{EA}$ ($/yr) | 7.34E+03 | |
| $t_f$ (yr) | 29 | |
| r (%/yr) | 0.07 | 0.03 |
| **$W_{EA}$ ($)** | **91,038** | **142,089** |

D.1.5.4.3 On-Site Exposure Cost

The values for on-site (occupational) exposure consist of "immediate dose" and "long-term dose." The best estimate value provided in NUREG/BR-0184 [D.1-35] for immediate occupational dose is 3,300 person-rem per event and long-term occupational dose is 20,000 person-rem (over a ten year clean-up period). The following equation is used to calculate "immediate dose" on-site exposure cost:

$$W_{IO} = D_{IO} \times CDF \times R\left(\frac{1 - e^{-rt_f}}{r}\right)$$

Where:

- $W_{IO}$ is the immediate monetary value of on-site exposure after discounting ($);
- $D_{IO}$ is immediate occupational dose (3,300 person-rem per event);
- CDF is the core damage frequency;
- R is the monetary equivalent of dose ($5,500 per person-rem);
- r is the real discount rate (7% or 3%); and
- $t_f$ is the years remaining until end of facility life (29 years).

Table D.1-25 provides the results for the immediate monetary cost of on-site exposure for RBS.

**Table D.1-25 – Immediate On-Site Exposure Cost for RBS**

| | RBS | |
|---|---|---|
| CDF(events/yr) | 2.79E-06 | |
| $D_{IO}$ (person-rem/event) | 3,300 | |
| R ($/person-rem) | 5,500 | |
| $t_f$ (yr) | 29 | |
| r (%/yr) | 0.07 | 0.03 |
| **$W_{IO}$ ($)** | **628** | **981** |

The following equation is used to calculate "long-term dose" on-site exposure cost [D.1-35]:

$$W_{LTO} = \left(\frac{D_{LTO} \times CDF \times R}{mr^2}\right)(1 - e^{-rt_f})(1 - e^{-rm})$$

Where:

- $W_{LTO}$ is the long-term monetary value of on-site exposure after discounting ($);

- $D_{LTO}$ is the long-term occupational dose (20,000 person-rem per event);
- CDF is the core damage frequency;
- R is the monetary equivalent of dose ($5,500 per person-rem);
- m is the number of years over which the long-term dose occurs (10 years);
- r is the real discount rate (7% or 3%); and
- $t_f$ is the years remaining until end of facility life (29 years).

Table D.1-26 provides the results for the long-term monetary cost of on-site exposure for RBS.

**Table D.1-26 – Long-Term On-Site Exposure Cost for RBS**

| | RBS | |
|---|---|---|
| CDF(events/yr) | 2.79E-06 | |
| $D_{LTO}$ (person-rem/event) | 20,000 | |
| R ($/person-rem) | 5,500 | |
| $t_f$ (yr) | 29 | |
| m (years) | 10 | |
| r (%/yr) | 0.07 | 0.03 |
| **$W_{LTO}$ ($)** | **2,739** | **5,135** |

The on-site exposure cost ($W_O$) is the sum of the immediate monetary value of on-site exposure after discounting ($W_{IO}$) and the long-term monetary value of on-site exposure after discounting ($W_{LTO}$). On-site exposure cost ($W_O$) is calculated in Table D.1-27 for RBS.

**Table D.1-27 – On-Site Exposure Cost for RBS**

| | RBS | |
|---|---|---|
| r (%/yr) | 0.07 | 0.03 |
| $W_{IO}$ ($) | 628 | 981 |
| $W_{LTO}$ ($) | 2,739 | 5,135 |
| **$W_O$ ($)** | **3,367** | **6,116** |

D.1.5.4.4 On-Site Cleanup Cost

The on-site cleanup cost is the estimated cost for cleanup and decontamination of the site. The total undiscounted cost of cleanup and decontamination for a single accident in constant year dollars is $1,500,000,000 [D.1-35]. The following equation is used to calculate the on-site cleanup cost:

$$W_{CD} = CDF\left(\frac{C_{CD}}{mr^2}\right)(1 - e^{-rm})(1 - e^{-rt_f})$$

Where:

- $W_{CD}$ is the on-site cleanup cost ($);
- CDF is the core damage frequency;
- $C_{CD}$ is the total undiscounted cost of cleanup and decontamination in constant year dollars ($1,500,000,000);

- m is the number of years over which cleanup occurs (10 years);
- r is the real discount rate (7% or 3%); and
- $t_f$ is the years remaining until end of facility life (29 years).

Using the core damage frequency (CDF) and the two discounting factors, on-site cleanup cost ($W_{CD}$) is calculated in Table D.1-28 for RBS.

**Table D.1-28 – On-Site Cleanup Cost for RBS**

| | RBS | |
|---|---|---|
| CDF (events/yr) | 2.79E-06 | |
| $C_{CD}$ ($) | 1,500,000,000 | |
| $t_f$ (yr) | 29 | |
| m (yr) | 10 | |
| r (%/yr) | 0.07 | 0.03 |
| **$W_{CD}$ ($)** | **37,345** | **70,020** |

D.1.5.4.5 Replacement Power Cost

Long-term replacement power costs were determined following the methodology in NUREG/BR-0184 [D.1-35]. Determining replacement power cost requires calculating the net present value of replacement power for a single event ($PV_{RP}$). The equation for $PV_{RP}$ is shown below:

$$PV_{RP} = \left( \frac{\varphi \times \frac{P_{SQN(x)}}{P_{GEN}}}{r} \right) (1 - e^{-rt_f})^2$$

Where:

- $PV_{RP}$ is the net present value of replacement power for a single event ($);
- φ is a constant representing a string of replacement power costs that occur over the lifetime of a reactor after an event (for a 910 MWe "generic" reactor, NUREG/BR-0184 [D.1-35] uses a value of $120,000,000/yr;
- $P_{RBS}$ is the power output of RBS (967 MWe) [D.1-2];
- $P_{GEN}$ is the power output of the "generic" reactor used in NUREG/BR-0184 (910 MWe);
- r is the real discount rate (7%); and
- $t_f$ is the years remaining until end of facility life (29 years).

For a 3% sensitivity discount rate, NUREG/BR-0184 [D.1-35] states that $PV_{RP}$ is $1,400,000,000. Table D.1-29 provides the values for net present value of replacement power for a single event.

**Table D.1-29 – Net Present Value Replacement Power for RBS**

| | RBS | |
|---|---|---|
| $\varphi$ ($) | 120,000,000 | |
| $P_{RBS}$ (MWe) | 967 | |
| $P_{GEN}$ (MWe) | 910 | |
| $t_f$ (yr) | 29 | |
| r (%/yr) | 0.07 | 0.03 |
| **$PV_{RP}$ ($)** | **1,374,587,573** | **1,400,000,000** |

Long-term replacement power costs can then be determined using the following equation [D.1-35]:

$$W_{RP} = \frac{CDF \times PV_{RP}}{r}(1 - e^{-rt_f})^2$$

Where:

- $W_{RP}$ is the long-term replacement power cost ($);
- CDF is the core damage frequency;
- $PV_{RP}$ is the net present value of replacement power for a single event ($);
- r is the real discount rate (7% or 3%); and
- $t_f$ is the years remaining until end of facility life (29 years).

Using the core damage frequency (CDF), the calculated values for $PV_{RP}$ as calculated above, and the two discounting factors, long-term replacement power cost ($W_{RP}$) is calculated in Table D.1-30 for RBS.

**Table D.1-30 – Long-Term Replacement Power Cost for RBS**

| | RBS | |
|---|---|---|
| CDF (events/yr) | 2.79E-06 | |
| $t_f$ (yr) | 29 | |
| $PV_{RP}$ ($) | 1,374,587,573 | 1,400,000,000 |
| r (%/yr) | 0.07 | 0.03 |
| **$W_{RP}$ ($)** | **41,337** | **43,953** |

D.1.5.4.6 Total Cost of Severe Accident Risk / Maximum Benefit

The sum of the baseline costs is shown in Table D.1-31 for RBS.

**Table D.1-31 – Maximum Averted Cost Risk for RBS**

| Cost | RBS | |
|---|---|---|
| | 7% Real Discount Rate | 3% Discount Rate Sensitivity |
| Off-Site Exposure Cost ($W_{PHA}$) | $82,585 | $128,896 |
| Off-Site Economic Cost ($W_{EA}$) | $91,038 | $142,089 |
| On-Site Exposure Cost ($W_O$) | $3,367 | $6,116 |
| On-Site Cleanup Cost ($W_{CD}$) | $37,345 | $70,020 |
| Replacement Power Cost ($W_{RP}$) | $41,337 | $43,985 |
| **Maximum Averted Cost Risk (MACR)** | **$255,672** | **$391,074** |

The MACR, $255,672 for RBS, is based on at-power internal event contributions.

The internal event MACR is multiplied by a factor of 7 to account for external event contributions. The resulting modified MACR (MMACR) is $1,789,764. Note that the value for the MMACR is slightly higher than multiplying the MACR value in Table D.1-31 by the external event multiplier of 7 due to rounding differences between the Level 3 analysis and the SAMA analysis. The MMACR value of $1,789,764 is used in the Severe Accident Mitigation Analysis (SAMA) screening process.

**D.1.5.5 Sensitivity Analyses**

Sensitivity analyses were performed to evaluate changes to the fraction of public evacuating, the evacuation speed, delay in ordering an evacuation and decontamination costs. The base case is based on 2013 meteorological data (with minimum mixing height average), 95% evacuation, and an evacuation speed of 10 m/s (22.4 mph). Evacuation speed sensitivities were performed at 5 m/s and 15 m/s. For the faction of the public evacuating, sensitivities were performed at 90% and 100%. Since the alarm time determined by the MAAP analysis represents the earliest time a general emergency could be declared, a sensitivity representing a 15 minute (900 second) delay in the declaration of the general emergency was performed. For the decontamination costs sensitivity, the decontamination time (TIMDEC) and non-farmland decontamination costs (CDNFRM) were adjusted to the maximum possible values in WinMACCS of 3.15E+7 sec (~365 days) and $100,000/person, respectively, for the highest decontamination level. This sensitivity analysis methodology bounds the sensitivity analysis recommended in the Indian Point order CLI-16-06 [D.1-42].

Table D.1-32 gives the results of the population dose risk, economic risk and MACR for the base case and all the sensitivity cases. Additionally a percentage difference between the sensitivity cases and the base case is calculated for each of the three results.

