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, nine are not applicable to WF3 because they apply to design or operational features that do not exist at the facility. Table 4.0-1 lists these nine issues and provides a brief explanation of why they are not applicable to the site. Table 4.0-2 lists the 51 issues applicable to the site. Entergy reviewed the NRC findings on these 51 issues and identified no new and significant information that would invalidate the findings for the site (Chapter 5). Therefore, Entergy adopts by reference the NRC findings for these Category 1 issues.

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, six are not applicable to WF3 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 11 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 WF3 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 (Endangered Species Act [ESA]): (1) would have no effect on federally listed species, (2) are not likely to adversely affect federally listed species, (3) are likely to adversely affect federally listed species, or (4) are likely to jeopardize a federally listed species 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 (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 NRC 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 NRC 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 WF3

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 completely within the Entergy Louisiana, LLC owned property.
Surface Water Resources	
Altered salinity gradients	WF3 does not discharge to an estuary.
Altered thermal stratification of lakes	WF3 is not located on a lake.
Groundwater Resources	
Groundwater use conflicts (plants that withdraw less than 100 gallons per minute)	WF3 does not withdraw groundwater from the site; potable water is provided by St. Charles Parish Water System, and once-through cooling water is supplied by the Mississippi River.
Groundwater quality degradation resulting from water withdrawals	WF3 does not withdraw groundwater from the site; potable water is provided by St. Charles Parish Water System, and once-through cooling water is supplied by the Mississippi River.
Groundwater quality degradation (plants with cooling ponds in salt marshes)	WF3 is located on a freshwater body and does not utilize cooling ponds.
Aquatic Resources	
Impingement and entrainment of aquatic organisms (plants with cooling towers)	WF3 is a once-through cooling plant and does not utilize cooling towers for condenser cooling purposes.
Thermal impacts on aquatic organisms (plants with cooling towers)	WF3 is a once-through cooling plant and does not utilize cooling towers for condenser cooling purposes.
Terrestrial Resources	
Cooling tower impacts on vegetation (plants with cooling towers)	WF3 is a once-through cooling plant and does not utilize cooling towers for condenser cooling purposes.

Table 4.0-2
Category 1 Issues Applicable to WF3

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
	Surface water use conflicts (plants with once-through cooling systems)
	Effects of dredging on surface water quality
	Temperature effects on sediment transport capacity
Groundwater Resources	Groundwater contamination and use (non-cooling system impacts)
Aquatic Resources	Entrainment of phytoplankton and zooplankton (all plants)
	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 sublethal stresses

Table 4.0-2 (Continued)
Category 1 Issues Applicable to WF3

Resource Issue	Subcategories
Terrestrial Resources	Exposure of terrestrial organisms to radionuclides
	Cooling system impacts on terrestrial resources (plants with once-through cooling systems or cooling ponds)
	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 spend 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

Table 4.0-2 (Continued)
Category 1 Issues Applicable to WF3

Resource Issue	Subcategories
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 Applicable to WF3

Resource Issue	Applicability	ER Section
Surface Water Resources		
Surface water use conflicts (plants with cooling ponds or cooling towers using makeup water from a river)	Not 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)	Not 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)	Applicable	4.6.1.1
Thermal impacts on aquatic organisms (plants with once-through cooling systems or cooling ponds)	Applicable	4.6.1.2
Water use conflicts with aquatic resources (plants with cooling ponds or cooling towers using makeup water from a river)	Not 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)	Not applicable	4.6.2.2
Special Status Species and Habitats		
Threatened, endangered, and protected species and essential fish habitat	Applicable	4.6.3
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

Table 4.0-3 (Continued)
Category 2 Issues Applicable to WF3

Resource Issue	Applicability	ER Section
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 Offsite Land Use in Transmission Line Right-of-Ways

4.1.3.1 Findings from 10 CFR Part 51, Subpart A, Appendix B, Table B-1

SMALL. Use of transmission line ROWs from continued operations and refurbishment associated with license renewal would continue with no change in land use restrictions.

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

As discussed in Section 2.2.5.1, in-scope transmission lines are located completely within the Entergy Louisiana, LLC owned property. Therefore, this issue is not applicable, and further analysis is not required.

4.1.4 Aesthetic Impacts

4.1.4.1 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.

4.1.4.2 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.

4.1.4.3 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, the WF3 plant is situated in a heavy industrial and commercial development area. Visual impacts from the site are limited to adjacent properties and traffic, associated with the Mississippi River, LA-18, LA-3127, and LA-628. No refurbishment or construction activities have been identified that would change the aesthetics of the WF3 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, St. Charles 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 WF3 air permit contains conditions established by the LDEQ to protect Louisiana's ambient air quality standards and ensure impacts are maintained at acceptable levels. These same conditions would regulate any future WF3 activities that may increase air pollutants or threaten the attainment status of St. Charles 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, WF3's in-scope transmission lines are 230 kV. Therefore, the production of ozone and oxides of nitrogen would be *de minimis*.

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 associated with plant operations is 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, noise associated with WF3 operational activities is within the EPA's 55-dBA threshold level to protect against excess noise during outdoor activities. Based on the previous 5 years (2010–2014), there have been no noise complaints associated with WF3's plant operations.

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 3.4.3.2 and 3.5.1.1.2, WF3 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 BMPs that will be 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 2.2.2 of this ER, WF3 utilizes a once-through cooling system and does not utilize cooling ponds or cooling towers for condenser cooling purposes. Therefore, this issue is not applicable and further analysis is not required.

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, WF3 does not have any onsite wells that are utilized for plant operations. The Mississippi River is the source of makeup cooling water, and potable water is supplied by the St. Charles Parish Water System as discussed in Section 2.2.2.6. Therefore, 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 2.2.2 of this ER, WF3 utilizes a once-through cooling system and does not utilize a closed-cycle cooling system for condenser cooling purposes. Therefore, this issue is not applicable and further analysis is not required.

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, WF3 utilizes a once-through cooling system 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 WF3 groundwater protection program is discussed in Section 3.5.2.4. Table 3.5-2 presents well construction details for the WF3 groundwater monitoring wells, while Figure 3.5-6 shows the location of the wells. Table 3.5-5 presents information on registered water wells within a 2-mile band around the Entergy Louisiana, LLC property boundary, while Figure 3.5-7 shows the location of these registered wells.

As discussed in Section 3.5.4.2.1, an inadvertent liquid radioactive release of approximately 800 gallons occurred due to the overfilling of the spent fuel pool which eventually reached the environment, flowing onto the asphalt and into the storm drain system. The spill contained a variety of radioisotopes released at a total count of 3.59E-02 curies (including tritium). Remediation efforts included removal of 5,000 cubic yards of affected pavement and soil outside the fuel handling building train bay door, flushing of the storm drains, and remediation of the drainage ditch. The concentration of the tritium in the release was approximately 22,000 picocuries per liter. As of June 2015, no tritium residual activity from this release remains.

As discussed in Section 3.5.2.3, water levels in shallow aquifers downstream of the Baton Rouge area closely follow the stage of the Mississippi River. Water from the Mississippi River seeps into shallow aquifers during periods of high river stage and from these aquifers into the river during periods of low river stage. Historically, shallow groundwater flow at WF3 has been described as flowing generally south-southwest away from the Mississippi River, except during low river stages when a transient groundwater divide is created. Water-level data collected as part of the NEI GPI program indicate two general groundwater flow scenarios. In the first scenario, the elevation of the Mississippi River is higher than onsite groundwater potentiometric elevations, and hydraulic gradients direct flow across the site away from the river (Figure 3.5-4). In the second scenario, the highest water-level elevations form a groundwater mound typically

coincident with northern portions of the plant foundation excavation. This groundwater mound creates a divide where hydraulic gradients direct a portion of groundwater flow away from the mound toward the Mississippi River (Figure 3.5-5).

WF3's groundwater monitoring program encompasses the existing quality of groundwater potentially affected by continued operations (as compared to the EPA primary drinking water standards) as well as the current and potential onsite and offsite uses and users of groundwater for drinking and other purposes. Currently, no groundwater beneath WF3 is radioactively contaminated. Since the groundwater monitoring program was initiated in 2007, no tritium or plant-related gamma isotopes or hard-to-detect radionuclides have been detected. Therefore, Entergy concludes that impacts from radionuclides to groundwater are SMALL and do not warrant additional mitigation measures beyond Entergy's existing groundwater monitoring program.

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

The following discussion is taken from Section 3.6.6 unless otherwise referenced.

The WF3 CWIS is located offshore in the main channel of the Mississippi River. As would be typical, the river's main channel harbors much lower densities of fish than the river's edges and backwaters. Data suggest that population densities in the main channel are less than 5 percent of what is observed in channel borders. The relatively low densities are driven by the high velocities and reduced preferred habitat, as well as significant suspended sediment load.

The high turbidities also 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 also 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. Low densities of zooplankton were also identified in the Mississippi River near the site (River Mile 129.6) during preoperational studies, and many likely originated from areas of slower current upstream of the sampling area.

Previous studies conducted at nearby Entergy facilities demonstrate that impingement rates are low at facilities on the LMR, the species impinged are common, and that impingement varies seasonally with fish abundance. Most species cannot tolerate the harsh conditions of the Mississippi River main channel due to the high velocities, increased debris, a constantly shifting river bed, lack of habitat/vegetation, and a reduction in productivity/food source.

Of the fish species that occur in the WF3 area, most species spawn in shallow areas, sheltered areas, smaller streams, backwaters, areas of aquatic vegetation, or over gravel and sand bottoms. The only abundant commercial or sport species that might spawn over the clay or mud substrate in the waters found in the vicinity of the WF3 area are threadfin shad and gizzard shad. These were the most abundant groups of ichthyoplankton captured during the preoperational monitoring program.

However during the 2006–2007 impingement study conducted at Waterford 1 and 2 (River Mile 129.9) located on the right descending bank of the Mississippi River, the only species composing greater than 1 percent of all organisms impinged included river shrimp, threadfin shad, channel catfish, freshwater drum, blue catfish, bay anchovy, and grass shrimp. The historic impingement studies performed during the period 1976–1977 indicated a similar balance of species with a few noticeable differences. In the historic study, gizzard shad and skipjack herring each accounted for greater than 1 percent of the total impingement sample. Additionally, grass shrimp did not account for more than 1 percent of the sample.

As previously discussed in Section 3.6.6.2, the number of organisms estimated to be impinged annually at WF3 was 3,472,951 as compared to that impinged annually at Waterford 1 and 2 (1,379,533). However, when comparing the proportion of fish impinged at WF3 to the number of fish in the river at the same time, this value is proportional to the amount of water actually being used by the plant relative to the amount of water flowing by the plant. Therefore in terms of actual numbers, WF3 impinges 3,472,951 fish annually compared to the estimated 723,531,458 total number of fish in the river at the same time as the water that is used by WF3. Thus, the total number of fish in the river is approximately 208 times greater than the number of fish impinged at WF3.