**Table D.1-32 – RBS WinMACCS Sensitivity Analyses Summary**

| Case | Population Dose Risk | Δ Population Dose Risk | Economic Risk | Δ Economic Risk | Maximum Averted Cost Risk | Δ Maximum Averted Cost Risk |
|---|---|---|---|---|---|---|
| | (person-rem/yr) | (%) | ($/yr) | (%) | ($/yr) | (%) |
| 2013min (Base) | 1.21E+00 | - | 7.34E+03 | - | 255,672 | - |
| 5 m/s | 1.21E+00 | 0% | 7.34E+03 | 0% | 255,672 | 0% |
| 15 m/s | 1.21E+00 | 0% | 7.34E+03 | 0% | 255,672 | 0% |
| 90% | 1.21E+00 | 0% | 7.34E+03 | 0% | 255,672 | 0% |
| 100% | 1.21E+00 | 0% | 7.34E+03 | 0% | 255,672 | 0% |
| Decon | 1.21E+00 | 0% | 1.31E+04 | 78% | 326,832 | 28% |
| Alarm | 1.21E+00 | 0% | 7.34E+03 | 0% | 255,672 | 0% |

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# ATTACHMENT D.2

# EVALUATION OF SAMA CANDIDATES

## D.2 EVALUATION OF RIVER BEND STATION SAMA CANDIDATES

This section describes the generation of the initial list of potential SAMA candidates, screening methods, and the analysis of the remaining SAMA candidates.

### D.2.1 SAMA List Compilation

A list of SAMA candidates was developed by reviewing industry documents, and considering other plant-specific enhancements not identified in the published industry documents. Since RBS is a BWR 6 with a Mark III containment, considerable attention was paid to the SAMA candidates from SAMA analyses for similar plants. Industry documents reviewed included the following:

1. NEI 05-01, Severe Accident Mitigation Alternatives (SAMA) Analysis Guidance Document [D.2-1];
2. NRC and industry documentation discussing potential plant improvements
    - FitzPatrick Nuclear Power Plant SAMA Analysis [D.2-2]
    - Columbia Generating Station SAMA Analysis [D.2-3]
    - Cooper Nuclear Station SAMA Analysis [D.2-4]
    - Oyster Creek Nuclear Generating Station SAMA Analysis [D.2-5]
    - Monticello Nuclear Generating Plant SAMA Analysis [D.2-6]
    - Brunswick Steam Electric Plant SAMA Analysis [D.2-7]
    - Pilgrim Nuclear Power Station SAMA Analysis [ D.2-8]
    - Susquehanna Steam Electric Station SAMA Analysis [D.2-9]
    - Vermont Yankee Nuclear Station SAMA Analysis [D.2-10]
    - Duane Arnold Energy Center SAMA Analysis [D.2-11]
    - LaSalle County Station SAMA Analysis [D.2-12]
    - Grand Gulf Nuclear Station SAMA Analysis [D.2-13]
    - Fermi 2 Nuclear Power Plant SAMA Analysis [D.2-14]
3. RBS Individual Plant Examination (IPE) [D.2-15], RBS Individual Plant Examination of External Events (IPEEE) reports and their updates [D.2-16].
4. NUREG-1742, Perspectives Gained From the Individual Plant Examination of External Events (IPEEE) Program [D.2-18]; and
5. RBS updated PRA model lists of risk significant contributors [D.2-17].

A comprehensive list of 206 candidate SAMAs were considered for implementation at RBS and is provided in onsite documentation [D.2-19].

### D.2.2 Qualitative Screening of SAMA Candidates (Phase I)

The purpose of the Phase I analysis is to use high-level knowledge of the plant and SAMAs to preclude the need to perform detailed cost-benefit analyses. Since many of the SAMAs were derived from industry sources, they include a variety of potential enhancements that may or may not be directly applicable to RBS. In addition, several candidate SAMAs initially considered may have already been implemented at RBS. Each SAMA was examined to determine if it met one of the five criteria discussed below. Potential SAMA candidates were screened out if they modified features not applicable to RBS, if they had already been implemented at RBS, if they were similar in nature and could be combined with another SAMA candidate to develop a more comprehensive or plant-specific SAMA candidate, if they had excessive implementation cost, or they had very low benefit to RBS.

- Not Applicable (N/A): If a proposed SAMA does not apply to the RBS plant design, it is not retained.
- Already Implemented: If the SAMA or equivalent was previously implemented, it is not retained.
- Combined With Another SAMA: If a SAMA is similar in nature and can be combined with another SAMA to develop a more comprehensive or plant specific SAMA, only the combined SAMA is further evaluated.
- Excessive Implementation Cost: If the estimated cost of implementation is greater than the modified Maximum Averted Cost-Risk, the SAMA cannot be cost-beneficial and is screened from further analysis.
- Very Low Benefit: If the SAMA is related to a non-risk significant system which is known to have negligible impact on the risk profile, it is not retained.

During this process, 158 SAMA candidates were screened out based on the criteria listed above. One of the remaining SAMA candidates was split into three different SAMAs to better evaluate the benefits, which resulted in 50 remaining candidates. **Table D.2-1** provides a description of each of the 50 Phase II SAMA candidates.

### D.2.3 Final Screening and Cost Benefit Evaluation of SAMA Candidates (Phase II)

A cost/benefit analysis was performed on each of the remaining SAMA candidates. If the implementation cost of a SAMA candidate was determined to be greater than the potential benefit (i.e. there was a negative net value) the SAMA candidate was considered not to be cost beneficial and was not retained as a potential enhancement.

The expected cost of implementation of each SAMA 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 sources:

- Browns Ferry Nuclear Plant SAMA Analysis [D.2-20]
- Cooper Nuclear Station SAMA Analysis [D.2-4]

- Duane Arnold Energy Center SAMA Analysis [D.2-11]
- Fermi 2 Nuclear Power Plant SAMA Analysis [D.2-14]
- James A. FitzPatrick Nuclear Power Plant SAMA Analysis [D.2-2]
- Grand Gulf Nuclear Station SAMA Analysis [D.2-13]
- Indian Point Nuclear Generating Station SAMA Reanalysis [D.2-21]
- LaSalle County Station SAMA Analysis [D.2-12]
- Monticello Nuclear Generating Plant SAMA Analysis [D.2-6]
- Pilgrim Nuclear Power Station SAMA Analysis [D.2-8]
- Susquehanna Steam Electric Station SAMA Analysis [D.2-9]

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. Several of the SAMA candidates were clearly in excess of the attainable benefit estimated from a particular analysis. For less clear cases, engineering judgment was applied to determine if a more detailed cost estimate was necessary to formulate a conclusion regarding the economic viability of a particular SAMA. In most cases, more detailed cost estimates were not required, particularly if the SAMA called for the implementation of a hardware modification. 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.

Based on a review of previous submittals SAMA evaluations and an evaluation of expected implementation costs at RBS, the following estimated costs for each type of proposed SAMA implementation were used. In most cases, the lower value in each range was assumed to be the minimum cost for that type of SAMA implementation. If a procedure change was deemed to require complex changes that would require input from engineering or an increase in training, an estimated cost of implementation in the middle of the range was applied.

| Type of Change | Estimated Cost Range |
|---|---|
| Procedural only | \$50,000 |
| Procedural change with engineering or training required | \$50,000 - \$200,000 |
| Procedural change with engineering and testing/training required | \$200,000 - \$300,000 |
| Hardware modification | \$100,000 - >\$1,000,000 |

When required, detailed cost estimates were based on the engineering judgment of project engineers experienced in performing design changes at the facility and these values were compared, where possible, to estimates developed and used at plants of similar design and vintage.

Bounding evaluations (or analysis cases) were performed to address specific SAMA candidates or groups of similar SAMA candidates. Such bounding calculations overestimate the benefit and thus are conservative calculations. For example, one SAMA recommended providing a portable diesel fuel oil transfer pump as an additional means of supplying the EDG day tank in the event a common cause failure prevents operation of the existing pumps. The bounding calculation estimated the benefit of this improvement by total elimination of risk due to the diesel fuel oil system (see analysis of Case 7 and Phase II SAMA 30 below). 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.

A description of the analyses cases used in the Phase II analysis follows.

Case 1: DC Power

This case was used to evaluate the change in plant risk from adding additional DC battery capacity. A bounding analysis was performed by setting battery related failure events to false to simulate no battery failures. The following basic events and gates were set to false; BYS-BAT-NO-04, BYS-BAT-NO-1A1, BYS-BAT-NO-1A2, BYS-BAT-NO-1B1, BYS-BAT-NO-1B2, BYS-BAT-NO-1C, E22-054-DG, E22-054-FLS, ENB-BAT-C2-ENBAB, ENB-BAT-C2-ENBAC, ENB-BAT-C2-ENBBC, ENB-BAT-C3-ENABC, ENB-BAT-C7-BATTS, ENB-BAT-NO-SWG1A, ENB-BAT-NO-SWG1B, ENB-BAT-PE-LBT2H, ENB-BAT-PE-LBT4H, ENB034-DG, ENB034-FLS, ENB044-DG, ENB044-FLS, EPS100A, IE-TDCI, IE-TDCII, X1C, EPS-BAT-C2-BYSA, EPS-BAT-C2-BYSB, EPS-BAT-C4-BYSAB, FPW-BAT-NO-P1A1, FPW-BAT-NO-P1A2, FPW-BAT-NO-P1B1, FPW-BAT-NO-P1B2, and FPW-BAT-C4-BAT04. This resulted in an internal and external benefit (with uncertainty) of approximately $142,991. This analysis case was used to model the benefit of Phase II SAMAs 1 and 2.

Case 2: Improve Charger Reliability

This case evaluated the change in risk from improving battery charger reliability. A bounding analysis was performed by eliminating battery charger failure logic for the safety related and the backup charger (ENB-SWG1B) in the PRA model. The following gates were set to false; E22-052A-FLS, E22-055A, E22CCF3, ENB032A-FLS, ENB032-CHG, ENB035-FLS, ENB036-FLS, ENB042A-FLS, ENB042-CHG, ENB042-FLS, ENB045-FLS, ENB-BCC-C4-ABCD, and EPS100B. This resulted in an internal and external benefit of approximately $92,619. This analysis case was used to model the benefit of Phase II SAMA 43.

Case 3: Increase Availability of On-Site AC Power

This case evaluated the change in risk from improving the availability of on-site AC power. A bounding analysis was performed by eliminating the failure logic of on-site power feeds to the safety related buses by setting the following gates to false; ENS004-

FLS, ENS004-ACT, ENS004-HVX, ENS004-PAS, ENS014-ACT, ENS014-FLS, ENS014-SSW, ENS014-PAS, E22-024-FLS, E22-024-HVX, and E22-024-SBO. This resulted in an internal and external benefit of approximately $752,845. This analysis case was used to model the benefit of Phase II SAMA 15.