Because the Mississippi River at WF3 lacks riffle areas, shallow backwaters and flood areas, and vegetated areas, it does not provide habitat suitable for spawning by many fish species. Although to the extent that sheltered locations are available (including cans, snags, etc.), a limited number of species may spawn near WF3. However, the spawning habitat appears not to be optimal even for these species as ichthyoplankton densities in this area are significantly less than 1 organism/m^3.

During the preoperational monitoring, densities of fish larvae were low in the WF3 area throughout the 1974–1976 sampling period. In addition, there were no important differences in the spatial distribution of the ichthyoplankton in the river in the WF3 vicinity. The spawning period of most native fishes in the LMR typically correlates to the seasonal flooding/high-water period. At WF3, seasonal average flows have been calculated to be 580,000; 650,000; 280,000; and 240,000 cfs for winter, spring, summer, and fall, respectively. Elevated flows increase the flood zone of the river and are most likely responsible for pushing the eggs and larval fish past the CWIS during this time.

The WF3 facility has been issued a number of previous NPDES and/or LPDES permits and has been withdrawing once-through, non-contact cooling water without any identified problems. Based on the information evaluated, there have been no past or current impacts identified associated with the withdrawal of the applicable cooling water. (Attachment A) In the 1991 WF3 NPDES permit issued by the EPA, the agency approved the WF3 intake structure as being BTA in accordance with Section 316(b) of the Clean Water Act. In 2010, LDEQ re-confirmed that the WF3 CWIS was also BTA, based on best professional judgment (Attachment A).

Because of the general lack of appropriate spawning habitat in the vicinity of WF3, the relatively small portion of the river flow utilized by WF3, and the large volume and turbulence of the LMR, it is doubtful that significant larval fish populations exist in this portion of the river.

Due to the dynamics of the Mississippi River at WF3 and the generally low populations of larval fish, Entergy concludes that impacts from impingement and entrainment of aquatic organisms during the license renewal term would be SMALL. Although additional mitigation measures may be implemented in the future as a result of the requirements in the final 316(b) Rule (79 FR 48300), these measures would minimize the already existing SMALL impacts.

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

The potential for impacts related to thermal discharges from WF3 have been investigated since 1979. Information presented in this section is based on information discussed in Section 3.6.6.2.3. WF3 does not possess a current 316(a) variance.

A study in 1979 determined that the balanced indigenous population of the Mississippi River would not be disrupted by the thermal discharge of WF3, and was substantiated by the following ecosystem characteristics: low productivity, sparse populations, absence of endangered species critical habitat, the unsuitability and non-uniqueness for fish spawning, and the presence of commercially important species. The combination of these ecological characteristics with the small volume of river to be thermally affected and the lack of potential for significant effects from cold shock demonstrates the low potential for adverse impact from the operation of WF3.

The 1979 study also determined that the benthic community near WF3 was relatively sparse. The river cross-sectional configuration at WF3 places a very small percentage of this community's habitat within the area affected by the thermal discharges. It was estimated that a total of 1 acre of benthic habitat would have contact with water heated greater than 3.6°F above ambient conditions.

Although the 1979 study stated that the thermal characteristics of the Mississippi River ecosystem could be affected by the combined thermal discharges from Waterford 1 and 2, WF3, and Little Gypsy, the plume configuration and detailed supporting data indicate that, with all generating stations operating during typical low flow and average seasonal flow conditions, a zone of passage conservatively estimated to exceed 90 percent of the river area will exist in all seasons. Therefore, because of the relatively small portion of the river profile that is affected by the thermal plumes in the Mississippi River at the WF3 plant, there remains a large portion of the river available for passage by aquatic organisms.

In 1998, WF3 requested that the temperature and heat discharge limits, which the facility was operating under (110°F and 8.5 x 10^9 Btu/hour), be increased to 118°F and 9.5 x 10^9 Btu/hour, respectively. The basis of the request for an increase in temperature and heat discharge limits was due to a planned "power uprate" to be implemented at WF3.

Based on LDEQ's evaluation, it was determined that the criteria specified in LAC 33:IX.1113.C.4.b.i.(a), the 5°F allowable rise of temperature above ambient at the edge of the mixing zone, would not occur with a discharge limitation for temperature at 118°F. In addition, it

was determined that approximately 81 percent of the river flow would be unaffected by the temperature increase after the WF3 power uprate, even under extreme low-flow conditions.

In LDEQ's evaluation, the combined thermal discharges from Waterford 1 and 2, WF3, and Little Gypsy were considered with respect to the cooling tower operations of a downstream facility, Union Carbide. LAC 33:IX.1115.C.7 specifies the mixing zone for streams with 7Q10 flow greater than 100 cfs as either 100 cfs or one-third of the flow, whichever is greater. Based on LDEQ's evaluation, it was determined that the increased heat discharge and temperature limits would continue to meet Louisiana Water Quality Criteria for temperature.

In conclusion, while there is a small thermal plume associated with the WF3 discharge, it represents a *de minimis* portion of the cross-sectional and vertical area of the Mississippi River. Because of the location of the discharge, it does not block the movement of fish, either upstream or downstream at the WF3 plant. In addition, no thermal exceedances have occurred since the increase in temperature and heat limit was granted by the LDEQ. Because there are no planned operational changes during the license renewal term that would increase the temperature of WF3's existing thermal discharge, impacts are anticipated to be SMALL, and further mitigation measures beyond the conditions outlined in LPDES permit LA0007374 are not warranted.

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 2.2.2 of this ER, WF3 utilizes a once-through cooling system and does not utilize cooling towers for condenser cooling purposes. Therefore, this issue is not applicable and further analysis is not required.

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 are anticipated to occur within previously disturbed 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 WF3 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 WF3 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 2.2.2 of this ER, WF3 utilizes a once-through cooling system and does not utilize cooling ponds or cooling towers for condenser cooling purposes. Therefore, this issue is not applicable, and further analysis is not required.

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 essential fish habitat 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 essential fish habitat 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, or EFH, and no further analysis is required.

4.6.3.1.3.2 Operational Activities

As discussed in Section 3.6.11.1, there are five federally listed species which are either threatened, endangered, or candidate species within St. Charles and St. John the Baptist parishes. A threatened and endangered species habitat survey was conducted on the Entergy Louisiana, LLC property located in St. Charles Parish in October 2014 (Entergy 2014e). This survey determined that no suitable habitat exists on or adjacent to the Entergy Louisiana, LLC property for the four species listed in St. Charles Parish. For the species listed in St. John the Baptist Parish (Alabama heelsplitter), it would not be anticipated to be present in the Mississippi River because it does not provide suitable habitat.

In addition, as discussed in Section 3.6.11.2, the LDWF has designated eight plants and six animals as species of special concern within St. Charles and St. John the Baptist parishes. For species listed in St. Charles Parish, suitable habitat does not exist on or adjacent to the Entergy Louisiana, LLC property for several of these species and, where suitable habitat is present, none of the species were observed during the October 2014 threatened and endangered species habitat survey. For the species listed in St. John the Baptist Parish (rooted spike-rush, alligator snapping turtle, and osprey), there are no offsite activities associated with license renewal which would affect these species.

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 which would affect threatened, endangered, and protected species.

As discussed in Section 9.6, Entergy has administrative controls in place at WF3 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, LDWF, and NMFS were also consulted. Based on this independent review, it was determined that there would be no effect on federally

and state-listed threatened, endangered, and protected species as a result of renewing the WF3 OL, nor was there any designated critical habitat. In addition, NMFS concluded there was no designated EFH in the vicinity of WF3. Copies of the consultation letters to the USFWS, LDWF, and NMFS 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 to any federally or state-listed species. Therefore, Entergy concludes that license renewal would have no effect on threatened, endangered, and protected species in the vicinity of WF3, 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 to historic and cultural resources, and no further analysis is required.

4.7.3.2 Operational Activities

As discussed in Section 3.1.1, the majority of the Entergy Louisiana, LLC property consists of wetlands (63 percent) and cultivated crops (23 percent). As discussed in Section 3.7.4, there have been five previous cultural resource surveys conducted either on the Entergy Louisiana, LLC property or within the vicinity. In addition, a Phase 1A sensitivity assessment was conducted in 2014 in support of license renewal (Section 3.7.4.1). The single cultural resource recorded on the Entergy Louisiana, LLC property was the Waterford Plantation (16SC41), which has been determined partially eligible/unknown for NRHP listing. There are no additional NRHP-eligible

cultural resources on the 3,560-acre Entergy Louisiana, LLC property, although there are several areas containing *in situ* archaeologic remains and identified zones of archaeological sensitivity.

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 consist of a fleet cultural resources protection plan, and a site-specific cultural resource protection plan to protect those areas on the property determined to be eligible for the NRHP, specifically the Waterford Plantation. Therefore, no adverse effects are anticipated to these sites during the WF3 license renewal term.

The area within a 6-mile radius of the site, consisting of land primarily within St. Charles and St. John the Baptist parishes, may be archaeologically sensitive (Table 3.7-1). However, adverse impacts would only occur to such sites 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 to these archaeological sites would occur.

There are also seven NRHP-listed aboveground historic properties, including the Kenner and Kugler Cemeteries Archaeological District, within a 6-mile radius of the site (Table 3.7-2). An additional unnamed archaeological site (16SC80) has an eligible status, but is yet unlisted (Table 3.7-1). Because the aboveground historic properties are located at distances ranging from 2.0 to 6.0 miles away from WF3, and WF3 is located in a heavy industrial area, aesthetic and noise impacts to these resources as a result of the continued operations of WF3 are not expected. Therefore, no adverse effects to 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 WF3, 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 Louisiana SHPO concurred that the renewal of the WF3 OL will have no effect on historic properties (Attachment C). Therefore, Entergy concludes that there will be no adverse effects as a result of continued operation of WF3 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 previously discussed in Section 3.1.3, the site is situated in a heavily industrialized and commercially developed area. As a result, the site does not visually impact areas that have a high degree of visitor use or recreational areas locally. 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 WF3 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 previously discussed in Section 2.2.2.2, WF3 is authorized under LPDES Permit No. LA0007374 to discharge once-through cooling 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 WF3's thermal discharges. As described in Section 3.9.2, the probability of a *Naegleria* infection in the Mississippi River in the vicinity of WF3 is low for the following reasons: (1) the design of the discharge structure promotes rapid mixing of thermal discharges with the Mississippi River, thereby limiting the area of conditions necessary for optimal growth of these thermophilic organisms; (2) the average heated discharge flow is small compared to the volume of river water flowing by the plant (approximately 500,000 cfs), thereby creating limited opportunity for rapid growth and population increases of thermophilic microorganisms; and (3) the Louisiana Department of Health and Hospitals has stated (as of June 2014) that from 2004 to 2013 there has never been a case of *Naegleria* infection attributable to the Mississippi River.

Section 3.9.2 further concludes that infection by thermophilic microorganisms in the vicinity of the WF3 discharge area has a low probability of occurring because public access is restricted, thus eliminating the nasal exposure pathway.

Therefore, Entergy concludes that the risk to public health from human exposure to thermophilic organisms resulting from the operation of WF3 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 Electrical 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 fields. The current is called "induced" because there is no direct connection between the line and 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 can receive 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 as well as its height and geometry.
- Size of the object on the ground.
- Extent to which the object is grounded.

In 1977, the NESC adopted a provision that describes 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 previously discussed in Section 2.2.5.4, it was determined that the transmission lines meet the applicable shock prevention provisions of the NESC, based on Entergy's analysis performed in conjunction with the proposed increase in the licensed power level. This analysis showed that

the calculated induced short circuit current was approximately 3.9 mA, which is within the NESC 5-mA standard. Because there has been no change in operating voltage associated with these transmission lines, Entergy's analysis remains valid.

In addition, as discussed in Section 2.2.5.1, all in-scope transmission lines are located completely within the Entergy Louisiana, LLC owned 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 electrical 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 WF3's existing in-scope transmission lines currently meet the NESC's 5-mA standard, and occupational safety and health measures are in place to address 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 WF3 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 WF3. 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 WF3 license renewal term.

Section 3.10.2 identifies the locations of minority and low-income populations as defined by NRR Office Instruction LIC-203 (NRC 2013d). Section 3.10.1.2 describes the search for subsistence-like populations near WF3, 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 WF3. 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 WF3 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 from the renewal of the WF3 OL.

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 WF3 would be Class A waste and can be shipped to licensed processors, such as the EnergySolutions facility in Oak Ridge, 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 WF3. As indicated in Section 2.2.3.4, Classes B and C wastes can 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.

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 for all nuclear plants, 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 (NRC 2014a). Based on Entergy's review, no new and significant information was identified as it relates to onsite storage of spent nuclear fuel, and 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. In the final Continued Storage of Nuclear Spent Rule 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 new and significant information was identified as it relates to offsite radiological impacts of spent nuclear fuel and high-level waste disposal, and 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, although LLMW would be managed and transported to an offsite facility licensed to accept and manage the wastes in accordance with appropriate site and company procedures, there is currently no mixed waste being generated or stored at WF3.

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 WF3 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 considered to be those that are reasonably foreseeable through the end of plant operation, which would include the 20-year license renewal term. The geographic area over which past, present, and future actions would occur is dependent on the type of action considered and is described below for each impact area.

The impacts of the proposed action are combined with other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. These combined impacts are defined as "cumulative" in 40 CFR 1508.7 and include individually minor, but collectively significant, actions taking place over a period of time. It is possible that an impact that may be SMALL by itself could result in a MODERATE or LARGE impact when considered in combination with the impacts of other actions on the affected resource. Likewise, if a resource is regionally declining or imperiled, even a SMALL individual impact could be important if it contributes to or accelerates the overall resource decline.

4.12.3.1 Air Quality and Noise

As described in Section 4.2 and Section 4.3, the incremental impacts on air quality and noise levels from the proposed renewal of the WF3 OL would be SMALL. 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. WF3 is located in St. Charles 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.

4.12.3.1.1 Air Quality

Section 3.2.4 presents a summary of the air quality designation status for parishes surrounding WF3. As noted in Section 3.2.4, the EPA regulates six criteria pollutants under the NAAQS including CO, Pb, NO_2, particulate matter ($PM_{2.5}$ and PM_{10}), ozone, and SO_2. St. Charles Parish is designated as unclassified or in attainment with respect to all criteria pollutants.

Criteria pollutant air emissions associated with WF3's plant operation are presented in Table 3.2-3. These emissions are from permitted sources such as emergency diesel generators, diesel fire pumps, portable auxiliary boiler, portable diesel/gasoline engines, and gasoline/diesel/lube oil storage tanks. As previously 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 St. Charles Parish would be the result of changes to present-day emissions, as well as future projects and actions within the parish.

Section 3.0.5 discusses present and reasonably foreseeable projects that could contribute to cumulative impacts to air quality. For example, the planned USACE levee project and urea manufacturing facility would be sources of future criteria air pollutants. Continued air emissions from existing projects and foreseeable projects discussed in Section 3.0.5, as well as proposed new source activities, would contribute to air emissions in St. Charles Parish. Development and construction activities associated with regional growth of housing, business, and industry, as well as associated vehicular traffic, will also result in additional air emissions. Project timing and location, which are difficult to predict, affect cumulative impacts to air quality. However, permitting and licensing requirements, efficiencies in equipment, cleaner fuels, and various mitigation measures can be used to minimize cumulative air quality impacts.

Climate change can affect air quality as a result of changes in meteorological conditions. Air pollutant concentrations are sensitive to winds, 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 region, 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 2015c, Section 4.16.1.1) Because WF3's fuel source for generating electricity does not produce GHG emissions, WF3's contribution to climate change in the region from other past, present, and future industrial and transportation sources would be SMALL.

4.12.3.1.2 Noise

Section 3.3 presents a summary of noise sources at WF3. The loudest noise generated at WF3 is the turbine generator. 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 are not audible at the property boundary and are intermittent and considered a minor nuisance (NRC 2015c, Section 4.16.1.2). As a major industrial facility, WF3 noise emissions can reach 65–75 dBA levels on site, which attenuates with distance (NRC 2015c, Section 4.16.1.2). Within the last 5 years, WF3 has not received any noise-related complaints from operation as discussed in Section 3.3. As discussed in Section 3.0.3, the residences nearest to WF3 are approximately 0.9 miles away, and as discussed in Section 3.0.4, the parks nearest to WF3 are located 1 mile away. Beyond any local ordinances, there are no federal regulations for public exposures to noise. As there are no planned license-renewal-related refurbishment activities, cumulative impacts to noise levels would be the result of continued operation sources from WF3 and around the site, as well as future projects and actions in the vicinity of WF3.

Section 3.0.5 provides a list of present and reasonably foreseeable projects that could contribute to cumulative noise impacts. Development and construction activities associated with regional growth of housing, business, and industry, as well as associated vehicular traffic, will result in additional noise generation. Construction equipment, for instance, can result in noise levels in the range of 85–95 dBA; however, noise levels attenuate rapidly with distance such that at half a mile distance from construction equipment, noise levels can drop to 51–61 dBA (NRC 2015c, Section 4.16.1.2). Therefore, contributions to noise levels from future actions are limited by projects in the vicinity of WF3. While the timing of these future activities is difficult to predict, noise emissions are expected to occur for short periods of time. Additionally, the residents or park visitors currently near WF3 are not anticipated to be affected because noise sources from WF3 are not audible at the property boundary.

Conclusions

Given that there is no planned site refurbishment associated with the WF3 license renewal and, therefore, no expected changes in air emissions or noise levels, cumulative air quality and noise impacts would be the result of changes to present-day and reasonably foreseeable projects and actions. As noted above, the timing and location of new projects, which are difficult to predict, affect cumulative impact on air quality and noise levels. However, various strategies and techniques are available to limit air quality impacts. Also, noise abatement and controls can be incorporated to reduce noise impacts. Therefore, Entergy concludes that the cumulative impacts from past, present, and reasonably foreseeable future actions on air quality and noise levels during the WF3 license renewal term would be SMALL.

4.12.3.2 Geology and Soils

This section addresses the direct and indirect effects of license renewal on geology and soils when added to the aggregate effects of other past, present, and reasonably foreseeable future actions. As noted in Section 2.3, Entergy has no plans to conduct license-renewal-related

refurbishment or replacement activities. Ongoing operation and maintenance activities associated with WF3 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. Considering ongoing activities and reasonably foreseeable actions, Entergy concludes that the cumulative impacts on geology and soils during the WF3 license renewal term would be SMALL.

4.12.3.3 Water Resources

4.12.3.3.1 Surface Water

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, WF3 withdraws cooling water from the Mississippi River through a series of intake pipes at a design flow rate of 1,555.2 MGD. The average flow in the Mississippi River in the vicinity of the WF3 plant (River Mile 129.6) is estimated to be approximately 500,000 cfs. Based on this information, it is determined that WF3 withdraws a maximum of approximately 0.48 percent of the flow in the Mississippi River.

During the license renewal term, WF3 is expected to consume water from the Mississippi River at current rates. Because WF3 utilizes a once-through cooling system, the majority of the water withdrawn is returned back to the Mississippi River. As discussed in Section 3.5.1, the Mississippi River is the largest river in the United States, having an average discharge of 593,000 cfs; therefore, the contribution of cumulative impacts to surface water use as a result of WF3 operations during the license renewal term is anticipated to be SMALL.

A summary of surface water use in St. Charles, Jefferson, and St. John the Baptist parishes along the Mississippi River is presented in Table 3.5-3. In 2013, power generation accounted for approximately 81 percent of all withdrawals from the Mississippi River in these three parishes. As discussed above, the majority of the water withdrawn for once-through cooling systems is returned back to the Mississippi River. The cumulative surface water withdrawals from the Mississippi River for all surface water use categories identified in Table 3.5-3, was 3,670.89 MGD. Based on the mean flow of the Mississippi River in the vicinity of WF3 (approximately 500,000 cfs), this volume would be approximately 1.1 percent of the mean annual flow.

As discussed in Section 3.0.5, AM Agrigen Industries is exploring the potential of developing a plant to manufacture granulated urea, a widely used fertilizer, in St. Charles Parish, Louisiana. The company is currently conducting a feasibility study on the project and the prospective 650-acre site near Killona. If the project proceeds, then the source of water for plant use would most likely be the Mississippi River. However, even with the addition of this plant, surface water use is anticipated to be a small fraction of the mean flow of the Mississippi River.

Therefore, it is anticipated that cumulative impacts from current and future surface water use from the Mississippi River during the license renewal term would be SMALL.

Water Quality Considerations

As previously discussed in Section 3.5.4.1, segment 070301 of the Mississippi River that stretches from Monte Sano Bayou to Head of Passes 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 WF3 is located is not impaired. Therefore, water quality in this segment of the Mississippi River is considered good.

Point source and stormwater discharges at WF3 are monitored and controlled by LPDES permit LA0007374 (Attachment A). The current LPDES permit authorizes discharges from 13 outfalls (3 external and 10 internal). The outfalls (Figure 3.5-3) and their associated effluent limits are shown in Table 3.5-1. The LPDES permit ensures that discharges to the Mississippi River from WF3's operations comply with limitations established in the permit that would be protective of the water quality in the Mississippi River. Therefore, WF3's contribution to cumulative impacts on surface water quality during the license renewal term would be SMALL.

Due to location in an industrial area, residential development in the immediate area is not expected. Any offsite development outside the immediate area could lead to additional discharges to the Mississippi River that could impact water quality. However, any such discharges, including stormwater, would be subject to LPDES permit limits designed to be protective of surface water resources, minimizing cumulative impacts.