Case 4: Improve AC power

This case evaluated the change in risk due to improvements in on the AC power system. A bounding analysis was performed by modifying the fault tree model by adding an independent power source to the safety related 4160VAC buses. The independent power source was modeled as a single basic event (CASE4PWR) with a failure probability of 1E-04 and added to the following gates; ENS003-FLS, ENS003-HVX, ENS013-FLS, ENS013-SSW, E22-023-FLS, E22-023-HVX, and E22-023-SBO. This resulted in an internal and external benefit of approximately $456,840. This analysis case was used to model the benefit of Phase II SAMA 34.

Case 5: Reduce Loss of Off-site Power during Severe Weather

This analysis case evaluated the change in plant risk from installing an additional buried off-site power source. A bounding analysis was performed by removing LOSP due to severe weather. The loss of offsite power initiating event was reduced by removing the weather contribution and the failure to recover offsite power events were also adjusted to remove the weather contribution. This resulted in an internal and external benefit of approximately $382,080. This analysis case was used to model the benefit of Phase II SAMA 14.

Case 6: Provide Backup EDG Cooling

This case was used to evaluate the change in plant risk from increasing EDG reliability by adding a backup source of cooling. A bounding analysis was performed by eliminating failure of Standby Service Water cooling to the EDGs (gates SWP001, SWPM01, SWP003-FLS, SWP003, SWP003-SBO, SWP002 and SWPM02 were set to false). This resulted in an internal and external benefit of approximately $78,846. This analysis case was used to model the benefit of Phase II SAMAs 21 and 22.

Case 7: Increase EDG Reliability

This analysis was used to evaluate the change in plant risk from improving the reliability of diesel generators by improving the fuel supplies to the diesels. The analysis was performed by eliminating failures of the EDG fuel supplies. Gates EGF-AFOXFR, EGF-BFOXFR, EGF-CFOXFR, EGFA, EGFB, and EGFC were set to false in the model. This resulted in an internal and external benefit of approximately $48,709. This analysis case was used to model the benefit of Phase II SAMAs 30 and 204.

Case 8: Improve DG Reliability

This analysis was used to evaluate the change in plant risk from providing a diverse swing diesel generator air start compressor for the EDGs. The analysis was performed by eliminating the common cause failure contribution of failure to start EDGs in the model (CCF events EGS-DGN-C2-DGFS and EGS-DGN-C3-SBDGS were set to false). This resulted in an internal and external benefit of approximately $6,456. This analysis case was used to model the benefit of Phase II SAMA 33.

Case 9: Reduce Plant Centered Loss of Off-site Power

This case was used to evaluate the change in plant risk from protecting switchyard transformers and main power feeds from failure. The analysis was performed by eliminating the failures of switchyard transformers and the main power feeds from the switchyard in the base model cutsets (basic events 230-PTR-OP-RTX1E, 230-PTR-OP-RTX1F, 230-PTR-OP-RTX1D, 230-PTR-OP-STX1C, 230-PTR-OP-RTX1C, 230-PTR-OP-STX1B, 230-PTR-OP-STX1A, IE-TRSS1, IE-TRSS2, 230-BAC-NO-RSS01, and 230-BAC-NO-RSS02 set to false) and removing the plant centered and switchyard portions of the Loss of Offsite power initiator. The evaluation was performed by creating a rule file, which was used to modify the IE-T1 frequency to 4.27E-03/yr and set the above events to false, in the base Level 1 and Level 2 cutset files. This resulted in an internal and external benefit of approximately $946,041. This analysis case was used to model the benefit of Phase II SAMA 38.

Case 10: Improve Service Cooling Water Fans

This case was used to evaluate the change in plant risk from increasing the capacity of the Service Water Cooling (SWC) tower fans. The analysis was performed by eliminating the failure of SWC cooling to the Normal Service Water system (gate SWPM112) in the model. The initiating event frequency for loss of Normal Service Water (IE-TNSW) was reduced from 3.4E-04/yr to 2.6E-04/yr to remove the initiating event contribution of the SWC tower fans. The updated IE-TNSW frequency was developed by quantifying the IE-TNSW fault tree with gates TSC007 and TSC260 set to false. This resulted in an internal and external benefit of approximately $43,588. This analysis case was used to model the benefit of Phase II SAMA 206.

Case 11: High Pressure Injection System

This analysis case evaluated the change in plant risk from plant modifications that would increase the availability of high pressure core spray (installing an independent high pressure injection system or a passive high pressure injection system). A bounding analysis was performed by modifying the PRA models to include an independent injection train. The new train was modeled as a single basic event (CASE11_MOD) with a failure probability of 1E-04 and was AND'ed to existing HPCS gates (U1 and U1-SBO). This resulted in an internal and external benefit of approximately $278,649. This analysis case was used to model the benefit of Phase II SAMA 44.

Case 12: Extend RCIC Operation

This analysis case was used to evaluate the change in plant risk from increasing the RCIC turbine backpressure set points. Since the RBS model does not model the backpressure set points, the case was evaluated by eliminating the contribution from RCIC turbine fail to run events in the model (basic events E51-TDS-FR-TC002, E51-TDS-FR-LT6HR, E51-TDS-FR-GT6HR, and E51-TDS-F1-PC001 were set to false). This resulted in an internal and external benefit of approximately $16,845. This analysis case was used to model the benefit of Phase II SAMA 46.

Case 13: Improve ADS System

This case was used to evaluate the change in plant risk from modifying automatic depressurization system components to improve their reliability by adding larger accumulators. To assess the change in plant risk for this SAMA, a bounding analysis was performed by eliminating the failure of air supplies to all ADS system Safety Relief Valve accumulators in the PRA model (gates ADS-22, ADS-26A and ADS-26B were set to false). This resulted in an internal and external benefit of approximately $3,242. This analysis case was used to model the benefit of Phase II SAMA 51.

Case 14: Improve Internal Flooding Procedures

This analysis case is evaluating a SAMA which would not mitigate internal event risk. Internal flooding was included in external events because the internal flooding analysis is not integrated into the Level 1 PRA model. This case addresses internal flooding risk by assuming new procedures for internal flooding will mitigate a significant portion of the internal flooding CDF. A bounding analysis was performed by eliminating the CDF from the top 10 internal flooding scenarios from the internal flooding total. The internal events model cannot be used to assess the benefit from this case. However, the consequences resulting from internal flooding core damage and internal event core damage would be comparable. Since the internal maximum benefit is known, the maximum benefit from removing all internal flooding risk can be estimated by reducing the maximum internal event benefit by the ratio of the total internal flooding CDF to the internal event CDF.

Given,

Maximum internal events (IE) benefit = $255,681
Total internal flooding (IF) CDF = 4.97E-06/rx-yr [Table 7-2, Reference D.2-17]
Internal events (IE) CDF = 2.79E-06/rx-yr

Maximum IF benefit = Maximum IE benefit X (Total IF CDF/Total IE CDF)

Maximum IF benefit = $255,681 X (4.97E-06/2.79E-06) = $455,460

Case 14 benefit = 48% X (Maximum IF benefit) = 0.48 X $455,460

Case 14 benefit = $218,621

This resulted in a case benefit of $218,621. This analysis case was used to model the benefit of Phase II SAMA 169.

Case 15: Revise FLEX Procedures for Non-ELAP conditions

This analysis case was used to evaluate the change in plant risk from revising the FLEX procedures to allow their use in non-Extended Loss of AC Power (ELAP) events. This change would ensure availability of a large cool source of suction water and DC power for RCIC to operate for extended time periods and provide an alternate method of suppression pooling using the Suppression Pool Cleanup (SPC) system and a portable generator. A bounding analysis was performed by removing the failure of the RCIC pump, power supply, suction paths and sensor signal failure logic from the RCIC system top logic gates U2 and U2-ST. Gates ICS025, ICS030, ICS004 and ENB031-FLS removed from a copy of the U2 gate and renamed to U2CS15. This new gate was substituted for gate U2 in sequences where RCIC fails. The same process was used to create gate U2-ST-CS15. Gates ICS025-SBO, ICS030-SBO, ICS007-SBO, ICS024 and basic event E51-XHE-FO-BYST were removed and U2-ST-CS15 was substituted for gate U2-ST in sequences where RCIC fails. Gates U2 and U2-ST in sequence success logic was not modified. The failure of the SPC suppression pooling cooling system was eliminated by setting gate W5 to false in a revised flag file. This resulted in an internal and external benefit of approximately $949,389. This analysis case was used to model the benefit of Phase II SAMA 205.

Case 16: ECCS Low Pressure Interlock

This analysis was used to evaluate the change in plant risk from installing a bypass switch to allow operators to bypass the low reactor pressure interlock circuitry that prevents opening the LPCI or LPCS injection valves following sensor or logic failures. A bounding analysis was performed by eliminating LPCI and LPCS permissives and interlock failures in the PRA model (gates ESF042A and ESF042B were set to false). This resulted in an internal and external benefit of approximately $2,054. This analysis case was used to model the benefit of Phase II SAMA 71.

Case 17: RHR Heat Exchangers

This analysis was used to evaluate the change in plant risk from implementing modifications to allow manual alignment of the fire water system to the RHR heat exchangers. A bounding analysis was performed by eliminating failure of SSW to provide cooling to the heat exchangers in the PRA model (gates SWP004 and SWP006 were set to false). This resulted in an internal and external benefit of approximately $149,829. This analysis case was used to model the benefit of Phase II SAMA 79.

Case 18: Service Water System Reliability

This analysis case was used to evaluate the change in plant risk from adding redundant DC control power for the standby service water pumps or installing an additional service water pump. A bounding analysis was performed by eliminating standby service water pump common cause failures, fail-to-start events, fail-to-run events and maintenance events from the PRA model. The following basic events were set to false in the model; SWP-MDS-C2-SSWFS, SWP-MDS-FR-SBP2B, SWP-MDS-C2-SSWFR, SWP-MDS-

FR-SBP2C, SWP-MDS-C3-3SWFR, SWP-MDS-FR-SBP2D, SWP-MDS-C3-3SWFS, SWP-MDS-FS-SWP2A, SWP-MDS-C4-SSWFR, SWP-MDS-FS-SWP2B, SWP-MDS-C4-SSWFS, SWP-MDS-FS-SWP2C, SWP-MDS-F1-SBP2A, SWP-MDS-FS-SWP2D, SWP-MDS-F1-SBP2B, SWP-MDS-MA-SWP2A, SWP-MDS-F1-SBP2C, SWP-MDS-MA-SWP2B, SWP-MDS-F1-SBP2D, SWP-MDS-MA-SWP2C, SWP-MDS-FR-SBP2A, and SWP-MDS-MA-SWP2D. This resulted in an internal and external benefit of approximately $517,426. This analysis case was used to model the benefit of Phase II SAMAs 75 and 80.

Case 19: Main Feedwater System Reliability

This analysis case was used to evaluate the change in plant risk from installing a digital feed water upgrade. A bounding analysis was performed by setting the loss of feedwater system initiating event (IE-T3B) to false in the base model Level 1 and Level 2 cutsets. This resulted in an internal and external benefit of approximately $53,951. This analysis case was used to model the benefit of Phase II SAMA 87.

Case 20: Increased Availability of Room Cooling

This case was used to evaluate the change in plant risk from installing redundant ventilation trains and enhancing response procedures for loss of HVAC. A bounding analysis was performed by removing failure of room cooling for ECCS and RCIC rooms in the Auxiliary Building (gates HVX009, HVX011, HVX007-SBO and HVX-007 set to false). This resulted in an internal and external benefit of approximately $242,279. This analysis case was used to model the benefit of Phase II SAMA 93.

Case 21: Increase Availability of DG Systems through HVAC Improvements

This analysis case was used to evaluate the change in plant risk from enhancing diesel generator room cooling. A bounding analysis was performed by eliminating failure of cooling to the three emergency diesel generator rooms in the PRA model (gates HVX001, HVX003 and HVX005 were set to false). This resulted in an internal and external benefit of approximately $51,216. This analysis case was used to model the benefit of Phase II SAMAs 100, 101 and 102.

Case 22: Procedures for Loss of Room Cooling

This analysis case was split into three cases in order to address the plant risk from developing procedures for loss of room cooling from three different room coolers.

Case 22a - This case was used to evaluate the change in plant risk from developing a procedure for loss of the room cooler for HPCS pump. A bounding analysis was performed by eliminating failure of cooling to HPCS pump room in the PRA model (gates HVX007 and HVX007-SBO were set to false). This resulted in an internal and external benefit of approximately $93,656. This analysis case was used to model the benefit of Phase II SAMA 94a.

Case 22b - This case was used to evaluate the change in plant risk from developing a procedure for loss of the room cooler for RHR B and RHR C pumps. A bounding analysis was performed by eliminating failure of cooling to RHR B and RHR C pump rooms in the PRA model (gate HVX011 was set to false). This resulted in an internal and external benefit of approximately $56,669. This analysis case was used to model the benefit of Phase II SAMA 94b.

Case 22c - This case was used to evaluate the change in plant risk from developing a procedure for loss of the room cooler for RHR A and LPCS pumps. A bounding analysis was performed by eliminating failure of cooling to the LPCS and RHR A pump rooms in the PRA model (gate HVX009 was set to false). This resulted in an internal and external benefit of approximately $102,638. This analysis case was used to model the benefit of Phase II SAMA 94c.

Case 23: Trip/Shutdown Risk

This analysis case was used to evaluate the change in plant risk from implementing Generation Risk Assessment (trip and shutdown risk modeling) into plant activities. A bounding analysis was performed by reducing all initiating event frequencies except those for LOCA's, pipe breaks and LOSP by 10%. (IE-SSW55A, IE-SSW55B, IE-TNSP-A, IE-TNPS-B, IE-T2, IE-TNSW, IE-T3A, IE-TSSWA, IE-T3B, IE-TSSWB, IE-T3C, IE-TIAS, IE-TCCP, IE-TMST, IE-TCCS, IE-TRLA, IE-TCRD, IE-TRLB, IE-TDCI, IE-TRLC, IE-TDCII, and IE-TRLD). This resulted in an internal and external benefit of approximately $55,053. This analysis case was used to model the benefit of Phase II SAMA 197.

Case 24: Improve Availability of SRVs and MSIVs

This analysis case was used to evaluate the change in plant risk from improving SRV and MSIV pneumatic components. A bounding analysis was performed by eliminating failure of SRV air supply logic, SRV common cause events and MSIVs in the PRA model; ADS-26A, ADS-26B, ADS-35, ADS-SRV-C6-SRVCC, ADS-SRV-CM-15SRV, B21-AOV-C2-OO22A, B21-AOV-C2-OO22B, B21-AOV-C2-OO22C, B21-AOV-C2-OO22D, B21-AOV-C4-22FRO, B21-AOV-C4-28FRO, B21-AOV-OC-F022A, B21-AOV-OC-F022B, B21-AOV-OC-F022C, B21-AOV-OC-F022D, B21-AOV-OC-F028A, B21-AOV-OC-F028B, B21-AOV-OC-F028C, B21-AOV-OC-F028D, B21-AOV-OO-F022A, B21-AOV-OO-F022B, B21-AOV-OO-F022C, B21-AOV-OO-F022D, B21-AOV-OO-F028A, B21-AOV-OO-F028B, B21-AOV-OO-F028C, and B21-AOV-OO-F028D. This resulted in an internal and external benefit of approximately $3,668. This analysis case was used to model the benefit of Phase II SAMA 108.

Case 25: Improve Suppression Pool Cooling

This analysis case was used to evaluate the change in plant risk from installing an independent method of suppression pool cooling. A bounding analysis was performed by eliminating the failure of suppression pool cooling in the PRA model (gate W1 was set to false). This resulted in an internal and external benefit of approximately $1,106,266. This analysis case was used to model the benefit of Phase II SAMA 110.

Case 26: Increase Availability of Containment Heat Removal

This case was used to evaluate the change in plant risk from increasing the availability of containment heat removal through use of a passive containment spray or containment venting system. A bounding case was performed by eliminating failure of the safety related containment unit coolers in the PRA model (gate W4 was set to false). This resulted in an internal and external benefit of approximately $1,057,071. This analysis case was used to model the benefit of Phase II SAMAs 115 and 120.

Case 27: Containment Filtered Vent for ATWS

This analysis case was used to evaluate the change in plant risk from modifications to install a filtered vent for ATWS events. A bounding case was performed using the same PRA model changes as Case 26 and also reducing the population dose for each source term release category by a factor of 5 to simulate removal of radionuclide products from the releases. This resulted in an internal and external benefit of approximately $1,234,717. This analysis case was used to model the benefit of Phase II SAMA 162.

Case 28: CRD Improvements

This analysis was used to evaluate the change in plant risk from adding the ability to cross-tie safety related power to the CRD pumps for vessel injection. A bounding analysis was performed by eliminating CRD injection events and the loss of CRD initiator from the PRA model (gates U3, U3-ECCS, U3X and IE-TCRD set to false). This resulted in an internal and external benefit of approximately $32,438. This analysis case was used to model the benefit of Phase II SAMA 59.

Case 29: Increase Recovery Time of ECCS upon Loss of SSW

This analysis case was used to evaluate the change in plant risk from upgrading procedures and operator training for alternating operation of the low pressure ECCS pumps for loss of SSW scenarios. A bounding analysis was performed by eliminating failure of room cooling, which is supported by SSW, for the LPCI, and LPCS pump rooms (set gates HVX009 and HVX011 to false). This resulted in an internal and external benefit of approximately $153,449. This analysis case was used to model the benefit of Phase II SAMAs 97 and 198.

Case 30: Reduce Hydrogen Ignition

This case was used to evaluate hydrogen control methods that would reduce the likelihood of hydrogen detonation or deflagration. Providing post-accident containment inerting capability, or installing a passive hydrogen control system would reduce the likelihood of hydrogen and carbon monoxide gas combustion. To evaluate the change in plant risk, a bounding analysis was performed by eliminating failure of the igniters in the PRA model (basic event IGNITERS was set to false). This resulted in an internal and external benefit of approximately $11,954. This analysis case was used to model the benefit of Phase II SAMAs 128 and 138.

Case 31: Improve RHR Heat Exchanger Availability

This case was used to evaluate the change in plant risk from adding a bypass around the RHR heat exchanger outlet valves (the RBS inlet valves are locked open). A bounding analysis was performed by eliminating failure of events associated with the SSW supply to the RHR heat exchanger (gates SWPM04, SWPM057, SWPM05, SU-MOV-MA-F068A, and SWP-MOV-MA-F068B set to false). This resulted in an internal and external benefit of approximately $75,823. This analysis case was used to model the benefit of Phase II SAMA 201.

Case 32: Improve RCIC Lube Oil Cooling

This case was used to evaluate the change in plant risk from adding a redundant RCIC lube oil cooling path. A bounding analysis was performed by eliminating the failure to cool RCIC lube oil in the PRA model (gate ICSM008 was set to false). This resulted in an internal and external benefit of approximately $7,950. This analysis case was used to model the benefit of Phase II SAMA 202.

Case 33: MSIV Design to Decrease Containment Bypass Scenarios

This case was used to evaluate the change in plant risk from improving MSIV design to decrease the likelihood of containment bypass scenarios. A bounding analysis was performed by eliminating failure of the MSIVs to close in the PRA model (basic events B21-AOV-OO-F022A, B21-AOV-OO-F022B, B21-AOV-OO-F022C, B21-AOV-OO-F022D, B21-AOV-OO-F028A, B21-AOV-OO-F028B, B21-AOV-OO-F028C, and B21-AOV-OO-F028D set to false). This resulted in an internal and external benefit of approximately $2,054. This analysis case was used to model the benefit of Phase II SAMA 147.

Case 34: SLC System

This analysis case was used to evaluate the change in plant risk from increasing boron concentration for the SLC system or addition of an alternate boron injection method. A bounding analysis was performed by eliminating failure of the SLC system from the PRA model (gate SLC set to false). This resulted in an internal and external benefit of approximately $7,639. This analysis case was used to model the benefit of Phase II SAMAs 156 and 158.

Case 35: SRV Reseat

This analysis was used to evaluate the change in plant risk from installing more reliable SRVs with improved reseating capabilities. A bounding analysis was performed by eliminating the initiator for inadvertent opening of an SRV and the basic events for stuck open SRVs from the PRA model (events IE-T3C, P1 and P2 set to false). This resulted in an internal and external benefit of approximately $709,644. This analysis case was used to model the benefit of Phase II SAMA 160.