Upstream development could lead to discharges to the Mississippi River that could affect water quality. Development projects can result in water quality impacts if they increase sediment loading to nearby surface water bodies. The magnitude of cumulative impacts would depend on the nature and location of the actions relative to surface water bodies, the number of actions (facilities or projects), and whether facilities comply with regulating agency requirements (e.g., permitted discharge limits). New and modified industrial and large commercial facilities would be subject to regulation under the Federal Water Pollution Control Act. This would include LDEQ-administered LPDES permit limits on point source and stormwater discharges designed to be protective of surface water resources. Likewise, it is this regulatory framework that presently governs wastewater effluent and thermal discharges from WF3, and other major industrial facilities in the vicinity of WF3.

Therefore, it is anticipated that cumulative impacts on water quality in the Mississippi River from current and future surface water discharges 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 WF3 and other major users. Therefore, the operation of WF3 and other thermoelectric plants on the Mississippi River could be altered as a result of climate change. (USGCRP 2009, page 56)

Computer models of future Mississippi River flow rates are highly varied in the outcome, ranging from reduction in river flow rates due to drought (USGCRP 2009, page 34), to an overall increase in flow rates due to increased precipitation and runoff in the Upper Mississippi River basin and Midwest United States. (USGCRP 2009, page 30) If the discharge volume of the Mississippi River at WF3 (approximately 500,000 cfs) decreased by 2 percent as a result of climate change and WF3's current water usage (1,555.2 MGD) increased by one and a half times, then the annual water use by WF3 would still be negligible. Therefore, WF3's contribution to cumulative impacts on surface water resources as a result of climate change during the license term would continue to be SMALL.

The magnitude of impacts in the Mississippi River associated with climate change when combined with other past, present, and reasonably foreseeable actions remains speculative. However, long-term warming could potentially affect navigation, power production, and municipal and industrial users, although the magnitude of the impact is uncertain. Because WF3's fuel source for generating electricity does not produce GHG emissions, WF3's contribution to climate change as it relates to surface water resources would be SMALL. Therefore, it is concluded that the cumulative impacts as a result of climate change on surface water resources during the license renewal term could range from SMALL to MODERATE.

4.12.3.3.2 Groundwater

As discussed in Section 3.5.3.2, groundwater usage in St. Charles and adjoining parishes is substantially less than surface water usage. WF3 does not use groundwater as discussed in Section 3.5.3.2. Industrial and potable water is provided by St. Charles Parish Water System. The source of water for the St. Charles Parish Water System is the Mississippi River. Therefore, WF3 would have no impact on the quantity of groundwater resources available for use.

Groundwater quality in the vicinity of WF3 may be affected by point source pollution, such as industries or septic tanks, and non-point source pollution, such as agricultural chemical usage and lawn chemicals. Other operational or planned projects or industries could affect groundwater quality but likely would not result in significant, widespread groundwater impacts.

As discussed in Section 3.5.3.2, the shallow aquifers at WF3 are not commonly used because of poor quality. The potential for development of these aquifers is slight; their utility is restricted by

their limited extent, poor water quality, and low permeability. Thus, offsite groundwater resources that are drinking water sources would be unaffected by WF3 operations.

WF3 has programs in place to protect the quality of groundwater resources from site industrial activities involving chemicals. As discussed in Section 3.5.4.2, these programs include spill prevention plans to prevent spills and implement immediate cleanup activities in the event of a spill to protect groundwater. Using these programs, no groundwater quality impacts are expected, and there would be no cumulative impacts to groundwater resources.

As discussed in Section 3.5.2.4, WF3 performs groundwater monitoring from 10 onsite locations to monitor for potential radioactive releases via groundwater pathways at the site in accordance with site procedures. Figure 3.5-6 shows locations of these groundwater monitoring wells with construction details presented in Table 3.5-2. As discussed in Section 4.5.2.4, there have been no tritium or plant-related gamma isotopes or hard-to-detect radionuclides detected since the groundwater monitoring program was initiated in 2007.

Considering ongoing activities and reasonably foreseeable actions, Entergy concludes that the cumulative impacts on groundwater use and quality during the WF3 license renewal term would be SMALL.

Climate Change Considerations

The magnitude of impacts of sea level rise associated with climate change when combined with other past, present, and reasonably foreseeable actions remains speculative. However, long-term sea level rises could potentially reduce the availability of fresh groundwater as a result of saltwater intrusion. Because WF3's fuel source for generating electricity does not produce GHG emissions, WF3's contribution to climate change as it relates to groundwater resources would be SMALL. Therefore, it is concluded that the cumulative impacts as a result of climate change on groundwater use and quality during the license renewal term could range from SMALL to MODERATE.

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 WF3. Potential biological stressors include continued potential impingement, entrainment, and thermal stresses from WF3; 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, Entergy determined that impingement and entrainment, and thermal impacts from renewal of the WF3 OL would be SMALL. The WF3 CWIS is located offshore in the main channel of the Mississippi River, which minimizes the fish and shellfish that enter the plant's cooling water system. In addition, most species cannot tolerate the harsh conditions of the Mississippi River main channel due to the high velocities, increased debris, a constantly shifting river bed, lack of habitat/vegetation, and a reduction in productivity/food source. The small thermal plume associated with the WF3 discharge, which is regulated under an LPDES permit, represents only a very small portion of the cross-sectional and vertical area of the Mississippi River. Because of the location of the discharge it does not block the movement of fish, either upstream or downstream at the WF3 plant. As a result, there is little, if any, thermal impact from the plant to the river and the associated aquatic life therein.

There are also three federally and/or state-listed fish species that may pass by the plant during various lifecycle migrations; however, WF3's activities do not interfere with such passages. It is unlikely that continued operation of the WF3 plant would cause any additional stresses to these federally and state-protected species than currently exist.

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 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

Entergy currently owns and operates 10 electricity-generating facilities that withdraw water from the Mississippi River as a cooling water source. Three of these facilities are located outside the state of Louisiana and two are located on the Mississippi River estuary; five are located along the mainstem of the river: Waterford 1 and 2 (River Mile 129.9), WF3 (River Mile 129.6), Little Gypsy (River Mile 129.3), and Ninemile (River Mile 104).

Several other existing facilities also withdraw water from the Mississippi River. Climate patterns and increased water demands upstream of WF3 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 WF3 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 LDEQ to ensure the permit limits provide the appropriate level of environmental protection. (NRC 2014b, Section 4.12.3.3) It is anticipated that foreseeable projects such as those listed in Section 3.0.5, which could withdraw and discharge to the Mississippi River, would not noticeably alter aquatic resources.

Climate Change

Climate change could noticeably alter aquatic resources near WF3. 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 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 with 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 WF3's fuel source for generating electricity does not produce GHG emissions, WF3's contribution to climate change as it relates to aquatic resources would be SMALL.

Conclusion

The impact from the renewal of the WF3 OL by itself would not noticeably alter the aquatic environment, and thus, would be SMALL.

However, the direct and indirect impacts to aquatic resources from historical Mississippi River modifications and pollutants and sediments introduced into the river have had a substantial effect on aquatic life and their habitat. The cumulative stress from the activities described above,

spread across the geographic area of interest, depends on many factors that cannot be quantified. This stress may noticeably alter some aquatic resources. For example, climate change may increase the temperature of the Mississippi River and rate of runoff into the river. This may noticeably alter the habitat for species most sensitive to nutrient loading, high levels of contaminants, and higher temperatures. (NRC 2014b, Section 4.12.3.5) Therefore, Entergy concludes that the cumulative impacts from the proposed license renewal and other past, present, and reasonably foreseeable projects could potentially be MODERATE.

4.12.3.5 Terrestrial Resources

This section addresses past, present, and future actions that could result in cumulative impacts on the terrestrial species and habitats, including protected terrestrial species described in Section 3.6.7. For purposes of this analysis, the geographic area considered in the evaluation includes WF3 and surrounding region.

Historic Conditions

WF3 is located in the Southern Holocene Meander Belts ecoregion. As discussed in Section 3.6.4, this ecoregion was once dominated by swamps, marshes, and bottomland forests, primarily oak-hickory-pine 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. This region is also a major bird migration corridor used in fall and spring migrations. Degradation and destruction of forest and wetland habitats and the construction of navigation and flood control systems have had detrimental effects on many of these bird populations. Development is likely to continue in the reasonably foreseeable future as a result of new residential and commercial activities.

Wildlife Preserves

Several wildlife refuges that are located within the region (Figure 3.0-6) would provide valuable habitat to native wildlife and migratory birds during the proposed license renewal period. As development and urbanization increase habitat conversion and fragmentation, these protected areas will become ecologically more important as they provide large, continuous areas of minimally disturbed habitat.

Development, Urbanization, and Habitat Fragmentation

As the region surrounding WF3 becomes more developed, habitat fragmentation will increase and the amount of forested and wetland areas are likely to decline. Increased development will likely decrease the overall availability and quality of forested, scrub-shrub, and wetland habitats. Species that require larger ranges, especially predators, will likely suffer reductions in their populations. Similarly, species with threatened, endangered, or declining populations are likely to be more sensitive to declines in habitat availability and quality.

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 WF3's fuel source for generating electricity does not produce GHG emissions, WF3's contribution to climate change as it relates to terrestrial resources would be SMALL.

Proposed Action

No refurbishment or other license-renewal-related construction activities have been identified; therefore, no terrestrial habitat areas would be impacted by renewal of the WF3 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 Entergy Louisiana, LLC property. While there is some limited habitat for state-listed plants, no listed plants were found on Entergy Louisiana, LLC property during a 2014 threatened and endangered species habitat survey. (Entergy 2014e) Similarly, bald eagles are seen from the site and overfly the site; however, they are not known to nest on the Entergy Louisiana, LLC property. It is unlikely that continued operation of the WF3 plant would cause any additional stresses to these federally and state-protected species than currently exist.

Conclusion

Section 4.6.2 of this ER concludes that the impact from the renewal of the WF3 OL by itself would not noticeably alter the terrestrial environment and, thus, would be SMALL.

However, as environmental stressors, such as industrial and agricultural runoff and climate change, continue over the proposed license renewal term, certain attributes of the terrestrial environment (e.g., species diversity and distribution) are likely to noticeably change. It is not expected that these impacts would destabilize any important attributes of the terrestrial environment because such impacts will cause gradual change, which should allow the terrestrial environment to appropriately adapt. (NRC 2014b, Section 4.12.4.6) Therefore, Entergy concludes that the cumulative impacts of the proposed license renewal of WF3 plus other past,

present, and reasonably foreseeable future projects or actions could potentially result in MODERATE impacts to terrestrial resources.

4.12.3.6 Historic and Cultural Resources

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 previously 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, in addition to the site's cultural resource protection plan. This fleet procedure and the cultural resource protection plan, both of which require reviews, investigations, and consultations as needed, ensure that existing or potentially existing cultural resources are adequately protected, and assist WF3 in meeting state and federal expectations.

As discussed in Section 4.7, it was determined that the renewal of the WF3 OL would not adversely affect historic aboveground properties or archaeological sites. Any future offsite developments from other than WF3, such as those projects listed in Section 3.0.5, would be required to comply with applicable federal and state laws regarding protection of cultural and archaeological resources, and any impacts would be mitigated accordingly.