Case 36: Add Fire Suppression System

This analysis case is evaluating a SAMA which would not mitigate internal event risk. This case addresses reducing fire risk by installing incipient fire detection in the Division 1 Switchgear Room electrical cabinets as well as adding fire suppression in the room. A bounding analysis was performed by eliminating the Division 1 Switchgear Room from the RBS fire CDF. The fire events model cannot be used to assess the benefit from this case. However, the consequences resulting from fire core damage and internal event core damage would be comparable. Since the internal maximum benefit is known, the maximum benefit from removing the fire risk can be estimated by reducing the maximum internal event benefit by the ratio of the total fire CDF to the internal event CDF.

Given,

Maximum internal events (IE) benefit = $255,681
Total Fire CDF = 9.0E-06/rx-yr [Section 7.5, Reference D.2-17]
Internal events (IE) CDF = 2.79E-06/rx-yr

Maximum Fire benefit = Maximum IE benefit X Total Fire CDF/Total IE CDF

Maximum Fire benefit = $255,681 X (9.0E-06/2.79E-06) = $824,776

Case 36 benefit = 21% X (Maximum Fire benefit) = 0.21 X $822,943

Case 36 benefit = $173,203

This resulted in a benefit of $173,203. This analysis case was used to model the benefit of Phase II SAMA 183.

Case 37: Reduce Risk From Fires That Require Control Room Evacuation

This analysis case is evaluating a SAMA which would not mitigate internal event risk. This case addresses reducing fire risk by including additional system controls for the non-Appendix R train in the remote shutdown panel to reduce the risk associated with fire in the Control Room. A bounding analysis was performed by eliminating the Control Room from the RBS fire CDF. The fire events model cannot be used to assess the benefit from this case. However, the consequences resulting from fire core damage and internal event core damage would be comparable. Since the internal maximum benefit is known, the maximum benefit from removing the fire risk can be estimated by reducing the maximum internal event benefit by the ratio of the total fire CDF to the internal event CDF.

Given,

Maximum internal events (IE) benefit = $255,681
Total Fire CDF = 9.0E-06/rx-yr [Section 7.5, Reference D.2-17]
Internal events (IE) CDF = 2.79E-06/rx-yr

Maximum Fire benefit = Maximum IE benefit X Total Fire CDF/Total IE CDF

Maximum Fire benefit = $255,681 X (9.0E-06/2.79E-06) = $824,776

Case 37 benefit = 22% X (Maximum Fire benefit) = 0.22 X $822,916

Case 37 benefit = $181,451

This resulted in a benefit of $181,451. This analysis case was used to model the benefit of Phase II SAMA 185.

Case 38: Large Break LOCA

This analysis case was used to evaluate the change in plant risk from installing a digital large break LOCA (leak before break) protection system. The analysis was performed by eliminating all large and medium LOCA initiating events (initiating events IE-A and IE-S1 set to false). This resulted in an internal and external benefit of approximately $7,813. This analysis case was used to model the benefit of Phase II SAMA 190.

### D.2.4 Sensitivity Analyses

Two sensitivity analyses were conducted to gauge the impact of key assumptions upon the analysis. The benefits (averted cost-risk) of each SAMA analysis with these sensitivities are presented in Table D.2-2.

The sensitivities performed are as follows:

Sensitivity Case 1: Conservative Discount Rate

The purpose of this sensitivity case was to investigate the sensitivity of each analysis case to the discount rate. A discount rate of 7.0% used in the base case analyses. A lower discount rate of 3.0% was assumed in this sensitivity case to investigate the impact on each analysis case. Sensitivity 1 identified three SAMA candidates that are potentially cost-beneficial (SAMAs 94a, 94c, and 198).

Sensitivity Case 2: 95$^{th}$ Percentile Uncertainty

The purpose of this sensitivity case was to investigate the sensitivity of the PRA model underestimating averted plant risk. If the best estimate failure probability values were consistently lower than the "actual" failure probabilities, the PRA model would underestimate plant risk and yield lower than "actual" averted cost-risk values for potential SAMAs. Re-assessing the cost benefit calculations using the high end of the failure probability distributions is a means of identifying the impact of having consistently underestimated failure probabilities for plant equipment and operator actions included in the PRA model. This sensitivity uses a multiplier of 4, which is conservative with respect to the CDF 95th percentile results (3.58), to examine the impact of uncertainty in the PRA model. Sensitivity 2 identified two SAMA candidates that are potentially cost-beneficial (SAMAs 94b and 102).

### D.2.5 References


D.2-1 NEI 05-01, "Severe Accident Mitigation Alternatives (SAMA) Analysis Guidance Document," November 2005, Revision A.

D.2-2 NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding James A. FitzPatrick Nuclear Power Plant – Final Report (NUREG 1437, Supplement 31)," January 2008.

D.2-3 NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Columbia Generating Station – Draft Report for Comment (NUREG 1437, Supplement 47)," August 2011.

D.2-4 NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants Regarding Cooper Nuclear Station, Unit 1 – Final Report (NUREG-1437, Supplement 41)," July 2010.

D.2-5 NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding Oyster Creek Nuclear Generating Station – Final Report, (NUREG-1437, Supplement 28)," January 2007.

D.2-6 NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding Monticello Nuclear Generating Plant – Final Report (NUREG-1437, Supplement 36)," August 2006.

D.2-7 NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding Brunswick Steam Electric Plant, Units 1 and 2 (NUREG-1437, Supplement 25)," April 2006.

D.2-8 NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding Pilgrim Nuclear Power Station – Final Report (NUREG-1437, Supplement 29)," July 2007.

D.2-9 NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding Susquehanna Steam Electric Station, Units 1 and 2 (NUREG-1437, Supplement 35)," March 2009.

D.2-10 NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding Vermont Yankee Nuclear Power Station – Final Report (NUREG-1437, Supplement 30)," August 2007.

D.2-11 NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding Duane Arnold Energy Center – Final Report (NUREG-1437, Supplement 42)," October 2010.

D.2-12 NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding LaSalle County Station, Units 1 & 2 – Final Report (NUREG0-1437, Supplement 57)," August 2016.

D.2-13 NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding Grand Gulf Nuclear Station – Final Report (NUREG-1437, Supplement 50)," November 2014.

D.2-14 NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding Fermi 2 Nuclear Power Plant – Final Report (NUREG-1437, Supplement 56)," September 2016.

D.2-15 Report EA-RA-93-0001-M, Revision 0, "Generic Letter 88-20 Individual Plant Examination Submittal for Internal Events at River Bend Station."

D.2-16 Report SEA-95-001, Revision 0, "River Bend Station Engineering Report for Individual Plant Examination of External Events Submittal for Internal Events (IPEEE)."

D.2-17 PSA-RBS-06-02, Revision 0, "Evaluation of River Bend Station PRA Model." ENERCON Report ENTGRB174-REPT-002, R0.

D.2-18 NUREG-1742, "Perspectives Gained From the Individual Plant Examination of External Events (IPEEE) Program – Final Report," April, 2002.

D.2-19 PSA-RBS-06-01, Revision 0, Cost-Benefit Analysis of Severe Accident Mitigation Alternatives (SAMA) Analysis, (ENERCON report ENTGRB174-REPT-003, R0)

D.2-20 NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding Browns Ferry Nuclear Plant, Units 1, 2, and 3, (NUREG-1437, Supplement 21), June 2005.

D.2-21 Entergy Letter NL-09-165, "License Renewal Application – SAMA Reanalysis Using Alternate Meteorological Tower Data," Dec. 11, 2009, ML093580089.

**Table D.2-1 – Summary of Phase II SAMA Candidates**

| Analysis Case (bold) SAMA Number and Title | Assumptions/ Source of Cost Estimate | CDF Reduction (%) | PDR Reduction (%) | OECR Reduction (%) | Internal and External Benefit ($) | RBS Cost Estimate ($) | Conclusion |
|---|---|---|---|---|---|---|---|
| **Case 1. DC Power** | **Eliminated failure of batteries** | 7.9% | 8.2% | 7.9% | $142,991 | | |
| SAMA 1 - Provide additional battery capacity | GGNS | | | | | $2,130,000 | Not cost-beneficial |
| SAMA 2 - Replace lead acid batteries with fuel cells | GGNS | | | | | $4,080,000 | Not cost-beneficial |
| **Case 2. Improve Charger Reliability** | **Eliminated failure of safety related and backup battery chargers** | 1.8% | 6.8% | 6.7% | $92,619 | | |
| SAMA 43 - Modify portable station generator to automatically align to 125 V DC battery chargers | Susquehanna | | | | | $400,000 | Not cost-beneficial |
| **Case 3. Increase Availability of On-Site AC Power** | **Eliminated failure of Emergency Diesel Generators** | 36.2% | 44.8% | 44.9% | $752,845 | | |
| SAMA 15 - Install a gas turbine generator with tornado protection | Plant-specific cost estimate | | | | | $10,006,000 | Not cost-beneficial |
| **Case 4. Improve AC Power** | **Added Independent AC Power Source to Each Safety 4160v Bus** | 20.1% | 28.0% | 28.2% | $456,840 | | |

**Table D.2-1 – Summary of Phase II SAMA Candidates**

| Analysis Case (bold) SAMA Number and Title | Assumptions/ Source of Cost Estimate | CDF Reduction (%) | PDR Reduction (%) | OECR Reduction (%) | Internal and External Benefit ($) | RBS Cost Estimate ($) | Conclusion |
|---|---|---|---|---|---|---|---|
| SAMA 34 - Provide alternate feeds to essential loads directly from an alternate emergency bus | Plant-specific cost estimate | | | | | $2,324,000 | Not cost-beneficial |
| **Case 5. Reduce Loss of Off-Site Power During Severe Weather** | **Removed weather contribution to LOSP initiator and to failure to recover OSP events.** | 21.1% | 21.5% | 21.4% | $382,080 | | |
| SAMA 14 - Install an additional, buried off-site power source | Cooper | | | | | $2,500,000 | Not cost-beneficial |
| **Case 6. Provide Backup EDG Cooling** | **Removed service water cooling to the EDGs** | 2.5% | 5.4% | 5.2% | $78,846 | | |
| SAMA 21 - Use fire water system as a backup source for diesel cooling | GGNS | | | | | $1,344,000 | Not cost-beneficial |
| SAMA 22 - Add a new backup source of diesel cooling | Cooper | | | | | $2,000,000 | Not cost-beneficial |
| **Case 7. Increase EDG Reliability** | **Eliminated failure of EDGs due to loss of fuel** | 2.5% | 3.0% | 2.7% | $48,709 | | |
| SAMA 30 - Provide a portable EDG fuel transfer pump | GGNS | | | | | $1,477,000 | Not cost-beneficial |