Based on this information, Entergy concludes that the continued operation of WF3 during the license renewal term would not incrementally contribute to cumulative impacts on historic and cultural resources on the Entergy Louisiana, LLC property and in the surrounding area. Therefore, Entergy determined that historic and cultural resources during the license renewal term would not be adversely affected from a cumulative impact perspective.

4.12.3.7 Socioeconomics

WF3 employees reside in 21 different Louisiana parishes and four other states as shown in Table 2.5-1. Therefore, the primary geographic area of interest considered in this cumulative analysis was St. Charles and Jefferson parishes where approximately 44 percent of WF3 employees reside. This area is where the economy, tax base, and infrastructure would most likely be affected given that a large number of WF3 employees and their families reside, spend their income, and use their benefits within these parishes.

Socioeconomic conditions of St. Charles and Jefferson 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 minority and low-income population information within a 50-mile radius of WF3, 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 WF3 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 WF3 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 from the renewal of the WF3 OL to minority or low-income populations in the region.

Therefore, the only contributory effects would come from other reasonably foreseeable, planned offsite activities such as those listed in Section 3.0.5. For example, industrial and residential development may increase in the WF3 area, but not to the point that overall socioeconomic conditions would noticeably change.

Therefore, based on this and the information presented in Sections 3.8 and 3.10.2, the additional contributory effect on socioeconomic conditions in the future from the continued operation of WF3 when combined with other past, present, and reasonably foreseeable future activities during the license renewal term beyond what is currently being experienced would be SMALL.

4.12.3.8 Human Health

4.12.3.8.1 Radiological 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 WF3 are below regulatory limits, and the impacts of these exposures would be SMALL.

The 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 WF3 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, WF3 conducts a REMP around its site. The program measures radiation and radioactive materials in the environment from WF3 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 WF3 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 WF3. However, Entergy plans to operate the onsite ISFSI at WF3, and there are likely to be medical, industrial, and research facilities that use radioactive materials within a 50-mile radius of WF3. These facilities could contribute to the cumulative radiological impacts in the vicinity of WF3. 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.

Based on WF3's radioactive effluent and environmental monitoring data, and the expected continued compliance with federal radiation protection standards, the cumulative radiological impacts from the operation of WF3 and its ISFSI would be SMALL. The NRC will regulate any future nuclear power facility construction and operation near WF3 that could contribute to cumulative radiological impacts. In addition, the state of Louisiana will regulate facilities using radioactive material licensed by the State. Therefore, the cumulative radiological impacts to human health from the continued operation of WF3, including other licensed users of radioactive material, during the license renewal term would be SMALL.

4.12.3.8.2 Microbiological Organisms

The geographic area considered in this analysis is the Mississippi River. The potential for exposure to microbiological agents was considered in Section 4.9.1. WF3 discharges heated effluent from the reactor cooling system to the Mississippi River. Section 4.9.1 concluded that impacts from microbiological agents resulting from the presence of elevated water temperatures would be SMALL because (1) the design of the discharge structure promotes rapid mixing of thermal discharges with the Mississippi River, thereby limiting the area of conditions necessary for optimal growth of thermophilic microorganisms; (2) the average heated discharge flow is small compared to the volume of river water flowing by the plant (approximately 500,000 cfs), thereby creating limited opportunity for rapid growth and population increases of thermophilic microorganisms; (3) infection by thermophilic microorganisms in the vicinity of the WF3 discharge area has a low-probability of occurring because access by the public is restricted, thus, eliminating the nasal exposure pathway; and (4) the Louisiana Department of Health and Hospitals has stated that from 2004 to 2013 there has never been a case of *Naegleria* infection attributable to the Mississippi River.

For existing and planned offsite facilities that would discharge into the Mississippi River, the magnitude of cumulative impacts would depend on the nature and location of the actions, the number of actions (facilities or projects), the level of the public's exposure, and whether facilities comply with regulating agency requirements (e.g., permitted discharge limits). However, as previously stated above, cases of *Naegleria* infection attributable to the Mississippi River have been very rare. Therefore, cumulative impacts on human health due to microbiological organisms are anticipated to be SMALL.

4.12.3.8.3 Electric Shock Hazards

Acute effects of electric shock from induced current under transmission lines could potentially be cumulative. As discussed in Section 4.9.2, Entergy's analysis showed that the calculated induced short-circuit current for the in-scope transmission lines at WF3 was approximately 3.9 mA, which is within the NESC 5-mA standard. In addition, as discussed in Section 4.9.2, all in-scope transmission lines are located completely within the Entergy Louisiana, LLC owned

property. Therefore, the public does not have access to this area and, as a result, no induced shock hazards would exist for the public.

For existing and planned offsite transmission facilities, the magnitude of cumulative impacts would depend on the nature and location of the actions, the number of actions (facilities or projects), and the level of the public's exposure. However, it is anticipated that any newly constructed transmission lines would comply with the NESC 5-mA standard. Therefore, cumulative impacts on human health due to electric shock hazards would be SMALL.

4.12.3.9 Waste Management

As with any major industrial facility, WF3 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 WF3 because they are shipped to an approved licensed facility for disposition on a quarterly basis.

As discussed in Chapter 2 of this ER, Entergy maintains waste management programs for all radioactive and nonradioactive waste generated at WF3 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 WF3 would likely remain unchanged during the license renewal term. Nonradioactive and nonhazardous waste generated during the license renewal term would continue to be shipped off site by commercial haulers to licensed treatment and disposal facilities.

Because current waste management activities at WF3 would continue during the license renewal term, there would be no new or increased contributory effect beyond what is currently being experienced. Therefore, the only new contributory effects would come from reasonably foreseeable future planned activities at WF3, unrelated to the proposed action (license renewal), and other reasonably foreseeable planned offsite activities. All radioactive and nonradioactive waste treatment and disposal facilities within a 50-mile radius of WF3 would also be required to comply with federal and state permits and other regulatory requirements. In addition, the waste management activities at other industrial facilities generating radioactive and nonradioactive waste would also have to meet the same or similar requirements. Based on this information, the cumulative effect from continued waste management activities at WF3 during the license renewal term would be SMALL.

4.12.3.10 Cumulative Impacts Summary

Entergy considered the potential impacts from continued operation of WF3 during the license renewal term and other past, present, and future actions for cumulative impacts. Based on the various impacts discussed above, Entergy's conclusion is the potential cumulative impacts resulting from WF3 operation during the license renewal term (2024 to 2044) would be SMALL

for air quality and noise, geology and soils, socioeconomics, human health, and waste management; SMALL to MODERATE for surface water and groundwater resources due to climate change; MODERATE for aquatic and terrestrial resources due to climate change; and no effect on historic and cultural resources.

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 Section 5.9.3 of the WF3 FES and was determined to be insignificant (NRC 1981). No changes in WF3 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 Section 5.9.3 of the WF3 FES and was determined to be insignificant (NRC 1981). The impacts were based on the values given in 10 CFR Part 51, Subpart A, Table S-3, and on an analysis of the radiological impact from radon releases (NRC 1981, Section 5.9.3). No changes in WF3 fueling practices have been identified for the license renewal term.

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 Section 5.9.3 of the WF3 FES and was determined to be insignificant (NRC 1981). The impacts were based on the values given in 10 CFR Part 51, Subpart A, Table S-3, and on an analysis of the radiological impact from radon

releases (NRC 1981, Section 5.9.3). No changes in WF3 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

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 is less than 5 percent, and average rod burn-up conditions are no more than 45,000 MWd/MTU. 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 during 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 Background

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

4.15.1.4 Analysis of Environmental Impact

The method used to perform the Severe Accident Mitigation Alternatives (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).

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.

(1) Establish the Baseline Consequences of a Severe Accident

Severe accident consequences were evaluated in four areas.

- Offsite exposure costs: Monetary value of consequences (dose) to offsite population.

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

- Offsite economic costs: Monetary value of damage to offsite property.

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

- 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 $2,000 per person-rem and a present worth discount rate of 7 percent).

- 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/ refurbishment costs were not included in onsite costs. Replacement power costs were considered.

(2) Identify SAMA Candidates

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

- SAMA analyses for other PWR plants.
- NRC and industry documentation discussing potential plant improvements.
- WF3 Individual Plant Examination (IPE) of internal and external events reports and their updates.
- WF3 updated PSA model lists of risk-significant contributors.

(3) Phase I—Preliminary Screening

Potential SAMA candidates were screened out if they modified features not applicable to WF3, if they had already been implemented at WF3, or if they were similar in nature and could be combined with another SAMA candidate to develop a more comprehensive or plant-specific SAMA candidate.

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

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

- The total benefit of implementing a SAMA candidate was estimated in terms of averted consequences (benefits estimate).
  - The baseline PSA model was modified to reflect the maximum benefit of the improvement. Generally, the maximum benefit of a SAMA candidate was determined with a bounding modeling assumption. For example, if the objective of the SAMA candidate was to reduce the likelihood of a certain failure mode, then eliminating the failure mode from the PSA would bound the benefit, even though the SAMA candidate would not be expected to be 100 percent effective in eliminating the failure. The modified model was then used to produce a revised accident frequency.

- Using the revised accident frequency, the method described for the four baseline severe accident impact areas was used to estimate the cost associated with each impact area following implementation of the SAMA candidate.

- The benefit in terms of averted consequences for each SAMA candidate was then estimated by calculating the arithmetic difference between the total estimated cost associated with all four impact areas for the existing plant design and the revised plant design following implementation of the SAMA candidate.

- The cost of implementing a SAMA was estimated by one of the following methods (cost estimate).

  - An estimate for a similar modification considered in a previously performed SAMA analysis was used. These estimates were developed in the past and no credit was taken for inflation when applying them to WF3.

  - Engineering judgment on the cost associated with procedural changes, engineering analysis, testing, training, and hardware modification was applied to formulate a conclusion regarding the economic viability of the SAMA candidate.

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

(5) Sensitivity Analyses

Two sensitivity analyses were conducted to gauge the impact of key assumptions upon the analysis. One sensitivity analysis was to investigate the sensitivity of assuming a 29-year period for remaining plant life (i.e., 9 years on the original plant license plus the 20-year license renewal period). The other sensitivity analysis was to investigate the sensitivity of each analysis case to a more conservative discount rate of 3 percent.

The SAMA analysis for WF3 is presented in the following sections. Sections D.1 and D.2 of Attachment D provide a more detailed discussion of the process presented above.

4.15.1.4.1 Establish the Baseline Consequences of a Severe Accident

A baseline was established to enable estimation of the risk reductions attributable to implementation of potential SAMA candidates. The baseline severe accident risk was estimated using the WF3 PSA model and the WinMACCS consequence analysis software code. The PSA model used for the SAMA analysis is an internal events risk model.

4.15.1.4.1.1 The PSA Internal Events Model—Level 1 and Level 2 Analysis

The PSA model (Level 1 and Level 2) used for the SAMA analysis was the most recent internal events risk model for WF3. This model is an updated version of the model used in the IPE. There have been no major plant hardware changes or procedural modifications since the release of the internal events model that would have a significant impact on the results of the SAMA analysis. Thus, the WF3 model used for the SAMA analysis is appropriate. The WF3 model adopts the small event tree / large fault tree approach and uses the Computer Aided Fault Tree Analysis (CAFTA) code for quantifying risk.