**Table D.2-1 – Summary of Phase II SAMA Candidates**

| Analysis Case (bold) SAMA Number and Title | Assumptions/ Source of Cost Estimate | CDF Reduction (%) | PDR Reduction (%) | OECR Reduction (%) | Internal and External Benefit ($) | RBS Cost Estimate ($) | Conclusion |
|---|---|---|---|---|---|---|---|
| SAMA 204 - Add capability to cross-tie fuel oil supply to emergency diesel generators | Hardware modification and new procedure | | | | | $200,000 | Not cost-beneficial |
| **Case 8. Improve DG Reliability** | **Eliminate common cause failure to start events for EDGs** | 0.0% | 0.7% | 0.4% | $6,456 | | |
| SAMA 33 - Provide a diverse swing diesel generator air start compressor | Minimum hardware modification | | | | | $100,000 | Not cost-beneficial |
| **Case 9. Reduce Plant Centered Loss of Off-site Power** | **Eliminated plant centered events contribution to the LOSP initiator and removed transformer failures** | 57.0% | 51.1% | 50.7% | $946,041 | | |
| SAMA 38 - Protect service transformers from failure | Plant-specific cost estimate | | | | | $9,998,000 | Not cost-beneficial |
| **Case 10. Improve Service Cooling Water Fans** | **Eliminated Service Water Cooling of the Normal Service Water System** | 1.8% | 2.9% | 2.6% | $43,588 | | |
| SAMA 206 - Improve flow capacity of Service Water Cooling fans for summer conditions | Hardware Modification | | | | | $200,000 | Not cost-beneficial |

**Table D.2-1 – Summary of Phase II SAMA Candidates**

| Analysis Case (bold) SAMA Number and Title | Assumptions/ Source of Cost Estimate | CDF Reduction (%) | PDR Reduction (%) | OECR Reduction (%) | Internal and External Benefit ($) | RBS Cost Estimate ($) | Conclusion |
|---|---|---|---|---|---|---|---|
| **Case 11. High Pressure Injection System** | **Modeled additional independent high pressure train** | 17.2% | 14.4% | 15.2% | $278,649 | | |
| SAMA 44 - Install an independent active or passive high pressure injection system | GGNS | | | | | $8,800,000 | Not cost-beneficial |
| **Case 12. Extend RCIC Operation** | **Eliminated RCIC turbine run failures** | 0.7% | 1.2% | 0.9% | $16,845 | | |
| SAMA 46 - Raise RCIC backpressure set points | Procedure Change with Engineering | | | | | $100,000 | Not cost-beneficial |
| **Case 13. Improve ADS System** | **Eliminated failure of air supply to ADS valves** | 0.0% | 0.5% | 0.1% | $3,242 | | |
| SAMA 51 - Modify automatic depressurization system components to improve reliability. [This SAMA will add larger accumulators thus increasing reliability during SBOs] | GGNS | | | | | $1,177,000 | Not cost-beneficial |
| **Case 14 Improve Internal Flooding Procedures** | **Removed CDF contribution of top 10 internal flooding scenarios** | n/a | n/a | n/a | $218,621 | | |
| SAMA 169 - Improve internal flooding procedures | Procedure with engineering | | | | | **$200,000** | **Potentially cost-beneficial** |

**Table D.2-1 – Summary of Phase II SAMA Candidates**

| Analysis Case (bold) SAMA Number and Title | Assumptions/ Source of Cost Estimate | CDF Reduction (%) | PDR Reduction (%) | OECR Reduction (%) | Internal and External Benefit ($) | RBS Cost Estimate ($) | Conclusion |
|---|---|---|---|---|---|---|---|
| **Case 15. Revise FLEX Procedures for non-ELAP conditions** | **Eliminated RCIC power, suction path and pump failures** | 47.0% | 55.8% | 56.0% | $949,389 | | |
| SAMA 205 - Revise FLEX procedures to allow use of FLEX equipment in non-ELAP conditions | Procedure with Engineering | | | | | **$200,000** | **Potentially cost-beneficial** |
| **Case 16 ECCS Low Pressure Interlock** | **Eliminated failures of LPCI/LPCS low pressure interlocks** | 0.0% | 0.4% | 0.0% | $2,054 | | |
| SAMA 71 - Modify procedures to allow operators to defeat the low reactor pressure interlock circuitry that inhibits opening the LPCI or LPCS injection valves following sensor or logic failures that prevent all low pressure injection valves from opening | Procedure | | | | | $50,000 | Not cost-beneficial |
| **Case 17. RHR Heat Exchangers** | **Removed failure of service water cooling for the RHR heat exchangers.** | 4.3% | 10.3% | 10.3% | $149,829 | | |
| SAMA 79 - Implement modifications to allow manual alignment of the fire water system to RHR heat exchangers | Pilgrim | | | | | $1,960,000 | Not cost-beneficial |

**Table D.2-1 – Summary of Phase II SAMA Candidates**

| Analysis Case (bold) SAMA Number and Title | Assumptions/ Source of Cost Estimate | CDF Reduction (%) | PDR Reduction (%) | OECR Reduction (%) | Internal and External Benefit ($) | RBS Cost Estimate ($) | Conclusion |
|---|---|---|---|---|---|---|---|
| **Case 18 Service Water System Reliability** | **Eliminated failure of SSW Pumps** | 29.4% | 28.8% | 28.6% | $517,426 | | |
| SAMA 75 - Add redundant DC control power for SSW pumps | Plant-specific cost estimate | | | | | $2,188,000 | Not cost-beneficial |
| SAMA 80 - Add another SSW pump | Cooper | | | | | $5,900,000 | Not cost-beneficial |
| **Case 19. Main Feedwater System Reliability** | **Eliminated loss of feedwater initiator** | 2.2% | 3.6% | 3.3% | $53,951 | | |
| SAMA 87 - Install digital feedwater upgrade | Indian Point | | | | | $900,000 | Not cost-beneficial |
| **Case 20. Increased Availability of Room Cooling** | **Eliminated failure of cooling to LPCS, RHR and HPCS rooms.** | 13.3% | 13.8% | 13.6% | $242,279 | | |
| SAMA 93 - Provide a redundant train or means of ventilation | Cooper | | | | | $2,200,000 | Not cost-beneficial |
| **Case 21. Increase Availability of DG Systems through HVAC Improvements** | **Eliminated failure of room HVAC for all three EDG rooms.** | 2.5% | 3.2% | 2.9% | $51,216 | | |
| SAMA 100 - Diverse EDG HVAC logic | GGNS | | | | | $1,148,000 | Not cost-beneficial |

**Table D.2-1 – Summary of Phase II SAMA Candidates**

| Analysis Case (bold) SAMA Number and Title | Assumptions/ Source of Cost Estimate | CDF Reduction (%) | PDR Reduction (%) | OECR Reduction (%) | Internal and External Benefit ($) | RBS Cost Estimate ($) | Conclusion |
|---|---|---|---|---|---|---|---|
| SAMA 101 - Install additional fan and louver pair for EDG HVAC | Cooper | | | | | $6,000,000 | Not cost-beneficial |
| SAMA 102 - Operator procedure revisions to provide additional space cooling to the EDG room via the use of portable equipment | Procedure with engineering analysis | | | | | $150,000 | Not cost-beneficial |
| **Case 22a. Procedures for Loss of Room Cooling (HPCS)** | **Eliminated failure of cooling to HPCS room.** | 5.4% | 5.3% | 5.1% | $93,656 | | |
| SAMA 94a - Enhance procedures for actions on loss of HVAC (HPCS) | Procedure with engineering analysis | | | | | $100,000 | Not cost-beneficial |
| **Case 22b. Procedures for Loss of Room Cooling (RHR B/C)** | **Eliminated failure of cooling to RHR B and C rooms.** | 2.9% | 3.5% | 3.1% | $56,669 | | |
| SAMA 94b - Enhance procedures for actions on loss of HVAC (RHR B/C) | Procedure with engineering analysis | | | | | $150,000 | Not cost-beneficial |
| **Case 22c. Procedures for Loss of Room Cooling (LPCS, RHR A)** | **Eliminated failure of cooling to LPCS, RHR A rooms.** | 5.4% | 6.1% | 5.7% | $102,638 | | |
| SAMA 94c - Enhance procedures for actions on loss of HVAC (LPCS, RHR A) | Procedure with engineering analysis | | | | | $150,000 | Not cost-beneficial |
| **Case 23. Trip/Shutdown Risk** | **Reduced all initiating events except LOCAs and LOSP** | 2.5% | 3.5% | 3.2% | $55,053 | | |

**Table D.2-1 – Summary of Phase II SAMA Candidates**

| Analysis Case (bold) SAMA Number and Title | Assumptions/ Source of Cost Estimate | CDF Reduction (%) | PDR Reduction (%) | OECR Reduction (%) | Internal and External Benefit ($) | RBS Cost Estimate ($) | Conclusion |
|---|---|---|---|---|---|---|---|
| SAMA 197 - Generation Risk Assessment implementation into plant activities (trip/shutdown risk modeling) | Cooper | | | | | $500,000 | Not cost-beneficial |
| **Case 24. Improve Availability of SRVs and MSIVs** | **Eliminated failure of SRV air supply, SRV common cause events and MSIV events** | 0.0% | 0.5% | 0.1% | $3,668 | | |
| SAMA 108 - Improve SRV and MSIV pneumatic components | Cooper | | | | | $1,500,000 | Not cost-beneficial |
| **Case 25. Improve Suppression Pool Cooling** | **Eliminated failures of suppression pool cooling** | 56.6% | 64.2% | 64.3% | $1,106,266 | | |
| SAMA 110 - Install an independent method of suppression pool cooling | Cooper | | | | | $5,800,000 | Not cost-beneficial |
| **Case 26. Increase Availability of Containment Heat Removal** | **Eliminated failure of containment unit coolers** | 53.4% | 61.6% | 61.9% | $1,057,071 | | |
| SAMA 115 - Install a passive containment spray system | Cooper | | | | | $5,800,000 | Not cost-beneficial |
| SAMA 120 - Install an unfiltered hardened containment vent | LaSalle | | | | | $13,000,000 | Not cost-beneficial |