The WF3 Level 2 analysis uses a Containment Event Tree (CET) to analyze all core damage sequences identified in the Level 1 analysis. The CET evaluates systems, operator actions, and severe accident phenomena to characterize the magnitude and timing of radionuclide release. The result of the Level 2 analysis is a list of sequences involving radionuclide release, along with the frequency, magnitude, and timing of release for each sequence.

4.15.1.4.1.2 The PSA External Events Model—Individual Plant Examination of External Events (IPEEE) Model

The WF3 IPEEE determined that the plant is adequately designed to protect against the effects of seismic, high wind, and external flooding events. The seismic portion of the IPEEE was completed using a seismic margin method following the guidance of NUREG-1407, *Procedural and Submittal Guidance for the Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities*, June 1991. Three plant improvements were identified as described in NUREG-1742, *Perspectives Gained from the IPEEE Program, Final Report*, April 2002. These improvements were implemented.

The WF3 fire analysis was performed using the EPRI Fire Induced Vulnerability Evaluation (FIVE) method for qualitative and quantitative screening of fire areas. Unscreened fire zones were then analyzed in more detail using a fire Probabilistic Risk Assessment (PRA) approach. The FIVE method is primarily a screening approach used to identify plant vulnerabilities due to fire initiating events. The end result of WF3 IPEEE fire analysis identified the CDF for significant fire areas.

The IPEEE fire analysis has been superseded by the WF3 fire PRA created for National Fire Protection Association Standard 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants" (NFPA 805), which utilizes guidance in NUREG/CR-6850. The WF3 fire PRA model is not fully integrated with the most recent Level 2 and 3 analyses and is based on NFPA 805 modifications that have not yet been implemented.

4.15.1.4.1.3 WinMACCS Model—Level 3 Analysis

A Level 3 model was developed using the WinMACCS consequence analysis software code (Version 3.10.0) to estimate the hypothetical impacts of severe accidents on the surrounding environment and members of the public. The principal phenomena analyzed were atmospheric

transport of radionuclides; mitigation actions (i.e., evacuation, condemnation of contaminated crops and milk) based on dose projection; dose accumulation by a number of pathways, including food and water ingestion; and economic costs. Input for the Level 3 analysis included the core radionuclide inventory, source terms from the WF3 PSA model, site meteorological data, projected population distribution (within a 50-mile radius) for the year 2045, emergency response evacuation modeling, and economic data. The WinMACCS input data are described in Section D.1.5 of Attachment D.

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

This section describes the method used to estimate the cost associated with each of the four impact areas for the baseline case (i.e., without SAMA implementation). This analysis was used to establish the maximum benefit that a SAMA could achieve if it eliminated all risk due to WF3 at-power internal events.

Offsite Exposure Costs

The Level 3 baseline analysis resulted in an annual offsite exposure risk of 15.9 person-rem. This value was converted to its monetary equivalent (dollars) via application of the $2,000 per person-rem conversion factor from the *Regulatory Analysis Technical Evaluation Handbook* (NRC 1997). This monetary equivalent was then discounted to present value using the formula from the same source:

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

where

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

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

F = accident frequency (events/year).

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

S = status quo (current conditions).

A = after implementation of proposed action.

r = discount rate (%).

t_f = license renewal period (years).

Using a 20-year period, a 7-percent discount rate, assuming F_A is zero, and the baseline release frequency of 1.05E-05/yr resulted in the monetary equivalent value of $341,881. This value is presented in Table 4.15-1.

Offsite Economic Costs

The Level 3 baseline analysis resulted in an annual offsite economic risk monetary equivalent of $147,339. This value was discounted in the same manner as the public health risks in accordance with the following equation:

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

where

AOC = monetary value of risk avoided from offsite property damage, after discounting.

P_D = offsite property loss factor ($/event).

F = accident frequency (events/year).

S = status quo (current conditions).

A = after implementation of proposed action.

r = discount rate (%).

t_f = license renewal period (years).

Using previously defined values, the resulting monetary equivalent is $1,587,336. This value is presented in Table 4.15-1.

Onsite Exposure Costs

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

Immediate Dose

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

where

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

IO = immediate occupational dose.

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

F = accident frequency (events/year).

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

S = status quo (current conditions).

A = after implementation of proposed action.

r = discount rate (%).

t_f = license renewal period (years).

The values used in the analysis were as follows:

R = $2,000/person-rem.

r = 0.07.

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

t_f = 20 years.

For the basis discount rate, assuming F_A is zero, the bounding monetary value of the immediate dose associated with WF3's accident risk is

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

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

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

For the baseline release frequency, 1.05 x 10^{-5}/yr,

$$W_{IO} = \$745$$

Long-Term Dose

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

where

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

LTO = long-term occupational dose.

m = years over which long-term doses accrue.

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

F = accident frequency (events/year).

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

S = status quo (current conditions).

A = after implementation of proposed action.

r = discount rate (%).

t_f = license renewal period (years).

The values used in the analysis were as follows:

R = $2,000/person-rem.

r = 0.07.

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

m = 10 years.

t_f = 20 years.

For the basis discount rate, assuming F_A is zero, the bounding monetary value of the long-term dose associated with WF3's accident risk is

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

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

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

For the release frequency for the baseline, 1.05 x 10^{-5}/yr,

$$W_{\mathrm{LTO}} = \$3{,}249$$

Total Occupational Exposures

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

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

where

AOE = onsite exposure avoided.

The bounding value for occupational exposure (AOE_B) is

$$AOE_B = W_{IO} + W_{LTO} = \$745 + \$3{,}249 = \$3{,}994$$

The resulting monetary equivalent of $3,994 is presented in Table 4.15-1.

Onsite Economic Costs

Cleanup/Decontamination

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

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

where

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

CD = cleanup/decontamination.

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

m = cleanup period (years).

r = discount rate (%).

Based upon the values previously assumed,

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

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

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

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

where

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

Based upon the values previously assumed,

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

Replacement Power Costs

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

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

where

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

t_f = license renewal period (years).

r = discount rate (%).

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

$$B = \left(\frac{1188}{910}\right) \times (1.20\times10^8) = \$1.57\times10^8$$

This cost was scaled to account for the plant-specific power after the EPU of 1,188 MWe.

Based upon the values previously assumed:

$$PV_{RP} = \left(\frac{B}{r}\right)(1 - e^{-rt_f})^2 = \left(\frac{\$1.57 \times 10^8}{0.07}\right)(1 - e^{-(0.07)20})^2$$

$$PV_{RP} = \$1.27 \times 10^9$$

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

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

where

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

t_f = license renewal period (years).

r = discount rate (%).

Based upon the values previously assumed:

$$U_{RP} = \frac{PV_{RP}}{r}(1 - e^{-rt_f})^2 = \frac{\$1.27 \times 10^9}{0.07}(1 - e^{-(0.07)20})^2 = \$1.03 \times 10^{10}$$

Total Onsite Property Damage Costs

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

$$AOSC = \Delta F(U_{CD} + U_{RP}) = \Delta F(\$1.16 \times 10^{10} + \$1.03 \times 10^{10})$$

$$AOSC = \Delta F(\$2.19 \times 10^{10})$$

where

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

For the baseline release frequency, 1.05×10^{-5}/yr,

$$AOSC = \$229,892$$

The resulting monetary equivalent of $229,892 is presented in Table 4.15-1.

4.15.1.4.2 Identify SAMA Candidates

Based on a review of industry documents, an initial list of SAMA candidates was identified. Because WF3 is a PWR, considerable attention was paid to the SAMA candidates from SAMA analyses for other PWR plants. Attachment D lists the specific documents from which SAMA candidates were initially gathered.

In addition to SAMA candidates from review of industry documents, additional SAMA candidates were obtained from plant-specific sources, such as the WF3 IPE and IPEEE. In the IPE and IPEEE, several enhancements related to severe accident insights were recommended. These enhancements were included in the comprehensive list of SAMA candidates and were verified to have been implemented during preliminary screening or were retained for evaluation (see Table D.2-1 of Attachment D).

In addition, the current WF3 PSA Levels 1 and 2 models were used to identify plant-specific modifications for inclusion in the comprehensive list of SAMA candidates. The risk-significant events from the PSA Level 1 and Level 2 models were reviewed for similar failure modes and effects that could be addressed through a potential enhancement to the plant. The correlation between candidate SAMAs and the risk-significant events are listed in Tables D.1-2, D.1-4, and D.1-5 of Attachment D. The comprehensive list contained a total of 201 SAMA candidates. The first step in the analysis of these candidates was to eliminate the non-viable SAMA candidates through preliminary screening.

4.15.1.4.3 Preliminary Screening (Phase I)

The purpose of the preliminary SAMA screening was to eliminate from further consideration enhancements that were not viable for implementation at WF3. Potential SAMA candidates were screened out if they modified features not applicable to WF3 or if they had already been implemented at WF3. In addition, where it was determined those SAMA candidates were potentially viable, but similar in nature, they were combined to develop a more comprehensive or plant-specific SAMA candidate.

During this process, 127 of the 201 initial SAMA candidates were eliminated, leaving 74 SAMA candidates for further analysis. The list of 201 original SAMA candidates and applicable screening criterion is available in onsite documentation.

4.15.1.4.4 Final Screening and Cost Benefit Evaluation (Phase II)

A cost/benefit analysis was performed on 71 of the remaining 74 SAMA candidates. Three of the Phase II SAMA candidates were retained without evaluation as they are already commitments in the NFPA 805 License Amendment Request (LAR). The method for determining if a SAMA candidate was cost beneficial consisted of determining whether the benefit provided by implementation of the SAMA candidate exceeded the expected cost of implementation. The benefit was defined as the sum of the reduction in dollar equivalents for each severe accident impact area (offsite exposure, offsite economic costs, occupational exposure, and onsite economic costs). If the expected implementation cost exceeded the estimated benefit, the SAMA was not considered cost beneficial.

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

Each SAMA evaluation was performed in a bounding fashion. Bounding evaluations were performed to address the generic nature of the initial SAMA concepts. Such bounding calculations overestimate the benefit and thus are conservative calculations. For example, one SAMA dealt with adding redundant and diverse limit switches to each containment isolation valve; the bounding analysis estimated the benefit of this improvement by eliminating containment isolation failure (see analysis for Phase II SAMA 55 in Table D.2-2 of Attachment D). Such a calculation obviously overestimated the benefit, but if the inflated benefit indicated that the SAMA is not cost beneficial, then the purpose of the analysis was satisfied.

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

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

where

APE = value of averted public exposure ($).

AOC = value of averted offsite costs ($).

AOE = value of averted occupational exposure ($).

AOSC = value of averted onsite costs ($).

COE = cost of enhancement ($).