**Table D.2-1 – Summary of Phase II SAMA Candidates**

| Analysis Case (bold) SAMA Number and Title | Assumptions/ Source of Cost Estimate | CDF Reduction (%) | PDR Reduction (%) | OECR Reduction (%) | Internal and External Benefit ($) | RBS Cost Estimate ($) | Conclusion |
|---|---|---|---|---|---|---|---|
| **Case 27. Containment Filtered Vent for ATWS** | **Eliminated failure of containment unit coolers and reduced dose by factor of 5** | 53.4% | 92.3% | 61.9% | $1,234,717 | | |
| SAMA 162 - Install an ATWS sized filtered containment vent to remove decay heat | Fermi | | | | | $40,000,000 | Not cost-beneficial |
| **Case 28. CRD Improvements** | **Eliminated CRD failures** | 1.8% | 1.1% | 2.5% | $32,438 | | |
| SAMA 59 - Implement ability to cross-tie safety related power to CRD pumps for vessel injection during LOSP | GGNS | | | | | $656,000 | Not cost-beneficial |
| **Case 29. Increase Recovery Time of ECCS upon Loss of SSW** | **Eliminated failure of room cooling for LPCI and LPCS Rooms** | 7.9% | 9.1% | 8.7% | $153,449 | | |
| SAMA 97 - Perform study and analysis to add steps to trip unneeded ECCS pumps on loss of HVAC | Procedural change with engineering | | | | | **$100,000** | **Potentially cost-beneficial** |
| SAMA 198 - Develop a procedure for alternating operation of low pressure ECCS pumps for loss of SSW | Procedural change with engineering and training | | | | | $200,000 | Not cost-beneficial |
| **Case 30. Reduce Hydrogen Ignition** | **Eliminated failure of igniters** | 0.0% | 1.2% | 0.8% | $11,954 | | |

**Table D.2-1 – Summary of Phase II SAMA Candidates**

| Analysis Case (bold) SAMA Number and Title | Assumptions/ Source of Cost Estimate | CDF Reduction (%) | PDR Reduction (%) | OECR Reduction (%) | Internal and External Benefit ($) | RBS Cost Estimate ($) | Conclusion |
|---|---|---|---|---|---|---|---|
| SAMA 128 - Provide post-accident containment inerting system | GGNS | | | | | $2,665,000 | Not cost-beneficial |
| SAMA 138 - Install passive hydrogen system | Monticello | | | | | $760,000 | Not cost-beneficial |
| **Case 31. Improve RHR Heat Exchanger Availability** | **Eliminated the SSW cooling water flow to the RHR heat exchangers** | 4.3% | 4.4% | 4.0% | $75,823 | | |
| SAMA 201 - Add a bypass around the RHR Hx outlet valves | GGNS | | | | | $2,832,000 | Not cost-beneficial |
| **Case 32. Improve RCIC Lube Oil Cooling** | **Eliminated RCIC lube oil cooler failures** | 0.4% | 0.7% | 0.3% | $7,950 | | |
| SAMA 202 - Add a redundant RCIC lube oil cooling path | GGNS | | | | | $1,803,000 | Not cost-beneficial |
| **Case 33. MSIV Design to Decrease Containment Bypass Scenarios** | **Eliminated failure of MSIVs to close** | 0.0% | 0.4% | 0.0% | $2,054 | | |
| SAMA 147 - Improve MSIV design to decrease likelihood of containment bypass scenarios | Cooper | | | | | $1,000,000 | Not cost-beneficial |
| **Case 34. SLC System** | **Eliminated SLC failure** | 0.0% | 0.8% | 0.5% | $7,639 | | |

**Table D.2-1 – Summary of Phase II SAMA Candidates**

| **Analysis Case (bold) SAMA Number and Title** | **Assumptions/ Source of Cost Estimate** | **CDF Reduction (%)** | **PDR Reduction (%)** | **OECR Reduction (%)** | **Internal and External Benefit ($)** | **RBS Cost Estimate ($)** | **Conclusion** |
|---|---|---|---|---|---|---|---|
| SAMA 156 - Increase boron concentration in the SLC system | Cooper | | | | | $50,000 | Not cost-beneficial |
| SAMA 158 - Provide ability to use CRD or RWCU for alternate boron injection | Minimum hardware modification cost | | | | | $100,000 | Not cost-beneficial |
| **Case 35. SRV Reseat** | **Eliminated inadvertent open SRV initiator and basic events for stuck open SRVs** | 35.8% | 41.5% | 41.4% | $709,644 | | |
| SAMA 160 - Increase safety relief valve (SRV) reseat reliability | FitzPatrick | | | | | $3,200,000(1) | Not cost-beneficial |
| **Case 36. Add Fire Suppression System** | **Eliminate fire CDF from Division 1 Standby Switchgear Room** | n/a | n/a | n/a | $173,203 | | |
| SAMA 183 - Add automatic fire suppression [Specifically, addition of incipient detection and suppression Div 1 Swgr Room] | Fermi | | | | | $1,100,000 | Not cost-beneficial |
| **Case 37. Reduce Risk from Fires That Require Control Room Evacuation** | **Eliminated fire CDF from the main control room** | n/a | n/a | n/a | $181,451 | | |
| SAMA 185 - Upgrade the ASDS panel to include additional system controls for opposite division | Cooper | | | | | $790,000 | Not cost-beneficial |

**Table D.2-1 – Summary of Phase II SAMA Candidates**

| Analysis Case (bold) SAMA Number and Title | Assumptions/ Source of Cost Estimate | CDF Reduction (%) | PDR Reduction (%) | OECR Reduction (%) | Internal and External Benefit ($) | RBS Cost Estimate ($) | Conclusion |
|---|---|---|---|---|---|---|---|
| **Case 38. Large Break LOCA** | **Eliminated large and medium LOCA initiators** | 0.0% | 0.8% | 0.5% | $7,813 | | |
| SAMA 190 - Install digital large break LOCA protection system | Duane Arnold | | | | | $13,000,000 | Not cost-beneficial |

Note 1. The implementation cost for SAMA 160 is based on the FitzPatrick estimate of $2,200,000 (i.e., eleven SRVs at $200,000 each). Because RBS has sixteen SRVs, the cost estimate total is 16 X $200,000 = $3,200,000.

**Table D.2-2 – Sensitivity Analysis Results**

| Analysis Case (bold) SAMA Number and Title | Internal and External Benefit Original | Sensitivity 1 3% Discount Rate | Sensitivity 2 95th Percentile Uncertainty | RBS Cost Estimate ($) | Conclusion |
|---|---|---|---|---|---|
| **Case 1. DC Power** | $142,991 | $219,383 | $571,962 | | |
| SAMA 1 - Provide additional battery capacity | | | | $2,130,000 | Not cost-beneficial |
| SAMA 2 - Replace lead acid batteries with fuel cells | | | | $4,080,000 | Not cost-beneficial |
| **Case 2. Improve Charger Reliability** | $92,619 | $143,695 | $370,477 | | |
| SAMA 43 - Modify portable station generator to automatically align to 125 V DC battery chargers | | | | $400,000 | Not cost-beneficial |
| **Case 3. Increase Availability of On-Site AC Power** | $752,845 | $1,157,605 | $3,011,381 | | |
| SAMA 15 - Install a gas turbine generator with tornado protection | | | | $10,006,000 | Not cost-beneficial |
| **Case 4. Improve AC Power** | $456,840 | $703,368 | $1,827,362 | | |
| SAMA 34 - Provide alternate feeds to essential loads directly from an alternate emergency bus | | | | $2,324,000 | Not cost-beneficial |

| Table D.2-2 – Sensitivity Analysis Results | | | | | |
|---|---|---|---|---|---|
| **Analysis Case (bold) SAMA Number and Title** | **Internal and External Benefit Original** | **Sensitivity 1 3% Discount Rate** | **Sensitivity 2 95th Percentile Uncertainty** | **RBS Cost Estimate ($)** | **Conclusion** |
| **Case 5. Reduce Loss of Off-Site Power During Severe Weather** | $382,080 | $586,167 | $1,528,319 | | |
| SAMA 14 - Install an additional, buried off-site power source | | | | $2,500,000 | Not cost-beneficial |
| **Case 6. Provide Backup EDG Cooling** | $78,846 | $121,854 | $315,385 | | |
| SAMA 21 - Use fire water system as a backup source for diesel cooling | | | | $1,344,000 | Not cost-beneficial |
| SAMA 22 - Add a new backup source of diesel cooling | | | | $2,000,000 | Not cost-beneficial |
| **Case 7. Increase EDG Reliability** | $45,709 | $74,816 | $194,835 | | |
| SAMA 30 - Provide a portable EDG fuel transfer pump | | | | $1,477,000 | Not cost-beneficial |
| SAMA 204 - Add capability to cross-tie fuel oil supply to emergency diesel generators | | | | $200,000 | Not cost-beneficial |
| **Case 8. Improve DG reliability.** | $6,456 | $10,076 | $25,822 | | |
| SAMA 33 - Provide a diverse swing diesel generator air start compressor | | | | $100,000 | Not cost-beneficial |

**Table D.2-2 – Sensitivity Analysis Results**

| Analysis Case (bold) SAMA Number and Title | Internal and External Benefit Original | Sensitivity 1 3% Discount Rate | Sensitivity 2 95th Percentile Uncertainty | RBS Cost Estimate ($) | Conclusion |
|---|---|---|---|---|---|
| **Case 9. Reduce plant centered Loss of Off-site Power** | $946,041 | $1,449,141 | $3,784,164 | | |
| SAMA 38 - Protect service transformers from failure | | | | $9,998,000 | Not cost-beneficial |
| **Case 10 - Improve Service Cooling Water Fans** | $43,588 | $67,169 | $174,352 | | |
| SAMA 206 - Improve flow capacity of Service Water Cooling fans for summer conditions | | | | $200,000 | Not cost-beneficial |
| **Case 11. High Pressure Injection System** | $278,649 | $426,632 | $1,114,595 | | |
| SAMA 44 - Install an independent active or passive high pressure injection system | | | | $8,800,000 | Not cost-beneficial |
| **Case 12. Extend RCIC Operation** | $16,845 | $25,947 | $67,382 | | |
| SAMA 46 - Raise RCIC backpressure set points | | | | $100,000 | Not cost-beneficial |
| **Case 13. Improve ADS** | $3,242 | $5,060 | $12,968 | | |