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

The SAMA analysis considered that external events (including fires and seismic events) could lead to potentially significant risk contributions. Also, internal flooding events are not included in the internal events model and could lead to potentially significant risk contributions. To account for the risk contribution from external events and internal flooding, the cost of SAMA implementation was compared with a benefit value estimated by applying a multiplier of 3.02 to the internal events estimated benefit. This value is defined as an "Internal and External Benefit." To account for uncertainties associated with the internal events CDF calculations, the cost of SAMA implementation was also compared with a benefit value estimated by applying an uncertainty multiplier of 1.99 to the internal and external estimated benefit. This value is defined as the "Internal and External Benefit with Uncertainty." Development of the multipliers for WF3 is described in the following paragraphs.

The WF3 IPEEE concluded for high winds, floods, and other external events that no undue risks are present that might contribute to CDF with a predicted frequency in excess of 1E-06/yr. As these events are not dominant contributors to external event risk and quantitative analysis of these events is not practical, they are considered negligible in estimation of the external events multiplier.

A seismic margin assessment was performed for the seismic portion of the WF3 IPEEE. Thus, no CDF sequences were quantified as part of the IPEEE seismic risk analysis. Though the IPEEE did not calculate a CDF due to seismic events, an Integrated Leak Rate Test (ILRT) Interval Extension Report calculated a value of 6.87E-07 for the seismic CDF. This value was conservatively used to calculate the internal/external events benefit multiplier.

The EPRI Fire PRA Implementation Guide was followed for the WF3 IPEEE fire analysis. The EPRI FIVE method was used for the initial screening, for treatment of transient combustibles, and as the source of fire frequency data. The CDF was determined to be 7.0E-06/yr. As discussed in Attachment D, the WF3 fire PRA model documented calculated a fire CDF of 1.80E-05, and this value is used in calculating the SAMA internal/external events multiplier.

The fire, seismic, and internal flooding CDF value is approximately 2.02 times the internal events CDF. This justifies use of a multiplier of 3.02 on the averted cost estimates (for internal events) to represent the SAMA benefits from both internal and external events.

The internal and external benefit with uncertainty is intended to account for both the internal and external events impacts with uncertainty. CDF uncertainty estimates conservatively resulted in a ratio of the 95th percentile to the mean of 1.99. Therefore, "Internal and External Benefit" values were multiplied by a factor of 1.99 to provide the "Internal and External Benefit with Uncertainty."

Use of an internal and external benefit (with uncertainty) is considered appropriate because of the inherent conservatism in the external events modeling approach and conservative assumptions in benefit modeling of individual SAMA candidates. In addition, not all potential enhancements would be impacted by an external event. In some cases, an external event would only impose partial failure of systems or trains. Therefore, using 6.01 times the internal events estimated benefit to account for internal and external events with uncertainty is appropriate.

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

- Davis-Besse
- South Texas project
- Callaway
- Seabrook Station
- Sequoyah
- ANO-2
- Indian Point (IP2)

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

Detailed cost estimates were often not required to make informed decisions regarding the economic viability of a potential plant enhancement when compared to attainable benefit. The implementation costs for several of the SAMA candidates were clearly in excess of the attainable benefit estimated from a particular analysis case. Nonetheless, the cost of SAMA candidates was conceptually estimated to the point where conclusions regarding the economic viability of the proposed modification could be adequately gauged. The cost benefit comparison and disposition of each of the 74 Phase II SAMA candidates is presented in Table D.2-2 of Attachment D.

4.15.1.4.5 Sensitivity Analyses

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

Sensitivity Case 1: Years Remaining Until End of Plant Life

The purpose of this sensitivity case was to investigate the sensitivity of assuming a 29-year period for remaining plant life (i.e., 9 years on the original plant license plus the 20-year license renewal period), rather than the 20-year license renewal period used in the base case. Changing this assumption does not cause additional SAMAs to be cost-beneficial.

Sensitivity Case 2: Conservative Discount Rate

The purpose of this sensitivity case was to investigate the sensitivity of each analysis case to the discount rate. The discount rate of 7 percent used in the base case analyses is conservative relative to corporate practices. Nonetheless, a lower discount rate of 3 percent was assumed in this case to investigate the impact on each analysis case. Changing this assumption does not cause additional SAMAs to be cost-beneficial.

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

4.15.1.5 Conclusion

This analysis addressed 201 SAMA candidates for mitigating severe accident impacts. Phase I screening eliminated 127 SAMA candidates from further consideration, based on either inapplicability to WF3's design or features that had already been incorporated into WF3's current design, procedures and/or programs. During the Phase II cost-benefit evaluation of the remaining 74 SAMA candidates, an additional 62 SAMA candidates were eliminated because their cost was expected to exceed their benefit.

Twelve Phase II SAMA candidates presented in Table 4.15-2 were found to be potentially cost-beneficial for mitigating the consequences of a severe accident at WF3.

SAMA 1 Provide additional DC battery capacity.

The WF3 direct current (DC) batteries are designed to provide an adequate amount of energy for all required emergency loads following the loss of AC power for 4 hours. This SAMA recommends replacing the current DC batteries with batteries that can provide power to emergency loads for longer than 4 hours following the loss of AC power.

SAMA 3 Provide DC bus cross-ties.

DC bus cross-tie capability is not currently possible at WF3. This SAMA recommends installing DC bus cross-ties, which would allow aligning of emergency loads to an alternate train if their normal DC power source is failed.

SAMA 5 Improve 4.16-kV bus cross-tie ability.

There are three 4.16-kV Class 1E busses at WF3: 3A, 3B, and swing bus 3AB. Cross-ties exist between 3A and 3AB and between 3B and 3AB, but not between 3A and 3B. This SAMA recommends installing a cross-tie between 4.16-kV busses 3A and 3B, which would allow aligning of emergency loads to an alternate train if their normal power source is failed.

SAMA 7 Install a gas turbine generator.

Following the loss of offsite alternating current (AC) power, two emergency diesel generators power the safety-related loads. This SAMA recommends installing a gas turbine generator to enhance redundancy and diversity of onsite AC power sources.

SAMA 11 Install a large volume EDG fuel oil tank at an elevation greater than the EDG fuel oil day tanks.

The WF3 emergency diesel generator (EDG) day tanks hold about 60 minutes of fuel oil, which is refilled from the fuel oil storage tank by fuel transfer pump. It is assumed the fuel oil transfer pump would need to cycle 6 times in a 24-hour period. This SAMA recommends gravity feeding fuel oil from the fuel oil storage tank to the day tanks, which would reduce the impact of the fuel oil transfer pump failing.

SAMA 26 Install improved reactor coolant pump seals.

The reactor coolant pump (RCP) seals are cooled by the CCWS. A failure of the CCWS will lead to a failure of the RCP seals and a LOCA event. This SAMA recommends replacing the current RCP seals with seals that can sustain for a longer time without cooling, which would allow for more time to trip the pumps during an accident.

SAMA 34 Use fire water system as a backup for steam generator inventory.

During emergency situations, the emergency feedwater (EFW) system, consisting of two motor-driven pumps and one turbine-driven pump, provides cooling water to the steam generators. Failure of the EFW system to cool the steam generators can lead to core damage. This SAMA recommends a modification to allow the fire water system to supply the steam generators as a backup to the EFW system.

SAMA 36 Implement procedures for temporary HVAC.

Following a loss of heating, ventilation, and air conditioning (HVAC), equipment failures and habitability issues may occur due to the increased heat. In order to mitigate these issues, actions can be taken to increase ventilation by setting up temporary fans and portable coolers or by opening doors. This SAMA recommends implementing procedures for temporary HVAC to mitigate the effects of a loss of HVAC for the battery, EDG, and main control rooms.

SAMA 40 Use the fire water system as a backup source for the containment spray system.

The purpose of the containment spray system is to remove heat during and following an accident which involves either a LOCA or a main steam line break (MSLB) inside containment, as well as reduce containment pressure. Failure of the containment spray system can lead to increased fission product leakage and containment failure. This

SAMA recommends upgrading the fire water system and adding a hard pipe connection to the containment spray system, thereby increasing redundancy.

SAMA 74 In Fire Area RAB 2 construct a radiant heat barrier to further separate the A and B trains of chilled water pumps.

Per the NFPA 805 LAR, a radiant heat barrier will be installed in Fire Area RAB 2 to separate the A and B chilled water pump trains. This modification protects each train's chiller pump (and associated nearby equipment) from a fire in the opposite train. This SAMA was retained as potentially cost-beneficial without evaluation.

SAMA 75 In Fire Area RAB 8C construct a radiant heat shield in Switchgear Room A/B.

Per the NFPA 805 LAR, a radiant heat shield will be installed in Fire Area RAB 8C, Switchgear Room A/B. This modification protects certain raceways from potential High Energy Arcing Fault (HEAF) effects. This SAMA was retained as potentially cost-beneficial without evaluation.

SAMA 76 In Fire Area RAB 6 install a 1-hour fire resistance rating ERFBS fire wrap barrier from fire damage.

Per the NFPA 805 LAR, Electric Raceway Fire Barrier System (ERFBS) will be installed in Fire Area RAB 6 to provide a qualified 1-hour fire resistance rating in accordance with requirements of NRC Generic Letter 86-10 and Generic Letter 86-10, Supplement 1. This SAMA was retained as potentially cost-beneficial without evaluation.

Although the above SAMA candidates do not relate to adequately managing the effects of aging during the period of extended operation, they have been submitted for detailed engineering project cost-benefit analysis to further evaluate implementation of these potentially cost-beneficial SAMAs. The sensitivity studies indicated that the results of the analysis would not change for the conditions analyzed.

Table 4.15-1
Estimated Present Dollar Value Equivalent of Internal Events CDF at WF3

Parameter	Present Dollar Value ($)
Offsite population dose	$341,881
Offsite economic costs	$1,587,336
Onsite dose	$3,994
Onsite economic costs	$229,892
Total	**$2,163,103**

Table 4.15-2
Final SAMAs

Phase II SAMA ID	SAMA Title	Result of Potential Enhancement	CDF Reduction	PDR Reduction	OECR Reduction	Internal and External Benefit	Internal and External Benefit with Uncertainty	WF3 Cost Estimate
1	Provide additional DC battery capacity.	Reduces risk of core damage during station blackouts.	34.4%	42.5%	44.5%	$2,812,956	$5,597,783	$3,172,695
	Basis for Conclusion: Eliminated station blackout risk contribution. The implementation cost is a WF3 plant-specific estimate.							
3	Provide DC bus cross-ties.	Increases the availability of DC power.	20.8%	31.0%	31.3%	$1,966,036	$3,912,412	$1,449,686
	Basis for Conclusion: Required failure of three DC power busses to fail a single DC power train. The implementation cost is a WF3 plant-specific estimate.							
5	Improve 4.16-kV bus cross-tie ability.	Increases the availability of AC power.	22.2%	32.0%	32.3%	$2,033,811	$4,047,285	$1,554,988
	Basis for Conclusion: Required failure of both A and B busses to fail single AC power train. The implementation cost is a WF3 plant-specific estimate.							
7	Install a gas turbine generator.	Reduces risk of core damage during station blackouts.	34.4%	42.5%	44.5%	$2,812,956	$5,597,783	$2,000,000
	Basis for Conclusion: Eliminated station blackout risk contribution. The implementation cost is a Davis-Besse modification cost estimate.							