**Table D.2-2 – Sensitivity Analysis Results**

| Analysis Case (bold) SAMA Number and Title | Internal and External Benefit Original | Sensitivity 1 3% Discount Rate | Sensitivity 2 95th Percentile Uncertainty | RBS Cost Estimate ($) | Conclusion |
|---|---|---|---|---|---|
| SAMA 51 - Modify automatic depressurization system components to improve reliability. [This SAMA will add larger accumulators thus increasing reliability during SBOs] | | | | $1.177,000 | Not cost-beneficial |
| **Case 14. Improve internal flooding procedures(1)** | **$218,621** | **$338,863** | **$874,484** | | |
| SAMA 169 - Improve internal flooding procedures | | | | **$200,000** | **Potentially cost-beneficial in base SAMA analysis** |
| **Case 15. Revise FLEX Procedures for non-ELAP conditions** | **$949,389** | **$1,459,193** | **$3,797,557** | | |
| SAMA 205 - Revise FLEX procedures to allow use of FLEX equipment in non-ELAP conditions | | | | **$200,000** | **Potentially cost-beneficial in base SAMA analysis** |
| **Case 16 ECCS Low Pressure Interlock** | $2,054 | $3,206 | $8,218 | | |
| SAMA 71 - Modify procedures to allow operators to defeat the low reactor pressure interlock circuitry that inhibits opening the LPCI or LPCS injection valves following sensor or logic failures that prevent all low pressure injection valves from opening | | | | $50,000 | Not cost-beneficial |
| **Case 17. RHR Heat Exchangers** | $149,829 | $231,779 | $599,316 | | |

**Table D.2-2 – Sensitivity Analysis Results**

| Analysis Case (bold) SAMA Number and Title | Internal and External Benefit Original | Sensitivity 1 3% Discount Rate | Sensitivity 2 95th Percentile Uncertainty | RBS Cost Estimate ($) | Conclusion |
|---|---|---|---|---|---|
| SAMA 79 - Implement modifications to allow manual alignment of the fire water system to RHR heat exchangers | | | | $1,960,000 | Not cost-beneficial |
| **Case 18. Service Water System Reliability** | $517,426 | $793,446 | $2,069,703 | | |
| SAMA 75 - Add redundant DC control power for SSW pumps | | | | $2,188,000 | Not cost-beneficial |
| SAMA 80 - Add another SSW pump | | | | $5,900,000 | Not cost-beneficial |
| **Case 19. Main Feedwater System Reliability** | $53,951 | $83,171 | $215,804 | | |
| SAMA 87 - Install digital feedwater upgrade | | | | $900,000 | Not cost-beneficial |
| **Case 20. Increased availability of room cooling.** | $242,279 | $371,763 | $969,116 | | |
| SAMA 93 - Provide a redundant train or means of ventilation | | | | $2,200,000 | Not cost-beneficial |
| **Case 21. Increase availability of DG Systems through HVAC Improvements** | $51,216 | $78,730 | **$204,865** | | |
| SAMA 100 - Diverse EDG HVAC logic | | | | $1,148,000 | Not cost-beneficial |

| Table D.2-2 – Sensitivity Analysis Results | | | | | |
|---|---|---|---|---|---|
| **Analysis Case (bold) SAMA Number and Title** | **Internal and External Benefit Original** | **Sensitivity 1 3% Discount Rate** | **Sensitivity 2 95th Percentile Uncertainty** | **RBS Cost Estimate ($)** | **Conclusion** |
| SAMA 101 - Install additional fan and louver pair for EDG HVAC | | | | $6,000,000 | Not cost-beneficial |
| SAMA 102 - Operator procedure revisions to provide additional space cooling to the EDG room via the use of portable equipment. | | | | **$150,000** | **Potentially cost-beneficial based on uncertainty** |
| **Case 22a. Procedures for Loss of Room Cooling (HPCS)** | $93,656 | **$143,590** | **$374,624** | | |
| SAMA 94a - Enhance procedures for actions on loss of HVAC (HPCS) | | | | **$100,000** | **Potentially cost-beneficial based on 3% discount and uncertainty** |
| **Case 22b. Procedures for Loss of Room Cooling (RHR B/C)** | $56,669 | $87,069 | **$226,678** | | |
| SAMA 94b - Enhance procedures for actions on loss of HVAC (RHR B/C). | | | | **$150,000** | **Potentially cost-beneficial based on uncertainty** |
| **Case 22c. Procedures for Loss of Room Cooling (LPCS, RHR A)** | $102,638 | **$157,609** | **$410,554** | | |
| SAMA 94c - Enhance procedures for actions on loss of HVAC (LPCS, RHR A) | | | | **$150,000** | **Potentially cost-beneficial based on 3% discount and uncertainty** |
| **Case 23. Trip/Shutdown risk** | $55,053 | $84,718 | $220,211 | | |

**Table D.2-2 – Sensitivity Analysis Results**

| Analysis Case (bold) SAMA Number and Title | Internal and External Benefit Original | Sensitivity 1 3% Discount Rate | Sensitivity 2 95th Percentile Uncertainty | RBS Cost Estimate ($) | Conclusion |
|---|---|---|---|---|---|
| SAMA 197 - Generation Risk Assessment implementation into plant activities (trip/shutdown risk modeling) | | | | $500,000 | Not cost-beneficial |
| **Case 24. Improve availability of SRVs and MSIVs** | $3,668 | $5,726 | $14,674 | | |
| SAMA 108 - Improve SRV and MSIV pneumatic components | | | | $1,500,000 | Not cost-beneficial |
| **Case 25. Improve availability of suppression pool cooling.** | $1,106,266 | $1,699,387 | $4,425,063 | | |
| SAMA 110 - Install an independent method of suppression pool cooling | | | | $5,800,000 | Not cost-beneficial |
| **Case 26. Increase availability of containment heat removal** | $1,057,071 | $1,624,157 | $4,228,286 | | |
| SAMA 115 - Install a passive containment spray system | | | | $5,800,000 | Not cost-beneficial |
| SAMA 120 - Install an unfiltered hardened containment vent | | | | $13,000,000 | Not cost-beneficial |
| **Case 27. Containment filtered vent for ATWS.** | $1,234,717 | $1,901,420 | $4,938,869 | | |
| SAMA 162 - Install an ATWS sized filtered containment vent to remove decay heat | | | | $40,000,000 | Not cost-beneficial |

**Table D.2-2 – Sensitivity Analysis Results**

| Analysis Case (bold) SAMA Number and Title | Internal and External Benefit Original | Sensitivity 1 3% Discount Rate | Sensitivity 2 95th Percentile Uncertainty | RBS Cost Estimate ($) | Conclusion |
|---|---|---|---|---|---|
| **Case 28. CRD Improvements** | $32,438 | $49,766 | $129,751 | | |
| SAMA 59 - Implement ability to cross-tie safety related power to CRD pumps for vessel injection during LOSP | | | | $656,000 | Not cost-beneficial |
| **Case 29. Increase recovery time of ECCS upon loss of SSW** | **$153,499** | **$235,705** | **$613,795** | | |
| SAMA 97 - Perform study and analysis to add steps to trip unneeded ECCS pumps on loss of HVAC | | | | **$100,000** | **Potentially cost-beneficial in base SAMA analysis** |
| SAMA 198 - Develop a Procedure for Alternating Operation of Low Pressure ECCS Pumps for Loss of SSW | | | | **$200,000** | **Potentially cost-beneficial based on 3% discount and uncertainty** |
| **Case 30. Reduce hydrogen ignition.** | $11,954 | $18,657 | $47,816 | | |
| SAMA 128 - Provide post-accident containment inerting system | | | | $2,665,000 | Not cost-beneficial |
| SAMA 138 - Install passive hydrogen system | | | | $760,000 | Not cost-beneficial |
| **Case 31. Improve RHR heat exchanger availability** | $75,823 | $116,274 | $303,293 | | |
| SAMA 201 - Add a bypass around the RHR Hx outlet valves | | | | $2,832,000 | Not cost-beneficial |

**Table D.2-2 – Sensitivity Analysis Results**

| Analysis Case (bold) SAMA Number and Title | Internal and External Benefit Original | Sensitivity 1 3% Discount Rate | Sensitivity 2 95th Percentile Uncertainty | RBS Cost Estimate ($) | Conclusion |
|---|---|---|---|---|---|
| **Case 32. Improve RCIC Lube Oil Cooling** | $7,950 | $12,236 | $31,800 | | |
| SAMA 202 - Add a redundant RCIC lube oil cooling path | | | | $1,803,000 | Not cost-beneficial |
| **Case 33. MSIV Design to Decrease Containment Bypass Scenarios** | $2,054 | $3,206 | $8,218 | | |
| SAMA 147 - Improve MSIV design to decrease likelihood of containment bypass scenarios | | | | $1,000,000 | Not cost-beneficial |
| **Case 34. SLC System** | $7,639 | $11,922 | $30,555 | | |
| SAMA 156 - Increase boron concentration in the SLC system | | | | $50,000 | Not cost-beneficial |
| SAMA 158 - Provide ability to use CRD or RWCU for alternate boron injection | | | | $100,000 | Not cost-beneficial |
| **Case 35. SRV Reseat** | $709,644 | $1,090,351 | $2,838,577 | | |
| SAMA 160 - Increase safety relief valve (SRV) reseat reliability | | | | $3,200,000[2] | Not cost-beneficial |
| **Case 36 - Add fire suppression system[1]** | $173,203 | $268,465 | $692,812 | | |

**Table D.2-2 – Sensitivity Analysis Results**

| Analysis Case (bold) SAMA Number and Title | Internal and External Benefit Original | Sensitivity 1 3% Discount Rate | Sensitivity 2 95th Percentile Uncertainty | RBS Cost Estimate ($) | Conclusion |
|---|---|---|---|---|---|
| SAMA 183 - Add automatic fire suppression [Specifically addition of incipient detection and suppression Div 1 Swgr Room] | | | | $1,100,000 | Not cost-beneficial |
| **Case 37. Reduce risk from fires that require control room evacuation** (1) | $181,451 | $281,249 | $725,804 | | |
| SAMA 185 - Upgrade the ASDS panel to include additional system controls for opposite division | | | | $790,000 | Not cost-beneficial |
| **Case 38. Large Break LOCA** | $7,813 | $12,195 | $31,253 | | |
| SAMA 190 - Install digital large break LOCA protection system | | | | $13,000,000 | Not cost-beneficial |

Note 1. The 3% Discount Rate sensitivity value was calculated by multiplying the Internal and External Benefit by a factor of 1.55 which is consistent with the ratios of 3% Discount value to the Internal and External benefit value for the other SAMAs.

Note 2. The implementation cost for SAMA 160 is based on the FitzPatrick estimate of $2,200,000 (i.e., eleven SRVs at $200,000 each). Because RBS has sixteen SRVs, the cost estimate total is 16 X $200,000 = $3,200,000.