Table 4.15-2 (Continued)
Final SAMAs

Phase II SAMA ID	SAMA Title	Result of Potential Enhancement	CDF Reduction	PDR Reduction	OECR Reduction	Internal and External Benefit	Internal and External Benefit with Uncertainty	WF3 Cost Estimate
11	Install a large volume EDG fuel oil tank at an elevation greater than the EDG fuel oil day tanks.	Eliminates the failure of the EDGs due to failures of the fuel oil transfer pump.	17.1%	20.8%	21.5%	$1,367,894	$2,722,110	$150,000
	Basis for Conclusion: Eliminated failure of fuel oil transfer pumps. The implementation cost is a Callaway modification cost estimate.							
26	Install improved reactor coolant pump seals.	Provides additional time to trip the RCPs in order to mitigate an RCP seal LOCA.	16.0%	31.6%	32.4%	$1,994,880	$3,969,811	$2,000,000
	Basis for Conclusion: Eliminated risk of RCP seal LOCA. The implementation cost is a Seabrook modification cost estimate.							
34	Use fire water system as a backup for steam generator inventory.	Reduces core damage due to failure of the steam generators from lack of cooling	67.3%	61.8%	62.9%	$4,126,742	$8,212,217	$3,073,130
	Basis for Conclusion: Reduced the frequency of the turbine-driven AFW pump failure during an SBO. The implementation cost is an Indian Point Unit 2 modification cost estimate.							

Table 4.15-2 (Continued)
Final SAMAs

Phase II SAMA ID	SAMA Title	Result of Potential Enhancement	CDF Reduction	PDR Reduction	OECR Reduction	Internal and External Benefit	Internal and External Benefit with Uncertainty	WF3 Cost Estimate
36	Implement procedures for temporary HVAC.	Reduces equipment and operator action failures following a loss of HVAC.	9.4%	11.9%	12.3%	$779,088	$1,550,385	$100,000
	Basis for Conclusion: Eliminated the failure of EDG room 3A room cooling. The implementation cost is a Callaway procedure change cost estimate.							
40	Use the fire water system as a backup source for the containment spray system.	Increases availability of the core spray system.	5.8%	17.2%	35.9%	$1,942,124	$3,864,827	$2,455,808
	Basis for Conclusion: Reduced failure of containment spray system. The implementation cost is a WF3 plant-specific estimate.							
74	In Fire Area RAB 2 construct a radiant heat barrier to further separate the A and B trains of chilled water pumps.	Provides separation between A and B chilled water pump trains.	N/A	N/A	N/A	N/A	N/A	N/A
	Basis for Conclusion: This modification is from the Waterford 3 NFPA 805 LAR. This SAMA candidate was retained without evaluation as it is already a commitment in the NFPA 805 LAR.							

Table 4.15-2 (Continued)
Final SAMAs

Phase II SAMA ID	SAMA Title	Result of Potential Enhancement	CDF Reduction	PDR Reduction	OECR Reduction	Internal and External Benefit	Internal and External Benefit with Uncertainty	WF3 Cost Estimate
75	In Fire Area RAB 8C construct a radiant heat shield in Switchgear Room A/B.	Reduced risk of core damage due to high energy arcing faults.	N/A	N/A	N/A	N/A	N/A	N/A
	Basis for Conclusion: This modification is from the Waterford 3 NFPA 805 LAR. This SAMA candidate was retained without evaluation as it is already a commitment in the NFPA 805 LAR.							
76	In Fire Area RAB 6 install a 1-hour fire resistance rating ERFBS fire wrap barrier from fire damage.	Reduced risk of core damage due to fires in this area.	N/A	N/A	N/A	N/A	N/A	N/A
	Basis for Conclusion: This modification is from the Waterford 3 NFPA 805 LAR. This SAMA candidate was retained without evaluation as it is already a commitment in the NFPA 805 LAR.							

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 impact 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 seriously different than previously envisioned impacts. Therefore, only new information that would suggest a change from SMALL impacts to either MODERATE or LARGE impacts for an issue considered in the GEIS or an issue not considered in the GEIS with MODERATE or LARGE impacts would be considered "significant." Section 4.0.2 of this ER presents the NRC definitions of SMALL, MODERATE, and LARGE impacts.

5.2 New and Significant Information Review Process

During preparation of the WF3 ER, Entergy reviewed the analyses of the Category 1 issues discussed in the GEIS that were applicable to WF3, and the permits and reference materials listed in Table 9.1-1 and Chapter 10, respectively. Entergy also conducted meetings and consultations with those state and federal agencies having regulatory oversight of WF3, 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 WF3 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 WF3 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.

As a result of this review, Entergy is aware of no new and significant information regarding the environmental impacts of license renewal associated with WF3.

6.0 SUMMARY OF LICENSE RENEWAL IMPACTS AND MITIGATING ACTIONS

6.1 License Renewal Impacts

Chapter 4 incorporates by reference NRC findings for the 51 Category 1 issues that apply to WF3 (plus the one uncategorized issue for which the NRC came to no generic conclusion), all of which have environmental impacts that are SMALL. The remainder of Chapter 4 analyzes the 17 Category 2 issues. Table 6.1-1 identifies the environmental impacts that renewal of the WF3 OL would have on resources associated with the Category 2 issues.

In summary, Entergy has reviewed the environmental impacts of renewing the WF3 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 WF3

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	No impact. Issue is not applicable because WF3 utilizes a once-through cooling system and does not utilize cooling ponds or cooling towers for condenser cooling purposes.
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 not applicable because WF3 does not withdraw groundwater from the site; potable water is provided by St. Charles Parish Waterworks and cooling water is supplied by the Mississippi River.
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	No impact. Issue is not applicable because WF3 utilizes a once-through cooling system and cooling water is supplied by the Mississippi River.
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 not applicable because WF3 does not utilize cooling ponds for condenser cooling purposes.
Radionuclides released to groundwater [10 CFR 51.53(c)(3)(ii)(P)]	4.5.2.4	SMALL impact. No tritium or plant-related gamma isotopes or hard-to-detect radionuclides have been detected since the groundwater program was initiated in 2007.
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	SMALL impact. CWIS is located offshore in main channel of river; most species cannot tolerate harsh conditions of river main channel due to the high velocities, increased debris, a constantly shifting river bed, lack of habitat/vegetation, and a reduction in productivity/food source; impingement and entrainment numbers are low; intake structure has been previously approved as BTA by the EPA (1991) and LDEQ (2010).

Table 6.1-1 (Continued)
Environmental Impacts Related to License Renewal at WF3

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	SMALL impact. Design of discharge structure promotes rapid mixing with the river; thermal plume represents a very small portion of the cross-sectional and vertical area of the river; thermal discharges do not block upstream or downstream movement of fish; thermal discharges continue to meet Louisiana water quality criteria for temperature.
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	No impact. Issue is not applicable because WF3 utilizes a once-through cooling system and does not utilize cooling ponds or cooling towers for condenser cooling purposes.
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	No impact. Issue is not applicable because WF3 utilizes a once-through cooling system and does not utilize cooling ponds or cooling towers for condenser cooling purposes.
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	No adverse effects on threatened and endangered species or essential fish habitat. No refurbishment or other license-renewal-related construction activities have been identified; management programs in place to protect threatened and endangered species; no essential fish habitat designated in the Mississippi River in the vicinity of WF3.

Table 6.1-1 (Continued)
Environmental Impacts Related to License Renewal at WF3

Issue	ER Section	Environmental Impact
Historic and Cultural Resources		
Historic and cultural resources [10 CFR 51.53(c)(3)(ii)(K)]	4.7	No adverse effects on historic properties. No refurbishment or other license-renewal-related construction activities have been identified; administrative procedure ensures protection of these type resources in the event of 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. Design of discharge structure promotes rapid mixing of thermal discharges with the Mississippi River; average heated discharge flow is small compared to the volume of river water flowing by the plant; no cases of *Naegleria* infection attributable to the Mississippi River from 2004 to 2013.
Electric shock hazard [10 CFR 51.53(c)(3)(ii)(H)]	4.9.2	SMALL impact. Transmission lines meet applicable shock prevention provisions of the NESC; transmission lines located totally within Entergy Louisiana, LLC owned property; occupational safety and health measures for plant workers in place to address shock hazards from overhead lines.
Environmental Justice		
Minority and low-income populations [10 CFR 51.53(c)(3)(ii)(N)]	4.10	No disproportionately high and adverse impacts or effects on minority and low-income populations identified.
Cumulative Impacts		
Cumulative impacts [10 CFR 51.53(c)(3)(ii)(O)]	4.12	SMALL to MODERATE impacts. SMALL for air quality and noise, geology and soils, socioeconomics, human health, and waste management; SMALL to MODERATE for surface water and groundwater resources due to climate change; MODERATE for aquatic and terrestrial resources due to climate change; and no effect on historic and cultural resources.

Table 6.1-1 (Continued)
Environmental Impacts Related to License Renewal at WF3

Issue	ER Section	Environmental Impact
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)]

NRC Regulatory Guide 4.2, Supplement 1, Revision 1, *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 need 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 6.1, impacts associated with WF3 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) that currently mitigate the operational environmental impacts of WF3 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 previously discussed in Chapter 4 of this ER, no license-renewal-related refurbishment or 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 51 Category 1 issues (NRC 2013b) applicable to WF3, 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 WF3 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 WF3). Uranium mining associated with the nuclear fuel cycle also has offsite land use implications.

- Aquatic organisms would continue to be impinged and entrained at the intake structure but, as discussed in Section 4.6.1.1, these impacts were determined to be SMALL.

- 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 WF3 results in consumptive use of Mississippi River water as a result of plant operations. However, this consumptive use is negligible, amounting to only 0.01 percent of the water withdrawn from the Mississippi River (NRC 1981, Section 5.3.1.1).

- Operation of WF3 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 WF3 results in a very small increase in radioactivity in the air. The incremental radiation dose to the local population resulting from WF3 operations is typically less than the magnitude of the fluctuations that occur in natural background radiation. Doses to the members of the public from WF3's gaseous releases would be well within the allowable limits of 10 CFR Part 20 and 10 CFR Part 50, Appendix I. Operation of WF3 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 WF3 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, low-level radioactive wastes generated as a result of plant operations, and sanitary wastes generated from normal industrial operations.
- Elemental materials that will become radioactive.
- Materials used for the normal industrial operations of WF3 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 WF3 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 plant as well as for fuel to run the plant. 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 of the Environment

> 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 WF3 began operations in 1985. The WF3 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 WF3 (NRC 1981, Section 6.5). The period of extended operation will not alter the short-term uses of the environment from the uses previously evaluated in the WF3 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 WF3 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 site area occupied by WF3 into a park or an industrial facility after decommissioning are quite different. However, extending WF3 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 WF3 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.